Where Open Badges Appear to Work Better: Findings from the Design Principles Documentation Project

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Executive Summary

This report presents insights gleaned from a study of 30 proposed digital badge systems funded in the 2012 Badges for Lifelong Learning initiative by the John D. and Catherine T. MacArthur Foundation's Digital Media and Learning program. The Design Principles Documentation (DPD) project, working out of the Center for Research for Learning and Technology at Indiana University, followed the efforts of these 30 initiatives as they tried to create a system for recognizing learning using "open digital badges." Unlike traditional grades and transcripts, these web-enabled credential can contain specific claims of learning and achievement, detailed evidence supporting those claims, links to additional information and evidence. Digital badges can circulate readily in digital social networks where they can gain “likes,” comments, and informal endorsements. Badges that adhere to the Open Badge Specifications that were established and published by this same initiative are interoperable (compatible across multiple systems) and extensible (compatible with future systems).

The DPD project did not set out to evaluate these 30 badge system design efforts. Rather, the project attempted to capture the "practical wisdom" that emerged within and across the badge systems. The project analyzed the various badge system designs and then documented the badge design practices that the badge systems intended (in their proposals), enacted (as the badge systems got underway), and formalized (after the funding period). These practices were studied in terms of recognizing, assessing, motivating, and studying learning. The relative success of the various badge system designs and the more specific badge design practice is intended to provide useful evidence and examples for others aiming to use this increasingly popular educational technology.

The findings in this report summarize an extensive public database that contains detailed accounts of each of the 30 badge design efforts. All of these badge design efforts were attempting to do something that had never been done before. Likewise, the DPD project was unlike any prior research study. As such these results are tentative and illustrative.

Looking across badge systems and badge design principles, the project uncovered patterns that support a number of general conclusions about badge system design, along with many more specific conclusions about using badges to recognize, assess, motivate, and study learning. These conclusions are presented in the report in the following order, along with the evidence and analysis that supported each conclusion. For more information, locate that principle in the body of the report.

Concerning open digital badges at general level, the project concluded that badges work better...

- in some places than others.
- where educational content already exists.
- when badge system designs take into account the constraints of the Open Badges Specifications
- when they present unique information and evidence.
- where expectations for assessment of individual skills and competencies are modest and manageable.
- where learning, recognition, and assessment is primarily social.
when awarded for completion of workshops, course, or projects, rather than highly specific skills or competencies.

Regarding the recognition of learning with open digital badges, the project concluded that **badges work better**…

- when used to map learning levels and pathways.
- when aligned to internal and/or external standards as appropriate.
- when communities of peer endorsers and networks of expert endorsers are already established.
- when any external endorsements are based on existing institutional relationships.
- as informal evidence-rich credentials that speak for themselves rather than formal credentials whose value is rooted in conventional accreditation systems.
- when they can be endorsed by multiple stakeholders after they are issued, based on the evidence contained in the badge.
- when used to recognize diverse types of learning.
- when used to communicate learning to external audiences.
- when the web-enabled evidence they contain is maintained.
- when awarded to both teachers and students.
- when not offered for formal course credit.
- when used to help learners discover opportunities to learn.
- when used to help programs discover and connect with learners and grow learning communities.

Regarding the use of assessments to generate evidence for awarding open digital badges, the project concluded that **badges work better**…

- when leveled assessment practices are carefully designed and based on successful examples from the field.
- when computer-based and expert assessment systems are carefully designed and based on successful examples from the field.
- when layered into an existing well-designed e-portfolio system that streamlines the creation, curation, and assessment.
- when formative feedback is both useful and used to support learning.
- when assessments are focused on broader projects and activities, rather than mastery of highly specific skills or competencies.
- when mastery learning is assessed by the computer rather than humans.
- when student involvement in the design of assessment practices is done carefully and judiciously.

Regarding the use of open digital badges to motivate learning, the project concluded that **badges work better**…

- when associated with intrinsically meaningful rewards rather than extrinsic incentives.
when learning is not motivated by formal course credit.
when competition concerns basic skills or participation in social practices, rather than learning from inquiry.
when learners control how their badges are displayed publically.
when they motivate learning by containing claims and evidence that will help earners secure opportunities and internships.
when they provide additional opportunities within the environment where the badges are issued.
when they motivate as informal evidence-rich credentials that speak for themselves.
when initial badges are easy to earn and provide access to more advanced badges.
when motivational goal setting practices are carefully designed and based on successful examples from the field.
when learners are motivated by informal (rather than formal) peer assessments.
when learners are motivated by computer-based assessments.
when learners are motivated by peer endorsers identified in existing communities or networks.
when learners reflect on their engagement in learning rather than the outcomes of that learning.
when they give earners opportunities to become peer mentors.
when used to help earners establish personal identities associated with disciplinary and professional communities.
when used to motivate engagement with disciplinary and professional communities.
when the impact of extrinsic rewards and competition is studied and refined primarily in terms of its impact on engaged participation.

Finally, the DPD project explored various intended and possible research designs for studying digital badges. While the project did not reach any conclusions regarding research designs, it did identify three important dimensions for thinking about research designs. The first is *purposes* of the research (i.e. summative research of badge systems vs. formative research for improving badge systems.) The second is *sources of evidence* (i.e., conventional evidence vs. new forms of evidence access from the badges themselves). Crossing these two dimensions results in four categories of badges research. Within each of those four categories is an additional dimension of research *scope* (i.e., specific badges, larger badge systems, and broader badge-based educational ecosystems).

- **Research of badges, systems, and ecosystems**
- **Research for badges, systems, and ecosystems**
- **Research with badged evidence and of badges, systems, and ecosystems**
- **Research with badged evidence and for badges, systems, and ecosystems**

The final section of the report describes the handful of research studies carried out by these thirty projects in each of these categories, along with some additional research studies carried out by other badge projects.
I. INTRODUCTION TO THE PROJECT

Over roughly a century, the existing systems for credentialing learning emerged alongside modern schooling. Traditionally speaking, schools use credentials to recognize learning, learners use credentials to show what they have learned, and employers use credentials to find individuals with particular education and skills. Digital badges are different than conventional credentials and transcripts because they can contain detailed claims about learning, evidence supporting those claims, and links to more information like completed student work. Open digital badges are different, still, because they allow this information to circulate readily in social networks, and earners can readily curate annotated collections of their badges for specific purposes. Open digital badges are a powerful part of educational technology currently changing learning in formal, informal, and crowd-sourced landscapes. The value and influence of badges has grown for entrepreneurs building platforms, for schools and after-school programs building digital communities, and for learners who can display learning interests, pursuits and achievements utilizing social media tools.

Historical Context

Open digital badges emerged as a concept in 2010-2011 around Peer to Peer University (P2PU). Around this time, P2PU was establishing itself as a more communal and decentralized alternative to the massively open online courses (MOOCs) that were then gaining a foothold (Gibson, et al., 2013). These years saw an explosion of interest around the relatively didactic “xMOOCs” like edX that mostly featured streaming videos, structured practice problems and multiple choice quizzes, but with relatively little interaction among users. P2PU had much more in common with the original “cMOOCs” that were based on connectivist (Siemens, 2005) principles and featured much more social learning and interaction.

The leaders of P2PU and collaborators at the Mozilla Foundation were struggling to define ways to recognize the impressive levels of individual and social learning occurring in many of the P2PU courses. Meanwhile, the MacArthur Foundation’s Digital Media and Learning (DML) initiative was establishing a vibrant community of informal educational providers who were also searching for ways to promote their offerings and to acknowledge the ensuing accomplishments outside of the conventional process, whereby schools were accredited by outside agencies and issued grades, certificates, and transcripts. A consensus began emerging that some entirely new alternative to static certificates was needed. The key insight was that a simple image backed up by a set of metadata (i.e., data about data) standards containing both claims about learning and evidence supporting those claims would be a transformative way of recognizing learning. Two particularly important insights concerned the value of including web-enabled evidence in such digital credentials and allowing those credentials to circulate in social networks where they could take on additional meaning. Both insights promised to provide alternative sources of the validation that accrediting agencies provide for traditional schools.

Drawing on these initial insights, the MacArthur Foundation’s Digital Media and Learning initiative announced the Badges for Lifelong Learning competition in 2011 to much fanfare. The kickoff event in Washington, D.C. featured then Secretary of Education Arnie Duncan and the heads of a number of federal agencies; the competition was widely cited in the popular and educational media. Over 600 proposals were submitted to design and implement badge systems; the Gates Foundation ultimately elected to contribute significant funding to the competition. In spring 2012, 30 badge system $100K-$200K and given one year to develop their badge systems. Additional grants were awarded to HASTAC (Humanities, Arts, Science, and
Technology Alliance and Collaboratory) at Duke University to support the badge systems development efforts, and to the Mozilla Foundation to build the necessary infrastructure. This included a formal set of metadata standards (Open Badges Infrastructure, or OBI), a digital “backpack” for hosting badges, and other needed elements of the larger open badges ecosystem. For more detailed information about open digital badges and additional insights gained from the Badges for Lifelong Learning initiative, readers are referred to Sheryl Grant’s 2014 book What Counts as Learning.¹

Project Goals

The initial goals of this project were negotiated with program officers and senior DML researchers as the 2012 competition was unfolding. Additional goals emerged as the project began. It is important to note that the project goals did not include supporting the 30 efforts to design and implement their badge systems. The DPD project did encourage members of the 30 teams contact team members of other teams when they faced similar challenges, but the task of supporting the 30 DML badge system teams and encouraging networking among them fell to the team led by Sheryl Grant.

Knowledge Discovery

The primary goal of this project as negotiated with the Foundation was to capture the more specific insights that emerged as the 30 DML badge system design efforts drew from and contributed to this explosion of new knowledge around open digital badges. As described in the next section, a hybrid method for doing so (combining qualitative and quantitative techniques) was refined in the initial phases of the project. Many of the findings in this report are highly specific to the contexts in which the 30 efforts were carried out. Additionally, many of the challenges that each of the DML efforts encountered were associated with the nascent and rapidly evolving nature of the larger open badges ecosystem. As such, the findings from this project are more illustrative and suggestive than they are directive and conclusive.

Knowledge Dissemination

An obvious secondary goal of this project was sharing out the findings across badge systems in ways that other badge systems and the larger community would find useful. This project was particularly focused on creating tools and practices for doing so that would build trust with the 30 teams (e.g. by allowing them to review system-specific findings) while also giving easy public access to this vetted information.

This process of vetting and disseminating findings proved problematic. An initial website for sharing out findings using MediaWiki proved cumbersome and unstable. Given MacArthur's investment in www.WorkingExamples.org, the project then elected to begin building these multimedia artifacts for a subset of the badge system designs to share out project findings. Dr. Hickey had been involved in this project from the start and already had working examples from other badge systems. The DPD project invested significant effort to create working examples for each of the categories of badge design practices² and for several of the badge system design.³

² For example, http://www.workingexamples.org/example/show/605
³ For example, http://www.workingexamples.org/example/show/609
However, the website also proved to be quite cumbersome and the DPD project abandoned WorkingExamples. The DPD project ultimately settled on a WordPress site, where all the project data continues to be shared and regularly accessed by anyone. This report is a synthesis of the more extensive data set that is freely available at the project website. Representatives of the 30 teams have been asked to review their findings at major junctures. Most of the teams reviewed findings and some of the descriptions and characterizations have been revised or refined accordingly. Readers are encouraged to consult the detailed appendices that are posted for each of the 30 proposed badge systems for additional information, and with individuals associated with the various badge system designs efforts.

**Following Up with the Badge Systems**

The original grants for the 2012 DML completion were for one year. However, many of the badge systems did not actually get started until well into 2013. Many of the efforts ran into significant delays getting their systems operational. Some of the teams requested delays in their final DPD project interviews. While the DPD project was intended to conclude in mid-2014, final data collection was not completed until early 2015. In an effort to be as current as possible, this report contains information gathered as late as December 2015, as iterative development of some of the badge systems continued. In particular, the DPD project was interested in documenting which proposals had resulted in badge-based ecosystems that could be characterized as “thriving” as of late 2015. Readers are encouraged to follow up directly with the various team members for subsequent developments.

**Recent Developments**

To put the findings in this report in context, it is worth noting the significant changes that occurred in the broader landscape following the ostensible end of the DPD project in 2014. In the ensuring period, the open badges landscape evolved considerably. For example, initial concerns that badges would be *interoperable* (workable across multiple current platforms) had broadened to include the concern that badges would be *extensible* (compatible with all future platforms). The general-purpose BadgeKit badge-issuing application from Mozilla gave way to multiple APIs (Application Program Interfaces) and extensions for specific learning management system and hosting solutions. The original JSON language was expanded to the new JavaScript Object Notation-Linked Data (JSON-LD) language and World Wide Web Consortium (W3C) standards.

In 2015, the Badge Alliance was reorganized, and significant efforts were under way to define new metadata standards that would offer new features while still allowing interoperability and promising extensibility. In April 2015, it was announced that the IMS Global Learning Consortium was establishing the *Digital Credentialing Initiative.* This work involved developing a “currency framework” consisting of “Open Badge Extensions for Education.” The year 2015 also brought major shifts in funding; the MacArthur Foundation ended the ten-year long Digital Media and Learning initiative by investing $25M to begin a new non-profit organization, Collective Shift, who “is dedicated to redesigning social systems for the connected age.” Their first project, LRNG, focuses on “working collaboratively with schools, businesses, 

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4 [http://dpdproject.info/](http://dpdproject.info/)
5 [https://medium.com/badge-alliance/an-evolution-of-open-badges-9025b7a95cd1#.n1qp4atwg](https://medium.com/badge-alliance/an-evolution-of-open-badges-9025b7a95cd1#.n1qp4atwg)
6 [http://www.imsglobal.org/pressreleases/pr150421.html](http://www.imsglobal.org/pressreleases/pr150421.html)
cities, and community institutions, such as libraries and museums, to redesign learning for the 21st century so all youth have the opportunity to succeed." Also by 2015, several new badging platforms emerged or became more widely used. These include the Open Badge Academy from DigitalMe in the UK,8 Badgr from Concentric Sky and the Badge Alliance,9 and BadgeList from Knowledgestream.10 Meanwhile, Acheiver, one of the original badge-specific startups, ceased operations. Finally, 2015 saw the emergence of an important new synergy between badges and e-portfolios with a pilot integrating Credly and Digication at Notre Dame.11

2016 saw additional important developments for the community, particularly in terms of integration of open badges with other learning technologies. This included additional synergy between badges and e-portfolios, whereby the Portfolium platform added Credly badges and Chalk & Wire Inc. announced their “learning recognition network” (LRN) known as MyMantl. Additionally, a number of badging tools became more broadly used in learning management systems thanks to the Learning Tools Interoperability standards from IMS Global. These standards allowed badging apps (including Accreditrust’s BadgeSafe, Credly’s BadgeOS, and Badgr) to be added to learning management systems in a similar manner as adding apps to smartphones. On December 31, 2016, the Open Badges 2.0 Specifications were released. On January 1, 2017, the IMS Global Learning Consortium adopted leadership of those specifications, along with most of the efforts to support the open badges community.12

These more recent developments suggest that the idea of agreed-upon standards for extensible digital credentials has, indeed, taken hold. While continuing changes will have consequences for the open badges “movement,” it appears certain the movement will continue. As such, it is expected that most of the findings and conclusion from this project should be widely useful for years to come, as open digital badges continue to find new ways of addressing long-standing challenges commonly encountered by schools, learners, and employers. It certainly seems possible that something other than open digital badges will help entities that aim to recognize learning and accomplishment. But, it also seems possible that educational programs and schools who continue to resist open e-credentials in 2017 may already have set in motion a slow decline similar to the publishers and retailers who dismissed e-commerce twenty years ago.

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7 www.collectiveshift.org
8 https://www.openbadgeacademy.com/
9 http://info.badgr.io/
10 https://www.badgelist.com/
11 http://blog.credly.com/digication-badges/
II. RESEARCH METHODOLOGY

The Design Principles Documentation Project was carried out at Indiana University’s Center for Research on Learning and Technology. The research methods were established in collaboration with the program officers and senior researchers associated with the MacArthur Foundation’s Digital Media and Learning Initiative (particularly Mimi Ito). The project was organized to capture the practical wisdom for using digital badges that emerged across the 30 DML badge content awardees. In epistemological terms, the project was attempting to capture what Aristotle labeled *phronesis* (which roughly translates to “practical wisdom”). By aiming to capture phronesis, the DPD team sought to move beyond scientific knowledge (what Aristotle labeled *episteme*) and technical know-how (*techne*) to balance episteme’s analytical rationale and techne’s instrumental rationale. The project found useful additional inspiration in Halverson’s studies of educational leadership using *artifact-based phronetic narratives*. Whereas Halverson created narratives of practical wisdom around the artifacts associated with running a school (e.g., schedules, curriculum, assessments, etc.), our project aimed to create a narrative of practical wisdom around the artifacts associated with digital badges (i.e., standards, competencies, designs, assessments, etc.)

The methodology also drew inspiration from contemporary “design-based” research methods (e.g., Cobb, Confrey, Lehrer, & Schauble, 2003) that focus on the derivation of “local” theories that pay close attention to the social, cultural, and technological contexts in which those insights emerged. This directed the project to focus on the derivation of badge design principles while identifying the contextual factors that give those principles meaning and value, rather than gathering evidence of learning outcomes or “proof” that badges “work.” Theoretically, the project embraced sociocultural theories (e.g., Lave & Wenger, 1991) that characterize learning in relatively broad terms. This allowed the project to appreciate learning as both processes associated with individuals as well as processes associated with the 30 DML efforts and the larger open badges community.

The project was not, strictly speaking, an objective ethnographic study. The research team brought values and biases. Nor was the project an empirical investigation. Just as the 30 teams were attempting something that had never been done, the DPD project knew of no other effort to capture the practical wisdom emerging across such a diverse pool of what were essentially pilot studies. As such, the research method necessarily emerged as the project unfolded. The dataset that resulted, regarding the final status of each proposed badge system and the fate of the various practices was iterative and sometimes quite unclear for some of the badge design efforts. As such the tone of this report and the wording of the final conclusions is quite tentative.

One set of methods was concerned with the proposed practices for using badges across the 30 proposed badge systems. These analyses provided evidence regarding which practices were easier vs harder to enact. A second set of methods was concerned with the success of the 30 proposed badge systems. These analyses provided evidence regarding which types of badge systems and other badge design factors were associated with and facilitated a successful implementation. It is important to note that the methods are described in chronological order (to provide a coherent narrative), but some of the results in the next section are presented in a different order (to provide more coherent conclusions).
Analysis of Badging Practices across Badge Systems

The DPD project used content analysis to identify the intended badge design practices in the 30 badge design proposals. The project then used thematic analyses of these findings to derive design principles that are more general across proposals. To organize this investigation, the DPD project first had to identify a manageable set of badge functions that were broad enough to capture both practices and principles, but also specific enough to organize the research effort and the findings. This focus on actual functions (rather than intended purposes) reflects a desire to capture both the intended and unintended consequences of particular uses of digital badges.

Categories of Badge Design Principles and Practices

After extensive deliberation and public discussion around a HASTAC blog post, the DPD project settled on the following four categories of functions.

**Recognizing learning.** Given that open badges primarily serve as “credentials” of learning and accomplishment, this is the primary function of digital badges. While badges are often characterized as assessments themselves, the primary use of badges is to recognize learning. All 30 of the badge system proposals clearly articulated the kinds of learning to be recognized with digital badges; some of the proposals were more specific than others in this regard. The proposals articulated a wide range of informal and formal learning to be recognized; just a few proposals (such as Badges for Vets) set out to recognize prior accomplishment.

**Assessing learning.** If some type of learning or accomplishment is to be recognized, then some sort of assessment is generally needed to generate the evidence that will be used to recognize that learning or accomplishment. The 30 proposals articulated a wide range of intended assessment practices, including portfolios, performance, peer, rubrics, etc. As with recognition, some of the proposals were more specific than others in this regard.

**Motivating learning.** Many uses of digital badges are explicitly intended to motivate learning; prior research argues that most efforts to recognize and assess learning are likely to impact motivation, and that those impacts will be complex and likely often unintended. Most of the 30 badge system proposals articulated motivational intentions for their badges; many of those proposals did not articulate specific motivational practices and few articulated specific theories of motivation to shape those practices. As such, the DPD project had to infer the likely or possible motivational consequences of the proposed badge system designs.

**Studying learning.** Unlike many educational research competitions, the Badges for Lifelong Learning initiative did not require specific project evaluation or outcomes assessment plans in the proposals. This made sense to the DPD project, given that

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14 It is worth noting that three of the teams were building badge systems within larger efforts to introduce competency-based education into K-12 school contexts as part of the Gates Foundations Project Mastery initiative. These three proposed badge systems (Youth Filmmaker Badges, Pathways to Global Competence, and Level Up) were all extensively and formally studied by a team at the Rand Foundation. The resulting report by Steele et al. was published in 2014.
digital badges were entirely new at the time. This meant that teams might have attempted formal evaluation of their badge system and document outcomes before they or the community even figured out how to use the innovation. Nonetheless, the DPD project embraced the potentially transformative possibility of using the evidence contained in digital badges to study learning and evaluate programs. Since few of the proposals articulated formal research designs or plans to evaluate their programs more formally, this set of badge functions was rather speculative.

As the various badge systems and the larger community evolved, the project eventually recognized a fifth distinct function of *discovering* learning which should be recognized going forward. As the notion of "playlists" and badge "pathways" emerged around 2014, it became quite apparent that many recognized that badges and sets of badges provide digital doorways to help individuals and communities find new opportunities to learn. In particular, it became apparent that when learners circulate the badges they earn over social networks and email, the earners' friends and peers learn about those opportunities and may follow links in the badges to those websites.

**Documenting Badge Design Practices**

The DPD project captured the more specific badge design *practices* and then organized those specific practices into more general badge design *principles*. It did so using regular interviews that explored intended, enacted, and formalized practices. From the outset, the DPD team assumed that success of specific practices, badge systems, and badge ecosystems would all be highly influenced by the social, pedagogical, and technological context where they were used. To reiterate, the DPD project also assumed that because this had never really been done before, all of these efforts were essentially pilots, hence the tentative tone of this report and the many qualifications of many of the conclusions.

The DPD project first analyzed the 30 badge system proposals to identify the intended *practices* for using digital badges to recognize, assess, motivate, and study learning. This analysis was carried in late 2012 using standard content analytics methods. As the 30 badge system development efforts got underway (late 2012 and early 2013), DPD project staff arranged for 60-90 minute interviews with team leaders to determine which of the intended practices had been enacted in a functioning badge systems. Specifically, the interviews explored whether each of the practices had been successfully enacted or abandoned, or whether the teams were still pursuing the practice. Additionally, the interviews attempted to uncover new badges design practices that the badge systems had embraced that were not articulated in their original proposals.

As the badge-specific funding for the 30 badge system design efforts was winding down in late 2013 and early 2014, DPD project staff carried out one or more interviews with representatives from each of the 30 badge systems to determine which of the enacted practices had been formalized and was likely to be continued. As described below, these final interviews also attempted to ascertain the final status of the larger proposed badge system. This was important because these two sets of findings interact with each other in complex ways that are important for deriving useful conclusions. In particular, some proposed badging practices were not enacted or formalized because the larger badge systems were never implemented or formalized. The challenge was distinguishing between intended practices that *incidentally* were not enacted or formalized, and which intended practices appeared to be *responsible* for their
badge systems not being implemented (presumably because they were central to the badge system and difficult to enact). Given that a central goal of the project was determining which practices were most challenging to formalize, these differences mattered.

Numerous judgement calls were made at this stage, given that some of the 30 teams were still attempting to establish their badge system. For some of the teams that never implemented their badge system, it proved challenging to locate an individual who was able and willing to be interviewed about their badge system. As this information was gathered and summarized, it was shared on the DPD project website in the form of project-specific appendices. As each appendix was posted, DML project staff were notified and asked to review the information for accuracy and appropriateness. To reiterate, most teams reviewed their data and some suggested a range of clarifications and corrections.

**Deriving General Badge Design Principles**

Also during late 2013 to early 2014, the specific badge design practices were organized into a smaller number of more general badge design principles used to organize the findings in this report. This organization was carried out using a simple card-sorting procedure whereby similar practices were grouped together. While the method was simple, numerous judgment calls were again required to determine which practices best fit together.

In order to validate the formalized practices and emergent principles, the DPD project organized a pre-conference workshop at the 2014 DML Conference in Boston, which all of the 2012 DML awardees were required to attend. During this four-hour workshop, representatives of the 30 teams were again asked to review their completed or draft appendices as well as the entire set of badge design practices and principles in each of the four areas. Extensive feedback was provided and revisions were made accordingly.

**Analyses of the 30 Proposed Badge Systems**

A second set of analyses was carried out to determine (a) what resources each of the proposed badge systems started out with, (b) determine the status of the 30 proposed badge systems in 2014 and 2015, and (c) to organize the badge systems as originally proposed according to the underlying learning theories that appeared to guide the design of the learning activities, badges, and assessments in each system.

**Analyzing Starting Resources**

One factor in the success of the proposed badge systems emerged after the DPD project was well underway. As Sheryl Grant explained in a widely read HASTAC blog post in late 2013, the badge system designs could be placed into one of five classes depending on their starting resources in terms of technology (i.e., a website) and educational content (i.e., instructional activities or educational programs to be badged):

- **Layered**: Start with technology and content (badges only)
- **Responsive**: Start with content (badges + tech)
- **Integrated**: Start with technology (badges + content)
- **New Build**: All designed simultaneously (badges + tech + content)
- **Badges-First**: Start with badges (badges + tech + content)
These distinctions certainly *seemed* important, but it was unclear how so. On one hand, the Layered designs only had to add badges to existing web sites and educational content. On the other hand, it was possible that existing content and (especially) assessment practices might be difficult to incorporate into a badge system. Likewise, starting with a website might be quite helpful, unless that website somehow interfered with the proposed badge system. As Grant (2013) put it:

> Badge systems, like other sociotechnical systems, are ways of building order in our world – but for now, at the early stages of design and development, we’re in an innovation free-for-all, which can be both exciting and daunting to newcomers. To build out the badge ecosystem, it’s important that we create a full library of toolkits, templates, and other signposts to guide people.

The fourth and fifth class of badge system design presented a particularly interesting distinction. In the Badges-First approach “the badges are design first and the learning content and technological platform are designed around the badges.” As Grant and others pointed out “many learning organizations are currently drawn to this 5th design approach.” Indeed, specifying competencies methods before designing curricula, assessments, and support technologies is consistent with the traditional “mastery learning” approaches and newer “competency-based” learning programs, as well as with “backward design” approaches to formative and summative assessment (e.g., Wiggins & McTighe, 2005). But, given that badges were entirely new, it seemed possible to design badges “in the abstract” that were difficult or impossible to enact pedagogically or technologically.

As illustrated by the deliberations by the awardees, this categorization proved difficult. The DPD project drew on information from the interviews with awardees and the Project Q&A reports to make these distinctions. In one case described below, the DPD project assigned one awardee to a different category than the one they in which they placed themselves.

**Determining the Final Status of the Proposed Badge Systems**

To reiterate, the project set out to capture “practical wisdom” for creating badge systems. As such it is crucial for the development of the field to provide a frank accounting of which types of intended badge systems were harder or even impossible to implement with the resources provided. Given that all 30 efforts were attempting to do something that had never been done before, it seemed likely that many would struggle to create the badge system that was proposed, while a few might not create a system at all. Furthermore, it was important to know when badge design principles were not formalized because the larger badge system was never implemented.

It proved quite challenging to empirically determine which of the 30 proposed badge systems were successfully implemented. On one hand, the Project Q&A Report that each team submitted in 2013-2014 to obtain the final installment of funding implied that most badge systems had been successfully implemented. Likewise, many of those badge systems had been described as successes that same year by third party reports (e.g., Alliance for Excellence in Education, 2014) in the educational media (e.g., Fain, 2014). On the other hand, the final DPD

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16 There is no central home page for these reports but they can be located by searching for “HASTAC Badge Project Q&A” followed by the name of the proposal.
project interviews carried out across 2014 revealed that some of these badge systems had already been suspended and a few had yet to award any badges to actual learners.

Due to discrepancies in the data, judgement calls were needed to conclude which badge systems could be characterized as being “implemented.” As described above, the DPD project had set out to determine whether the resulting badge systems were similar or different from the proposed systems and whether the larger badge-based educational ecosystem was similar or different. Ultimately, the DPD Project team members were unable to consistently and reliably make these distinctions based on the final interviews and corroborating evidence. Consequently, the distinction between similar vs. different was abandoned as was the effort to determine whether the teams had succeeded in creating the larger ecosystem. Thus, as described below, the 30 badge systems were only categorized in terms of suspended (which included badge systems that were never piloted), partial (where a part of the proposed system was implemented and badges were issued to actual learners), or implemented (where a relatively complete badge system was implemented, including some that scaled back parts). 17

However, this still left the problem that, in 2014, some design leaders had characterized their badge systems in rather aspirational terms; some indicated that they were still working on the system, and others indicated they were awaiting additional staff or funding. As such, the DPD project carried out a follow up study in the second half of 2015. DPD project staff conducted additional interviews and scoured the Internet for evidence that (a) badges were still being issued, (b) new learners were finding opportunities to learn, and (c) earners were displaying and sharing their badges. This data was then used to categorize the 30 badge systems as thriving, existing, or suspended.

Characterizing Badge Systems by Learning Theories

At the urging of project advisors, the DPD project ultimately added an additional research goal of exploring which types of badge systems appeared to be most successful, in terms of the learning theories that the system appeared to embrace. Only a few of the badge system proposals articulated specific theories of learning. Nonetheless, many of the proposals featured educational activities and assessments that were generally consistent with one of three widely acknowledged "grand theories" of knowing and learning. These three perspectives are rooted in more fundamental philosophies and epistemologies (e.g., Popper, 1956), are detailed in Greeno, Collins, and Resnick (1996) and Case (1996), and are widely understood by many researchers and theorists. More specifically, it appeared that the educational programs and assessments of learning within most (but not all) of the 30 proposed badge systems appeared relatively consistent with one of three widely recognized theories of knowing and (therefore) learning.

Associationist approaches. Some of the proposed badge system designs appeared to be most consistent with associationist theories. These rather traditional theories (sometimes labeled didactic or empiricist) assume that knowledge consists of a relatively large number of specific associations. These theories further assume that “higher order” knowledge consists of organized hierarchies or networks of these smaller associations. These views of knowledge are rooted in British empiricist philosophy and are most strongly associated with Behaviorism and its focus on stimulus-response associations (e.g., Skinner, 1953). However, associationist perspectives are well represented in the work of many cognitive scientists who focus on cognitive “if-then” associations (e.g., Anderson, 2013) and embraced by many instructional technologists (e.g.,

17 However, some of this information is included in the narrative sections of the results and more of this information is available in the appendices posted for each badge system at the DPD project website at http://dpdproject.info/
Gagne, 1985). Associationist perspectives are particularly appealing to instructional designers who worry about "cognitive load" (e.g., Sweller, Van Merrienboer, & Paas, 1998) that results when too much information is presented to learners.

This theory of knowledge leads to characterization of learning as building and strengthening specific associations and associations between associations. As such they are appealing to those who characterize learning in terms of specific measureable competencies (e.g., Everhart, Sandeen, Seymour, & Yoshino, 2014). This is important because many of the initial proponents of digital badges are also proponents of competency-based education (CBE) that is organized around specific measurable competencies. This also includes related “gamification” strategies that draw inspiration from the way badges serve to recognize specific achievements in video games (e.g., Hamari, 2015).

The DPD project concluded that badge system designs that were consistent with associationist perspectives would emphasize (a) badges for self-paced individualized mastery of specific competencies, (b) summative assessments of those competencies, and (c) external and extrinsic forms of motivation. It seemed appropriate to characterize badge systems that prioritized such features as competency-based systems.

**Constructivist approaches.** Constructivist perspectives offer a rather different approach to developing badge systems. This broad class of perspectives is rooted in Piaget’s (1970) genetic epistemology and is associated with modern learning perspectives that emerged in the 1980s. This perspective is widely embraced by many cognitive scientists (e.g., Glaser, 1984) and (arguably) most educational psychologists (e.g., Savery and Duffy, 1995) and teacher educators (e.g., Richardson, 2003). Constructivist perspectives embrace a rationalist theory of cognition which assumes that that knowledge consists of broader conceptual schema that the human mind constructs when attempting to make sense of (i.e., "rationalize") new information in the world. Rather than numerous specific stimulus-response or if-then patterns of associationist perspectives, constructivist perspectives lead to instruction that focuses on fewer "higher-order" competencies, and typically includes domain general competencies such as problem-solving and critical thinking.

Constructivism embraces a range of perspectives, including radical constructivist approaches that focus almost exclusively on individual sense-making (e.g., Von Glaserfeld, 1995), problem-based learning (e.g., Hmelo-Silver, 2004), and social constructivism (e.g., Garrison, 1997). It is worth noting that rationalist perspectives historically emerged as antithetical responses to associationist perspectives; many of the most corrosive tensions in education can be traced back to the differences between these two very different characterizations of the way that individuals learn. As elaborated below, a good deal skepticism about digital badges is rooted in constructivist models of motivation and hundreds of studies that document how “extrinsic” rewards undermine “intrinsic” motivations for learning.

The DPD project deemed proposed badge systems to be consistent with constructivist perspectives when they emphasized (a) awarding badges for completing larger projects or investigations, (b) higher order conceptual understanding, and (c) performance-based and portfolio-based assessment methods. It seemed appropriate to characterize badge systems that emphasize such features as inquiry-based systems (though a few might be more appropriately characterized as project-based).

**Sociocultural approaches.** Sociocultural perspectives offer a third approach to badge system design. This theory is rooted in the early work of the early Soviet psychologist Lev Vygotsky (1980) and emerged in its contemporary form in the 1990s (e.g., Lave & Wenger,
One well known strand of sociocultural perspectives is called situated cognition to reflect the assumption that knowing is strongly bound (i.e. "situated") in the social, cultural, and technological contexts in which that knowledge is learned and used. These perspectives are strongly embraced by some cognitive scientists (e.g., Pea, 1993; Greeno, 1998) and many learning scientists (e.g., Engle & Conant, 2002). These perspectives assume that knowledge is primarily represented in social and cultural practices of groups of people, and therefore view learning in terms of increasingly successful participation in those social practices.

Sociocultural perspectives are not as widely appreciated as associationist or constructivist perspectives and are often under-represented as socio-constructivism. But, it is important to recognize that these perspectives were highly influential in MacArthur’s Digital Media and Learning initiative from which open digital badges emerged (i.e., Yowell & Smylie, 1999; Chaplin, 2014). Compared to associationist and rationalist perspectives, situative perspectives do not point as directly to specific educational practices. Furthermore, as outlined in Greeno (1998), these perspectives lead to the notion of the "situative synthesis" which can be used as a "higher order" perspective to reconcile the tensions between associationist and constructivist practices. Perhaps the most useful example of defining characteristics follows from Collins, Brown, and Newman’s (1989) notion of cognitive apprenticeship, and the corresponding practices of modeling, coaching, scaffolding, articulation, and reflection, carried within what Lave and Wenger (1991) characterized as a community of practice.18

The DPD concluded that proposed badge systems were consistent with sociocultural perspective when they emphasized (a) badges for engaged participation in social learning and completion of group projects, (b) peer-assessment or “crowdsourced” assessment practices, (c) and more social and cultural forms of motivation. It seemed appropriate to characterize badge systems that emphasized these features as participation-based systems.19

Hybrid approaches. An initial review confirmed that most (but not all) of the proposed badge systems that did not fit into the three categories above included instruction and assessment practices that appeared consistent with two or even three of these perspectives. For example, some of the proposed badge systems included participation badges, but did not emphasize them and include them alongside competency-based and project-based badges. It seemed appropriate to characterize all of the remaining badge systems that did not fit into one of the three categories as hybrid systems.

18 Illustrating the continuing under-representation of these perspectives, the current Wikipedia entry opens with the assertion that “Constructivist approaches to human learning have led to the development of a theory of cognitive apprenticeship. https://en.wikipedia.org/wiki/Cognitive_apprenticeship

19 It is important to distinguish between badges awarded for engaged participation in the social practices of learning and badges awarded for mere attendance (which are sometimes derisively labeled as “participation badges”). Kyle Bowen of Purdue university coined the term “carpetbadging” to refer to such practices, while Serge Ravet (2015) characterized this practice as “spray and pray”. The widespread practice of awarding such badges for attendance at educationally-oriented conferences started around 2013 and seems to have broadly undermined the motivational appeal of badges for many potential stakeholders.
III. FINDINGS ACROSS BADGE SYSTEMS

Following is a summary of the more general findings and conclusions that emerged across the 30 badge systems that were proposed by the awardees in the 2012 Badges for Lifelong Learning initiative.

Characteristics and Final Status of the 30 Proposed Badge Systems

Illustrating the tremendous diversity across the 30 badge system designs, Figure 1 displays the intended educational setting, learners, and educational standards in the proposed badge systems. The 30 proposed badge systems are listed alphabetically along with this information and apparent badge system status in 2014 and 2015.

Figure 1. Characteristics of the 30 Proposed Badge Systems
<table>
<thead>
<tr>
<th>Name (Type)</th>
<th>Learning/ Program</th>
<th>Setting</th>
<th>Learners</th>
<th>Standards</th>
<th>Build</th>
<th>2014 Status</th>
<th>2015 Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-H/USDA(I)</td>
<td>STEM in new robotics curriculum</td>
<td>After School</td>
<td>Middle/ Secondary</td>
<td>P21 Skills</td>
<td>New Build</td>
<td>Partial</td>
<td>Existing</td>
</tr>
<tr>
<td>AQUAPONS (I)</td>
<td>Aquaponics for sustainable agriculture</td>
<td>School</td>
<td>Secondary</td>
<td>CCSS</td>
<td>Responsive</td>
<td>Partial</td>
<td>Thriving</td>
</tr>
<tr>
<td>Badges for Vets (H)</td>
<td>Civilian recognition of military skills</td>
<td>Informal</td>
<td>Vocational</td>
<td>None</td>
<td>New Build</td>
<td>Partial</td>
<td>Existing</td>
</tr>
<tr>
<td>BuzzMath (C)</td>
<td>Online drill and practice mathematics</td>
<td>School</td>
<td>Middle School</td>
<td>CCSS</td>
<td>New Build</td>
<td>Partial</td>
<td>Thriving</td>
</tr>
<tr>
<td>Cooper-Hewitt DesignPrep (P)</td>
<td>Design portfolios for NYC students</td>
<td>Museum</td>
<td>Secondary</td>
<td>None</td>
<td>Layered</td>
<td>Implemented</td>
<td>Thriving</td>
</tr>
<tr>
<td>CS2N (H)</td>
<td>Computer Science Student Network from CMU</td>
<td>After School</td>
<td>Middle/ Secondary</td>
<td>Industry</td>
<td>Responsive</td>
<td>Partial</td>
<td>Thriving</td>
</tr>
<tr>
<td>Design for America (P)</td>
<td>Solutions for community challenges</td>
<td>Informal</td>
<td>University</td>
<td>Community</td>
<td>Responsive</td>
<td>Implemented</td>
<td>Existing</td>
</tr>
<tr>
<td>Disney-Pixar Explorers (I)</td>
<td>STEM wilderness learning</td>
<td>After School</td>
<td>Elementary</td>
<td>Unknown</td>
<td>New Build</td>
<td>Suspended</td>
<td>Suspended</td>
</tr>
<tr>
<td>EarthWorks Rising (I)</td>
<td>Native American history and culture</td>
<td>Informal</td>
<td>Secondary</td>
<td>Community</td>
<td>Badges First</td>
<td>Suspended</td>
<td>Suspended</td>
</tr>
<tr>
<td>Intel Science Fair(I)</td>
<td>Existing Intel Science Fair</td>
<td>School</td>
<td>Secondary</td>
<td>NAS</td>
<td>Layered</td>
<td>Implemented</td>
<td>Thriving</td>
</tr>
<tr>
<td>LevelUp (C)</td>
<td>Competency based math games (Gates PM)</td>
<td>School</td>
<td>K – 12</td>
<td>CCSS</td>
<td>Integrated</td>
<td>Suspended</td>
<td>Suspended</td>
</tr>
<tr>
<td>Leverage for Digital On-Ramps (H)</td>
<td>College and readiness for urban students</td>
<td>School</td>
<td>Secondary</td>
<td>P21 Skills</td>
<td>Integrated</td>
<td>Partial</td>
<td>Suspended</td>
</tr>
<tr>
<td>Manufacturing Institute (C)</td>
<td>Competencies for computer-aided manufacturing</td>
<td>Community College</td>
<td>Vocational</td>
<td>Industry</td>
<td>Responsive</td>
<td>Implemented</td>
<td>Existing</td>
</tr>
<tr>
<td>Manufacturing Institute (C)</td>
<td>Course badges based on Skills USA assessments</td>
<td>Community College</td>
<td>Vocational</td>
<td>Industry</td>
<td>Responsive</td>
<td>Suspended</td>
<td>Suspended</td>
</tr>
<tr>
<td>Microsoft Partners in Learning Network (H)</td>
<td>Proficiencies for digitally sophisticated educators</td>
<td>Informal</td>
<td>Educators</td>
<td>UNESCO</td>
<td>Layered</td>
<td>Partial</td>
<td>Thriving</td>
</tr>
<tr>
<td>Mouse Wins! (P)</td>
<td>STEM learning, technology and design.</td>
<td>School</td>
<td>Middle/ Secondary</td>
<td>Community</td>
<td>Layered</td>
<td>Implemented</td>
<td>Thriving</td>
</tr>
<tr>
<td>My Sash is an App (I)</td>
<td>Leadership and smartphone apps</td>
<td>Informal</td>
<td>K – 12</td>
<td>Community</td>
<td>New Build</td>
<td>Partial</td>
<td>Existing</td>
</tr>
<tr>
<td>Nature-Badges (I)</td>
<td>Smithsonian Natural Sciences Activities</td>
<td>Museum</td>
<td>All Levels</td>
<td>None</td>
<td>Responsive</td>
<td>Implemented</td>
<td>Thriving</td>
</tr>
<tr>
<td>PASA Paths for Livelong Learning (H)</td>
<td>Diverse after-school activities</td>
<td>After School</td>
<td>Middle/ Secondary</td>
<td>CCSS</td>
<td>Integrated</td>
<td>Implemented</td>
<td>Suspended</td>
</tr>
<tr>
<td>Pathways to Global</td>
<td>Asia Society global</td>
<td>School</td>
<td>Secondary</td>
<td>CCSS/ Internal</td>
<td>Responsive</td>
<td>Suspended</td>
<td>Suspended</td>
</tr>
<tr>
<td>Competence (C)</td>
<td>competencies (Gates PM)</td>
<td>School</td>
<td>Secondary</td>
<td>P21 Skills</td>
<td>Responsive</td>
<td>Implemented</td>
<td>Thriving</td>
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<tr>
<td>----------------</td>
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</tr>
<tr>
<td>PBS Newshour (P)</td>
<td>Student reporting labs for media</td>
<td>School</td>
<td>Secondary</td>
<td>P21 Skills</td>
<td>Responsive</td>
<td>Implemented</td>
<td>Thriving</td>
</tr>
<tr>
<td>Planet Stewards (I)</td>
<td>Personalized STEM learning from 3D GameLab</td>
<td>School/ After School</td>
<td>Secondary</td>
<td>NGSS</td>
<td>Integrated</td>
<td>Implemented</td>
<td>Existing</td>
</tr>
<tr>
<td>Roadtrip Nation (I)</td>
<td>Mapping oral histories to futures</td>
<td>Informal</td>
<td>Secondary</td>
<td>CCSS/P21 Skills</td>
<td>Layered</td>
<td>Partial</td>
<td>Suspended</td>
</tr>
<tr>
<td>Starlite Robotics Badges (I)</td>
<td>Robotics and STEM learning w/ NASA Content</td>
<td>School</td>
<td>K – 12</td>
<td>CCSS/NGSS</td>
<td>Responsive</td>
<td>Implemented</td>
<td>Existing</td>
</tr>
<tr>
<td>StoryCorps U (I)</td>
<td>PBS media literacy and storytelling</td>
<td>School</td>
<td>Secondary</td>
<td>P21 Skills</td>
<td>Layered</td>
<td>Suspended</td>
<td>Suspended</td>
</tr>
<tr>
<td>Supporter 2 Reporter (P)</td>
<td>Sports journalism skills for UK football clubs</td>
<td>School</td>
<td>Middle/ Secondary</td>
<td>Community</td>
<td>Integrated</td>
<td>Implemented</td>
<td>Thriving</td>
</tr>
<tr>
<td>Sustainable Agriculture &amp; Food Safety (C)</td>
<td>New degree at UC Davis</td>
<td>University</td>
<td>University</td>
<td>Internal</td>
<td>Responsive</td>
<td>Suspended</td>
<td>Suspended</td>
</tr>
<tr>
<td>Who Built America? (I)</td>
<td>Social history education for history teachers</td>
<td>Informal</td>
<td>Educators</td>
<td>CCSS/Community</td>
<td>Responsive</td>
<td>Partial</td>
<td>Thriving</td>
</tr>
<tr>
<td>YALSA (C)</td>
<td>Young Adult Library Services Association skills</td>
<td>Informal</td>
<td>Librarians</td>
<td>Internal</td>
<td>Responsive</td>
<td>Implemented</td>
<td>Existing</td>
</tr>
<tr>
<td>Youth Digital Film Maker (C)</td>
<td>Language arts via film making (Gates PM)</td>
<td>After School</td>
<td>Secondary</td>
<td>CCSS</td>
<td>New Build</td>
<td>Suspended</td>
<td>Suspended</td>
</tr>
</tbody>
</table>

* C = Competency-Based, I = Inquiry-Based, P = Participation-Based, H = Hybrid

**Final Status across Badge Systems**

Figure 2 displays the status of the 30 proposed badge systems in 2014 (at the end of data collection and after funds for building the badge system had been spent) and again in 2015 (from the follow up study that searched for evidence of “thriving” badge systems. In contrast to many of the Project Q&A Reports submitted by the 30 teams and a number of characterizations of these badge systems in third party reports and the media, less than half of the teams had implemented a complete badge system by 2014, and just over one third of those systems were (generously) deemed to be “thriving” in 2015 (essentially issuing more than a trivial number of badges that appeared to have value to learner). These findings support the first general conclusion of this report: **Badges work better… in some places than others.**

Given that all of these design efforts were proposing to do something that had never been done before, and with relatively modest resources, this is a **remarkable** accomplishment. But is essential for subsequent badge design efforts to see what factors appear to have contributed in building thriving badge systems compared to factors that appear to have kept others from even piloting their badges.
Status by Starting Resources

As shown in the two left columns of Figures 3a and 3b, the awardees that attempted to layer badges (into existing content and technology) and that were responsive (to existing content, but had to build a new website) were generally more successful than the awardees who also attempted to create badges and educational content (the center column) or the awardees who attempted to create badges, content, and a website. This leads to the second general conclusion of this report: Badges work better… where educational content already exists. This seems to be a particularly important finding given the likelihood that badge systems are proposed and developed as part of efforts to develop new content and assessment.

Given the difficulty of categorizing badge systems on these dimensions and the small numbers, this is certainly a tentative conclusion. But, it seems to provide a particularly helpful way of thinking about badge design. The one awardee that the DPD project concluded was a Badges First design provides a useful example. While the Earthworks Rising project director described their badge system as a New Build design, the DPD project concluded that they were more appropriately characterized as a Badges First project. This is because the entire proposed badge systems (and elements of the proposed badge ecosystem) were organized around “pie badges” that had individual “slices” that would be illuminated as additional accomplishments were made. Unfortunately, this feature was not technically possible in any existing system for issuing badges and such badges would not be possible in any system that was compatible with the Open Badges Specifications. But, the Earthworks badge system and some of the curriculum had already been conceptualized around this badge feature. From the perspective of the DPD project, the challenges of designing their badge system “in the abstract” seemed to overwhelm this effort and they ran out of resources before even piloting a badge system (see Daigle, 2016). This observation is based on a single proposed badge system; therefore, this finding is certainly

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tentative. But, this finding does seem important given the popularity of this approach to badge design reported by Grant (2013) and the popularity of “backward design” approaches to assessment (e.g., Wiggins & McTighe, 2006). This led the project to the conclusion that **badges work better… when badge system designs take into account the constraints of the Open Badges Specifications.** The point here is the specifications that make Open Badges interoperable and extensible also introduce constraints in Open Badge systems that designers need to take into account from the start.\(^{21}\)

Findings across Badge Systems for Factors and Practices
In contrast to the constraints of Open Badges technologies, a less obvious (but potentially

\(^{21}\) It is worth noting that one of the Layered badges design efforts (Microsoft Partners in Learning) and one of the New Build efforts (BuzzMath) also encountered challenges with the constraints of Open Badges technologies. Both created badge systems that were thriving in 2015, but neither deployed Open Badges; Microsoft was constrained by their existing web technology, while BuzzMath was constrained by the use of email addresses as identifiers in the initial Open Badges Specifications because that precludes issuing Open Badges to children under the age of 13.
more important) set of constraints in badge system design emerged around the kinds of learning that the proposed badge systems were intended to recognize. Generally speaking, these constraints reflected the larger educational context in which the badge system was designed and flowed across the different types of badge design practices. As shown in Figure 4, one of the broader themes that emerged in the project interviews was the general flow of constraints (i.e., limitations) and affordances (i.e., possibilities) from the broader context and then across the four types of practices. More specifically, the broader context of the badge design efforts introduced constraints and affordances for the kinds of learning that badges can be used to recognize; those recognition choices affected the types of assessment practices that were necessary or possible. Those recognition and assessment practices in turn impacted the presumed or likely motivational impact of the badges and the most appropriate research designs for studying the badge systems.

Figure 4. Relationships between Badge Design Factors and Practices

The parenthetical descriptions below each of the labels in Figure 4 summarize the distinction between external factors, intended purposes, and observed/presumed functions, as discussed in the introduction. While these distinctions are initially nuanced, they are crucial for appreciating why some badge design practices were easier to document than others, and for organizing specific practices within each of the four areas. These factors, purposes, and functions, and the relationships among them, are detailed next.

**Contextual factors in recognition and assessment practices.** Obviously, the broader institutional context in which each badge system was designed introduces constraints and affordances for the kinds of learning that badges can be used to recognize. An initial set of these factors was elaborated in Hickey (2012) in the form of questions to be asked before attempting to design a badge system. The DML proposals ranged in the extent to which these factors were articulated; given the proposal page limits, it was not surprising that many said little about the context and how it shaped the proposed badge systems. The resulting badge systems varied in the extent to which (a) badge system designs accounted for these factors and (b) these factors supported or undermined the establishment of a badge-based ecosystem. The two most salient

examples that the DPD project uncovered are described next.

Obviously, the existing practices for recognizing and assessing learning are likely to affect the introduction of new badging practices for doing the same. Consider, for example, the 4-H/USDA Robotics Badges. The proposed badge system aimed to recognize learning in an extensive suite of project-based robotics activities developed by the University of Nebraska, with the support of the National Science Foundation. Those badges and the intended embedded performance assessments needed to function within the larger 4-H organization and the needs of the education officers at the US Department of Agriculture who support that organization. More specifically, the badges and assessments needed to function alongside the existing 4-H social network (e.g., school clubs and county fairs), recognition practices (e.g., ribbons and trophies), assessment practices (e.g., expert judging), and record keeping (i.e., workbooks and notebooks). In key respects, the 30 badge design teams attempted to model the new badge system around the existing recognition and assessment practices, and gradually introduce them alongside the robotics curriculum.

However, the 4-H/USDA team encountered significant technical challenges building its badge system and assessment technologies. Project Director Tony Cook reported that educators and learners found the new features redundant with the existing recognition, assessment, and record-keeping practices. As such, the collective enthusiasm for the new practices needed to work through the technology challenges never materialized. The proposed badge system was only partially implemented and the larger ecosystem envisioned in the proposal never emerged around the badge system.23

In a similar way, the National Manufacturing Institute's Computer Integrated Manufacturing Badge (CIM) appeared to be redundant with the recommended assessment and grading practices for the corresponding vocational curriculum distributed by Project Lead the Way.24 This meant that the CIM badge provided no additional information or evidence beyond the record on the earner’s transcript; in fact, that grade the student earned provided more information than the badge. As such, there was little reason for students to claim or share the badge and the project could find no evidence that students were doing so in 2015.

Both the 4-H/USDA and Manufacturing Institute's CIM badge systems were deemed to be existing in 2015 rather than thriving or suspended. These two seemingly clear examples and several other less clear examples in other badge systems lead to the conclusion that badges work better... when they present unique information and evidence. Put differently, the DPD Project concluded that badge systems redundant with existing recognition, assessment, and information practices appeared to be less successful than systems where the badges contained unique information and evidence that was not easily accessible or available elsewhere.

Impact of recognition and assessment practices on motivation and research. As highlighted by the parenthetical labels in Figure 4 and summarized in the introduction, only some of the badge system proposals articulated specific motivational practices for using badges, and few of the proposals articulated specific theories of motivation. As elaborated below, the DPD team was mostly forced to infer both the intended motivational purposes and the likely motivational functions of the proposed recognition and assessment practices. Hence, the DPD Project’s documentation of the motivational practices and likely functions were mostly

23 It is worth noting the 4-H team went on to develop a thriving badge system for its Rockets to the Rescue curriculum, https://www.canvas.net/courses/digital-badge-rockets-to-the-rescue. Project Director Tony Cook is leading continued to move more of the 4-H curriculum online via a modern LMS with integrated badges.
24 https://www.pltw.org/our-programs/pltw-engineering/pltw-engineering-curriculum
speculations based on the DPD team's collective knowledge of motivational practices in general and the presumed motivational consequences of the various recognition and assessment practices. This is discussed in more detail in the context of the design principles for motivating learning with digital badges.

Regarding the use of badges to study learning, we reiterate that the DPD project recognized that the claims and evidence in badges have unique potential for studying learning and evaluating programs. The value of this evidence is bolstered by the deliberations that projects must undergo to determine (a) what claims to support, (b) what evidence can support those claims, and (c) what assessment practices will deliver this evidence. The value of this evidence is further bolstered by the fact that these claims and evidence would be circulating publically on the Internet as earners shared their badges. Indeed, the transparency of this process proved daunting for some of the badge system teams. For example, Sustainable Agriculture and Food Systems (SA&FS), Manufacturing Institute, and 3D Game Labs Planet Stewards teams all reported that the process of defining claims and evidence came under additional institutional scrutiny when the sponsoring organizations realized that resulting information would be circulating freely on the Internet.

While the process of defining claims and evidence was presumed to bolster the value of badges as evidence for studying learning and evaluating programs, none of the DML badge systems had proposed doing so. Indeed, few of the 30 badge system proposals even articulated formal research designs for evaluating their badge systems. Nonetheless, the DPD project hoped that at least some of the 30 badge systems would begin exploring this potential value as their badge system design unfolded. Thus, the principles summarized in the next section for using badges to study learning were defined by the DPD team based on their knowledge of badges and typical research and evaluation designs. This aspect of the project is elaborated in Hickey and Willis (2015) and discussed in more detail below in the context of design principles for studying learning with digital badges.

**Findings across Types of Badge Systems**

As elaborated above, only few of the proposals articulated specific theories of learning behind their badge systems. When the DPD project analyzed the 30 proposed badge systems, most (but not all) emphasized features that were consistent with one of three widely acknowledged "grand theories" of cognition and learning. To reiterate, these broad perspectives as labeled associationist, constructivist, and sociocultural, and the corresponding badge systems were labeled competency-based, project-based, and participation-based. The remaining badge systems were labeled “hybrid” because they embraced recognition and assessment practices that appeared consistent with multiple perspectives. Following is a summary of the design and apparent status of these four different types of proposed badge systems.

**Competency-Based Badge Systems**

To reiterate, the associationist assumption that knowledge can and should be broken down into many specific associations emphasizes (a) mastery of specific competencies gained in self-paced individualized activities, (b) summative assessment of those competencies, and (c) extrinsic forms of motivation. Among the 30 DML 2012 proposals, this perspective was explicitly represented in the three proposals that were funded as part of the Gates Foundation's Project Mastery Initiative. This initiative supported K-12 efforts to implement “proficiency-based pathways” which offer “opportunities for students to engage in a learning experience
where they can demonstrate mastery of content and skills and earn credit towards a diploma, certificate, or some other meaningful marker” (Gates Foundation, 2012, p. 7). These three proposals aimed to create badge systems as part of a larger effort to move away from a recognition of “seat time” (for attendance or participation) and towards a focus on mastery of specific measurable (and ideally, measured) competencies. Consistent with Competency-Based Education (CBE), all three proposed badge systems were intended to recognize individualized self-paced mastery of a relatively large number of specific competencies, using summative assessments designed to measure those competencies. All three of the proposed systems were subjected to a comprehensive summative evaluation carried out by the Rand Corporation, (Steele, et al., 2014)

- The Pathways to Global Competence badge system was proposed by the Asia Society, a New York-based non-profit that was already implementing its curriculum in dozens of US secondary schools with a Project Mastery grant. They proposed to build an open badge system around a sophisticated e-portfolio system in partnership with a commercial e-portfolio provider (ShowEvidence, Inc.).
- The LevelUp badge was proposed by the Adams 50 school district in Colorado, as part of a comprehensive effort to reform several of its underperforming schools using CBE. They partnered with EffectiveSC, a non-profit that was developing the open-source LevelUp personalized competency tracking platform, and Intific, a Texas software development firm that was funded to develop four Space Wolf competency-based “learning progression games.”
- The Youth Digital Filmmaker Badge System was proposed by the School District of Philadelphia, who partnered with the Youtopia’s commercial badging/gamification platform and the Philadelphia Youth Network. The proposal aimed to build a badge system as part of an effort to enhance the SchoolNet LMS (from Pearson) and its Pathbrite e-portfolio system to better support competency-based learning by allowing teachers to award course credits for competencies demonstrated in non-school projects.

As elaborated in Rand report and Hickey (2016), all three of these design teams struggled with technology, validity, and personnel issues. The Global Competence badge system was never implemented and the other two badge systems were suspended after pilot implementations. In particular, all of the badge systems struggled to implement and manage the relatively massive demands for summative assessment of specific competencies from student generated work. This included gathering all of the elements of student work, presenting that work to qualified teachers or experts, keeping track of scores and competencies, and representing the resulting evidence meaningfully in digital badges.

Four other proposed badge systems were generally consistent with associationist perspectives and self-paced CBE:

- The SA&FS team proposed to build its badge system within a larger effort to create a new competency-based interdisciplinary major in the College of Agriculture and Environmental Sciences at the University of California-Davis. The DML badges grant was won after the new major had been approved and the program began admitting students. This larger effort had already engaged in an extensive competency-mapping process with prospective employers. With the DML award, the team aimed to capitalize
on the rich framework and design research to provide a visible tangible mechanism for students and faculty to engage with the core principles that had been established for the major. They succeeded in building and piloting a sophisticated custom e-portfolio system with comprehensive scoring rubrics targeting those competencies and issuing badges. The CBE program and badge system stalled when both failed to gain broader support from the university; the Project Director took a position elsewhere and a conventional course-based degree program was established.\(^\text{25}\)

- The Young Adult Library Services Administration (YALSA) team implemented a comprehensive badge system and peer assessment system for members who demonstrated mastery of specific professional standards for youth-serving librarians. While the YALSA badge system was implemented and still existed in 2015, Project Director Linda Braun reported that just a handful of learners had completed the activities needed to earn the badges, and that she herself had carried out all of the peer reviews. Braun concluded that the list of competencies and the expectations for peer review were too extensive in light of the informal value of the badge; she reported that the system might have thrived if used in a formal course context.\(^\text{26}\)

- The National Manufacturing Institute proposed the aforementioned Computer Integrated Manufacturing (CIM) badge for students at partner schools who completed PLTW’s standardized curriculum and attained a passing score on PLTW’s end of course assessment. As described above, the badge still existed in 2015. But, it appeared entirely redundant with the grading structure of the course and there was no evidence that any students were earning the badge, claiming it, or sharing the badge over social media.\(^\text{27}\)

- The National Manufacturing Institute proposed a second more ambitious badge system with SkillsUSA, a workforce development organization. The Manufacturing Institute proposed to issue badges for secondary vocational students in automated manufacturing programs who attained passing scores on standardized performance-based assessments developed by SkillsUSA for industry-defined competencies. However, the badge system stalled when the team was unable to secure a formal endorsement for its badges from employers; this removed the incentive for vocational education programs from purchasing and using the SkillsUSA assessments.

Finally, one of the 2012 DML awardees proposed a variant of CBE consistent with modern “gamification” techniques:

- Buzzmath badge system was proposed by ScoLab, a small educational software firm in Montreal. They proposed to issue badges to recognize mastery of specific competencies as learners progressed through a drill and practice game for middle school mathematics (akin to MathBlaster). The firm used the grant to develop the badges as well as the larger Buzzmath platform. The team succeeded in building both the platform and the badges and aligning both to Common Core math standards. The system has proven to be a commercial success and continues to thrive; an independent evaluation showed that students and teachers believe that playing the games had a positive impact on math

\(^\text{26}\) As of March 1, 2017, YALSA ceased monitoring or updating their badges website: [http://yalsabadges.ala.org/](http://yalsabadges.ala.org/)
\(^\text{27}\) [https://www.pltw.org/pltw-engineering-curriculum](https://www.pltw.org/pltw-engineering-curriculum)
achievement and understanding (Morrison, Ross, & Lesiczka, 2015). However, privacy concerns precluded the use of web-enabled open badges and a planned peer tutoring system (the use of email addresses as identifiers violated the stipulations of the US Children’s Online Privacy Protection Act). They were also unable to secure external endorsements of their badges by schools or the organizations associated with the Common Core standards that their badges had been aligned to.

Thus, none of the eight proposed badge systems that were most consistent with associationist perspectives succeeded in establishing an educational ecosystem around Open Badges that was still thriving at the end of 2015.

As elaborated in Hickey (2016), the challenges that many of these badge systems faced went well beyond the decision to implement a competency-based system. Put differently, the DPD project did not conclude that these badge systems would have been more successful had they attempted to issue “time-based” badges based on participation in courses or other education activities. Nonetheless, these findings suggest that caution is needed when developing competency-based badge systems. In particular, it seems competency-based systems should anticipate the challenges that the DPD project uncovered as well as the tensions in CBE implementations reported in the separate evaluation of the three Gates’ Project Mastery initiatives (Steele et al., 2014). That report cited the following challenges:

- Equating evidence from anytime/anywhere learning with conventional criteria;
- Determining who can authorize credit;
- Maintaining a common definition of proficiency;
- Building a sustainable model;
- Technical financial, and logistical barriers to efficiency;
- Concerns with equity

In key ways, these conclusions bolster the concerns about CBE in a report on the credit hour from the Carnegie Foundation (Silva, White, & Toch, 2015), while also highlighting the challenges that student information systems present for CBE summarized by Leuba (2015).

The concern that emerges from these findings is that badge systems that emphasize mastery of specific, measured competencies may overwhelm available assessment capacity. These assessment challenges are likely increased by the self-paced and individualized learning (because they eliminate some of informal assessment that teachers carry out as cohorts of learners progress through curriculum or projects together). Consistent with most visions of competency-based education, most of these proposed badge systems intended to allow learners to submit complex individualized artifacts (e.g., scripts, films, e-portfolios, curricula, etc.) that were then to be judged as valid evidence of many very specific competencies. As assessment experts like James Popham (e.g., 1997) have long argued, this is time consuming, difficult to do, and requires a substantial degree of expertise regarding the targeted disciplinary knowledge and substantial expertise of the assessment artifacts and projects that embody that knowledge.

**Inquiry-Based Badge Systems**

The largest category of proposed badge system were those that emphasized features consistent with “constructivist” theories of knowing and learning. To reiterate, the constructivist focus on higher order conceptual knowledge leads to an emphasis on (a) awarding badges for
inquiry-oriented learning, typically via completion of complex projects, (b) informal formative assessments of that learning via performance and portfolio assessment, (c) more intrinsic forms of motivation associated with curiosity and interest, and (d) formative research that attempts to improve badge systems. These are represented by the second type of practice listed for each of the four categories in Figure 4.

Of the 30 DML 2012 proposals, 12 fell into this category. Of those 12, four resulted in badge systems that appeared to be thriving in 2015:

- NatureBadges were proposed for existing web-based inquiry-learning activities that extended exhibits at the Smithsonian Natural History Museum. This was a Responsive badge system design, in that they needed to add badges and some new web technology for managing computer-based assessments and badges. The collaborative effort involved Learning Times, a private firm that was subsequently renamed Credly and expanded with the support of the DML 2012 initiative. The NatureBadges badge system was successfully implemented in 2014 and evolved into a new initiative known as Q?rius which appeared to be thriving in 2015.28 Credly eventually came to dominate the commercial open badges market and continues to host the badges issued by the museum.

- The Intel and Society for Science and the Public team planned to create digital badges to help recognize smaller successes towards nationwide success in inquiry-oriented learning in the well-established Intel Science Fair. The team was able to layer Open Badges into Intel’s existing curriculum and web technology implement to implement a successful badge system in 2014 that appeared to be thriving in 2015.29

- The Sweetwater Foundation’s proposed AQUAPONS was an urban aquaponics project. They proposed to add badges for sophisticated STEM e-portfolios, expert/peer assessment of scientific inquiry skills, and formal course credit to existing content in an afterschool urban aquaculture program. However, the team was unable to implement the portfolio assessment system and the badge system was only partially implemented in 2014. A scaled back version of the program was offered in 2015 as part of the Cities of Learning initiative and this more modest badge system appeared to be thriving in that context.

- Who Built America was a collaboration between the American Social History Project, Electric Funstuff, Inc., and the Educational Development Center. They proposed to build a badge system around an effort to transform an existing FTF project-based history teacher professional development project into web-based investigations and portfolio assessments. Despite enhanced funding from the Gates foundation, the team was unable to implement all aspects of an ambitious web-based peer/expert assessment system. The badge system and the curriculum was successfully implemented in 2014, and their badges have been approved by the New York City Department of Education’s After School Professional Development Program.30 While substantially scaled back from its original goals, this system appeared to be thriving in 2015.

Thus, of the four inquiry-based badge systems that were thriving in 2015, one of them (NatureBadges) relied on computer-based assessments, while another (Intel) took advantage of

28 https://qrius.si.edu/teens/about-badges
29 http://badging.societyforscience.org/badges
30 http://badges.ashp.cuny.edu/
an extensive network of existing assessment practices associated with its well-established science fairs. The other two teams that succeeded in implementing their badge systems both substantially reduced their intended assessment practices.

Four of the proposed inquiry-oriented badge systems succeed in implementing a badge system, but there was no evidence that the systems were thriving in 2015:

- The aforementioned 4-H/USDA badge systems was proposed for a new project-based robotics curriculum being introduced into this well-established youth agriculture program. They proposed to develop technology-based performance and portfolio assessments and scoring rubrics for use by adult leaders and judging panels. As described above, the badge system stalled in the face of technology challenges with the badging and assessment systems and the redundancy of the badge system with the existing practices. While the curriculum and badge system still exists, it is was reportedly not being used.

- The proposed Starlite Academy Robotics badge system was a collaboration between Project White Card, a Winnipeg-based startup, and the Center for Educational Technologies at Wheeling Jesuit University. They proposed to develop a badge system and new web technology for existing NASA-funded virtual game-based simulations and web-based inquiry-oriented activities. The badge system was successfully implemented in 2013 at www.AstronomyAcademy.org, but that site has been taken down. The game was renamed Star Rangers\(^{31}\) and is now available at STEAM.com and will reportedly issues badges for STEM learning.\(^{32}\) But there was no evidence in 2015 that any of these badge systems were “thriving” in 2015 or early 2017.\(^{33}\)

- Planet Stewards from 3D Game Labs concerned inquiry-based STEM career "quests" consisting of new project-based and game-based curricular modules developed in collaboration with the National Oceanic and Atmospheric Administration, using NOAA data. They proposed to integrate badges and this new content into an existing website that was not previously OBI compliant. This ambitious system was successfully implemented in 2013. However, no evidence could be located that suggested the badge system was still thriving in 2015.\(^{34}\)

- My Sash is an App from the Girl Scouts featured project-based modules from Motorola for developing mobile phone apps and a sophisticated assessment system featuring a combination of peer, expert, and computer-based assessments. While there was some existing content, the badge system design was classified as New Build because of the amount of new content and web technology that was necessary. Team leaders reported significant challenges with its technology and partner organizations. The system was partially implemented in 2014 and reportedly still existed in 2015, but no evidence of a thriving badge system was uncovered in 2015.

\(^{31}\) http://store.steampowered.com/app/333340/Star_Rangers/ As of April 29 2017, the early access version of the game does not appear to issue badges, but stated that “Star Ranges will award official Mozilla badges for building and operating custom rocket-sleds, asteroid mining operations, rovers, robots, and more.

\(^{32}\) http://star-rangers.com/?q=nasa

\(^{33}\) For example, in April 2016, this page still listed features that were in development in 2013: http://astronautacademy.org/astem-badges/for_educators#overlay-context= Likewise the Project Moonwalk game was still in 2013 beta tests stage in 2016: http://www.projectmoonwalk.com/

\(^{34}\) As of April 2016, the badge system website still referred to activities coming in 2013: https://planetstewards.wordpress.com/
The four remaining proposed inquiry-based badge systems never implemented their badge system before larger design effort or the badge system design effort was suspended:

- The Wilderness Explorers Badges from Disney and Pixar proposed to offer badges for project-based explorations and learning about conservation issues. The team ultimately produced an elementary grades life science game concerning the life cycle of endangered sea turtles, but the badge system was never implemented.\(^\text{35}\)
- The Earthworks Rising badge system proposed by Ohio State University and Digital Watershed proposed to build a badge system around a curriculum focused on the earth mounds built by Native Americans. They proposed a series of inquiry-based investigations and sophisticated rubrics whereby student work would be judged by peers and representatives of the Native American community. As described above, the DPD project concluded that this was a Badges First design, because extensive deliberations were conducted at the outset of the effort for a very specific type of badge which was technically possible in any system consistent with the Open Badge Specifications. Nonetheless, extensive development efforts were carried out along with a detailed set of rubrics for evaluating student work. These prototypes were reviewed and approved by peer audiences members and educators which included representatives of Native America communities and organizations. However, the prototype badge system was suspended before any of the curricular materials or elements of the badge system were implemented.
- Roadtrip Nation and Story Corps U badges were proposed as part of a larger initiative to layer badges into existing content and websites for students who successfully completed project-based learning activities via those websites. However, both badge systems were suspended very early on, and most of the CPB badging effort was directed at the News Hour Student Reporting Lab badge system described below.

While there are many reasons eight of these twelve proposed badge systems failed to result in thriving badge systems, the common thread in all of them was the intention to implement ambitious technology-supported performance and portfolio assessments. Such assessment systems were intended to help teachers or outside experts assess complex student work for evidence of relatively high-level student learning outcomes. One seemingly important observation across interviews with several of the teams was a concern about having evidence gathered from such assessments included in Open Badges potentially circulating freely in social networks. Some teams were concerned that this would lead to additional scrutiny of that evidence and the manner in which it was gathered. On one hand, such concerns encourage badge system design efforts to develop high quality assessment practices; on the other hand, doing so is challenging, particularly when attempting to resolve such concerns in the planning stages (as opposed to addressing them once an initial badge system is in place). Regardless, the lesson here is that badge system design should keep in mind that developing assessment systems (and particularly detailed rubrics for assessing learner artifacts) is a time consuming process that requires specific expertise with both assessment and the domain and likely requires extensive refinement.

Thus, one tentative conclusion from these findings is that Open Badges may heighten the

\(^{35}\) There is no appendix for this project at the DPD project website because the project was never able to interview anyone associated with the badge system design effort.
assessment challenges that prior constructivist assessment reforms have encountered in designing performance and portfolio assessments that yield valid evidence of disciplinary understanding (e.g., Shavelson, Baxter, & Pine, 1992). These challenges were devastating to large-scale assessment reforms that many US states implemented in the early 1990s and promptly abandoned around 1995. As reported by Koretz, Stecher, Klein and McCaffrey (1994) and others, these challenges were particularly concerning in light of poor reliability and lack of evidence of promised positive consequences for teaching and learning. Put differently, it seems possible that the transparency and potential scrutiny associated with assessment practices may increase the stakes associated with those assessment practices.

**Participation-Based Badge Systems**

To reiterate, the focus on social engagement in disciplinary practices in sociocultural theories leads to an emphasis on (a) badges for engaged participation in social learning and completion of group projects, (b) transformative peer-assessment or “crowdsourced” assessment practices, (c) more social and cultural forms of motivation, and (d) research using the evidence in badges to iteratively refine the badges. Five of the funded DML 2012 proposals appeared to be relatively consistent with this perspective:

- Design for America is an interdisciplinary network of university students and community members founded by students in engineering and learning sciences at Northwestern University; it aims for positive social impact by using the needs of the community members to guide design and interaction. DFA proposed to add badges to its existing programs and technology, allowing the program to award Open Badges for the successful completion of social impact projects. They succeeded in implementing its Digital Lofts Badge System in 2013 and were awarded an NSF Cyberlearning Grant to expand badges and other features of the Digital Loft. While DFA and the Digital Loft certainly appeared to be thriving in 2015, the DPD project could not locate evidence that Open Badges were still being used and thus, the badge system was deemed to be existing.

- The Cooper-Hewitt Design Prep badge system was proposed by partnership between the Smithsonian National Design Museum and Cooper-Hewitt School of Design. The teams proposed to layer badges into Cooper-Hewitt's existing DesignPrep program and technology that helps students from underserved schools in New York develop design, collaboration, and presentation skills while developing a portfolio of project in fashion, 3D modeling, and architecture. The initial badge system that was implemented in 2012 focused on discrete skills and accomplishment. But, few earners claimed their badges; interviews with students revealed they were more interested in "pre-professional" badges that focused more on their professional roles. In 2015, the badges were prominently featured on the new DesignPrep website and were being offered in ongoing programs. While the badges did not appear as widely claimed and shared as the next projects, this evidence appeared sufficient to characterize the badge system as thriving.

- The aforementioned Mouse Inc. badges were proposed to recognize middle and

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secondary students learning useful technical skills. Among others, by forming a help desk for their schools’ media and technology. Mouse Inc., a New York based non-profit, proposed to layer the badges into its existing web-based program. The team proposed (a) Community Win! badges specifically designed to recognize engaged participation in the Mouse network, (b) the organization of cohorts of students (some called “Squads”) to complete workshops and projects together, and (c) a sophisticated tracking system that allowed each squad to keep track of its collective progress. The badge system was successfully implemented in 2013, and there was ample evidence that the program and the badge system were thriving in 2015.41 The program and one if its many successful graduates are described in more detail in O’Byrne, Schenke, Willis, and Hickey (2015).

- The Supporter to Reporter (S2R) badge system was proposed by MakeWaves in the UK for its existing youth sports apprenticeship network. S2R had already developed a sophisticated website that included extensive networked peer endorsement and discussion of web-based student projects (mostly videos). The proposed badges were awarded for completion of projects, and most projects were completed collaboratively by cohorts of students, with particular attention directed at teamwork and collaboration. The badge system was successfully implemented in 2013. The program and the badges were thriving in 2015.42,43 In 2016, MakeWaves parlayed their success into a standalone open source badge and content management platform known as Open Badge Academy. MakeWaves and the platform were then acquired by the Cities and Guilds Group, the leading vocational training and credentialing organization in the UK.44

- The aforementioned PBS News Hour Student Reporting Labs (SRL) badges were proposed as part of a larger set of badge development efforts as part of the Corporation for Public Broadcasting’s American Graduate program for secondary school students. They proposed to layer badges into their existing curriculum and website for secondary students who completed web-based news articles and video, typically in high school journalism and media classrooms. The program places particular emphasis on building communities of learners, both within the individual schools, as well as across schools via its website. A sophisticated badge system was implemented in 2013, and the badge system and program were still thriving in 2015, with over 300 SRL Superstar badges issued and the introduction of a new STEM badge.

Three characteristics of these five badge systems appear noteworthy. First, all of the badges were associated with learning that was mostly social and/or networked. Two of the badge systems focused on the completion of socially networked media projects, and all of the badge systems were organized around the completion of workshops, projects, and programs, generally with cohorts of students, which often involved collaborative work.

The second noteworthy characteristic of the participation-based badge systems concerns the recognition of specific skills and more general competencies. While the badges recognized such competencies, when awarded for completion of workshops, course, or projects, rather than highly specific skills or competencies. Rather badges were awarded for completing projects,

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41 https://create.mouse.org/login
42 https://www.makewaves/s2rforsuccess
43 https://www.youtube.com/watch?v=w9-sddUCHKg
workshops, and programs, usually with a cohort of peers. For example, while the SRL Video Editing Badge was awarded to students who "Demonstrated an understanding of pacing, effective transitions, sequencing the use of natural sound, and b roll." To earn the badge, students were required to first upload their video to the project website and complete six written reflections on their project and their competencies. Teachers could then award the badge or request further refinement or reflection from the student. However, the evaluation was holistic and carried out at the discretion of the teacher. Likewise, the SRL Project Leadership badge was awarded for leading a team who successfully completed a digital media project. The completed project was itself treated as evidence of leadership, and the awarding of the badge was left to the teacher's discretion. Notably, the student work was forwarded on for endorsement by producers at the PBS affiliates only after they were approved by the teachers. In contrast to many of the other badge systems, these four teams seemed keenly aware of the limited time and patience for assessment available among educators and (particularly) outside experts. In this way, these teams appear to have heeded concerns raised by leading assessment experts (e.g., Popham, 1997; Tierney & Simon, 2004) about excessively detailed scoring rubrics.

The third noteworthy characteristic of these systems is that badges were generally awarded for taking on expert roles and for successful participation in the duties of that role. Rather than certification of competency or skills by individuals, the badges functioned as endorsement of the individual ability to perform a role that was recognized and valued in that particular community of learners.

**Hybrid Badge Systems**

Not all badge system proposals could be clearly classified in one of the three categories above; rather, these proposals emphasized practices that were consistent with all three perspectives:

- The Philadelphia School District proposed the Leverage for Digital On-Ramps badge system as part of an ambitious program to prepare high school students, grades 10-12, for entry into college and the workforce. They intended to add badges to the Philadelphia Academy's Post-Secondary and Career Readiness Course, a developmental multi-year course designed to provide 21st century and post-secondary readiness skills to high school students. The courses and the proposed badge system included features that were consistent with all three perspectives, including competency-based programs, individual and group projects, problem solving activities, and FTF and networked social interaction. While the badge system was only partly implemented in 2014 and then suspended, this work laid important groundwork for subsequent participation in Cites of Learning and Project LRNG.

- Microsoft proposed to add open digital badges to its existing Partners in Learning Network (PiLN) of educators and school leaders to promote technological competencies and relevant skills in today’s digital age. A worldwide initiative, the PiLN aims to equip educators with the capacity to teach information and communications technology and 21st century skills. The network employed features consistent with all three perspectives, including self-paced competency-based programs, cohorted workshops, problem solving activities, and extensive social interaction. While an internal badge system was implemented in 2014 and the

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network appeared to be thriving in 2015, technology constraints with the existing network prevented them from implementing Open Badges.46

- The Providence After School Alliance (PASA) partnered with after school and extracurricular programs to offer learning experiences to middle and high school students. It aimed to expand and improve quality afterschool, summer, and other expanded learning opportunities for the youth of Providence by organizing a sustainable public/private system that contributes to student success and serves as a national model. PASA collaborated with Achievery Inc., a badges startup. The program included a very diverse range of after-school activities, including self-paced, competency-based activities, conventional courses, collaborative projects, etc. As was announced in the national educational media, PASA and Achievery successfully implemented its badge system in 2013. While PASA's badge system still exists, they stopped issuing badges in 2014 for reasons describe below; Achievery suspended operations in 2015.

- Computer Science Student Network (CS2N) was a collaboration between Carnegie-Mellon University (CMU) and the Defense Advanced Research Projects Agency (DARPA). They intended to develop educational systems for computer science and other STEM fields for diverse learning groups ranging from middle school students to adult learners and hobbyists. They intended the badge system to serve as a guided pathway for learners to acquire skills in robotics, computer science, and related STEM content areas, using ambitious artificial intelligence systems designed to track and develop learners’ progression throughout the program. CS2N utilized associationist perspectives in their mapping of competencies in robotics and artificial intelligence, and constructivist perspectives in the emphasis on critical thinking in computer science, engineering, and robotics, and included some networked social activities. While the badge system was only partially developed in 2014, further funding and development has resulted in a thriving badge-based ecosystem in the Carnegie Mellon CS-STEM network and affiliation with Cities of Learning and Project LRNG.47 48

- The aforementioned Badges for Vets proposal aimed to connect civilian employers with veterans by translating their skills directly to the workplace. Importantly, organizations and agencies did not cooperate as originally envisioned, so the larger ecosystem around the website and badge system did not fully emerge. Rather, the badge system took on a social network function as veterans began to connect with one another; in turn, this minimized the role of the badges. The act of translating military skills to civilian work-ready skills seemed to call on practices that were consistent with multiple perspectives and other practices that did not really call on assumptions about knowing and learning. While the badge system was implemented in 2013 and still exists, it has never seen significant usage.

46 The entire website has been reorganized and renamed as Microsoft Educator Community and the program is now called Microsoft Innovative Educator. The site-specific (i.e., non-open) badges are featured more prominently with a point-intensive gamification system: https://education.microsoft.com/badges-points-certificates/badges-and-points 47 https://www.cs2n.org/ 48 https://www.cs2n.org/summer-of-learning
Summary of Findings across Proposed Badge System Types

Figures 5 and 6 display the 2014 and 2015 status of the 30 badge systems for each of the four types of proposed badge systems. Of course, many other factors were at play in establishing a badge system that continued to thrive after the funds to build the badge system were exhausted. It is particularly noteworthy that just one of the seven proposed competency-based badge systems was thriving in 2015. However, the Buzzmath badges were not open and shareable, but rather functioned like tokens as are common in drill and practice programs. In contrast four of the twelve badge systems that proposed inquiry-based badge systems were found to be thriving in 2015. Notably, those four badge systems either built on existing well-established assessment practices and/or significantly scaled back their intended practices for assessing learning. Likewise, the one team that succeeded in establishing a thriving Open Badge systems emphasized computer-based assessments for their competency-based badges. These observations lead to a fourth general conclusion in this report: **Badges work better… where expectations for assessment of individual skills and competencies are modest and manageable.**

To varying degrees, all four types of badge systems included various forms of social interaction among learners. However, those interactions were only emphasized in the participation-based badge systems, and were mostly represented in the other types of badge systems as peer-assessment of individual competencies or projects. The fact that four of those five badge systems appeared to be thriving and that one led to an entirely new badging platform that is gaining wider use leads to a fifth general conclusion: **Badges work better… where learning, recognition, and assessment is primarily social.**

Finally, it is worth noting that the proposed competency-based and inquiry-based badge systems intended to award badges for evidence of specific competencies or more conceptual understanding. In contrast, the proposed participation-based badge systems intended to award badges for completion of projects, workshops, apprenticeships, and courses, typically with cohorts of other learners. Notably, most of these badges did include claims of specific competencies or higher order skills. But, rather than directly assessing that knowledge, these badge systems left it up to educators or experts to make the judgement that someone who completed the particular program, activity, or course had demonstrated those competencies or understanding. This appears to support a sixth general conclusion: **Badges work better… when awarded for completion of workshops, course, or projects, rather than specific skills or competencies.**
Figure 5. Badge System Status in 2014 by Type
Figure 5. Badge System Status in 2015 by Type
IV. FINDINGS FOR RECOGNIZING LEARNING WITH DIGITAL BADGES

This section describes the findings of the Design Principles Documentation project in terms of the principles and practices for using open badges to recognize, assess, motivate, and study learning. To reiterate the methods detailed in Section II, the project documented the intended practices (in the proposals), enacted practices (as badge systems were getting underway) and the formalized practices (which endured after the funding was exhausted) in each of the four areas. The project then clustered the more specific practices into more general design principles.

The data in this chapter (and the three that follow) are drawn from the 29 appendices presented at the DPD project website.49 Our primary goal in this section is documenting which badge design principles were easier to implement and which were particularly challenging to implement and why. For many of the specific badge design practices, it was difficult to determine whether the principle was difficult to implement because any conclusion had to take into account whether or not the larger badge system was implemented. In other words, if certain practices were not enacted but the larger badge system was successfully established, those practices were likely difficult to implement. This is different than practices that were not implemented because the larger badge system was never established. Furthermore, it was often a subjective judgement as to whether or not a principle was successfully enacted. This was largely based on information provided in the various interviews. The natural optimism associated with such efforts presumably led to over-reporting of success, or the characterization of practices that teams were still working to enact as successes. So the following narratives attempt to take all of the information available for the practices associated with each design principle in an attempt to reach generalizable conclusions from each of the design principles the DPD project identified.

Recognition Design Principles, Practices, and Conclusions

To reiterate, badges are fundamentally a credential used to recognize learning. While this learning can include achievement, completion, participation, etc., the primary function of badges is to serve as a credential in this regard. The principles are presented in descending order of the frequency with which each principle was intended across the 30 proposed badge systems.

Use Badges to Map Learning Trajectories

Many proposed badges appreciated that badges can be used to define trajectories, for the benefit of the learner as well as the educators. Thirteen of the badge systems intended to do so by using leveled badges, with lower-level badges for smaller accomplishment and higher-level badges for larger accomplishments. For example, Who Built America designed a detailed hierarchy of badges for their history teachers, including three tiers of Builder badges (Apprentice, Journeyman, and Master), a Specialist badge to recognize particularly specialized history knowledge, and Community badges for posting to discussion forums and interacting with peers. These various levels mapped a sophisticated path towards the Master History Teacher badge to be awarded only twice per year. This principle was not particularly challenging to enact and most of the teams that implemented their badge system (eight) were able to formalize it.

Another way badge systems intended to use badges to map learning trajectories was to define "pathways" (with or without leveled badges). Eight of the systems intended to do so. For

49 http://dpdproject.info/details/category/badge-system-analysis/. No appendix is included for the Disney Pixar Wilderness Explorers badges because the DPD project staff were unable to locate a member of that team to participate in our interviews.
example, the Cooper-Hewitt Design Prep badges designed a very carefully structured "flat" pathway for their badges. In the follow-up interview, Halima Johnson elaborated that the badges would be defined around skills, which would show students how their different experiences connect, and give them useful credentials for applying to colleges:

We are not badging that workshop as “you developed these specific skills by working with an architect one day,” but rather we are breaking down bite size pieces, so we identified some skills and competencies that we value as a design museum….and we are looking at those as the basis of our badging system. So, instead of getting broad and wildly diverse badges… and having the students not see the connection between those elements, [we are] showing them that within each of the workshops that they have participated in, they are working on some of the same skills. We are pulling out those different items, and those are what we are building the badges around.

This was a particularly manageable practice, in that all eight of the badge systems that intended to use badges to provide learning pathways succeeded in formalizing the practice.

The fact that most of the systems were able to enact this principle leads us to conclude that badges work better... when used to map learning levels and pathways. In retrospect, this is a very sensible outcome and it highlights one of the central goals of the open badges initiative. Indeed, the notion of playlists and pathways are the focus of the DML 2016 competition\textsuperscript{50} and the larger LRNG project that is continuing the prior Cities of Learning initiative.\textsuperscript{51}

**Align Badges to Standards**

The majority of the badge systems intended to align their badges to one or more sets of standards. Five of the systems intended to align their badges to standards that were internal to the community. For example, the Sustainable Agriculture and Food Systems badges were aligned to an extensive list of competencies that had been identified via detailed surveys and interviews with potential employers, educators, and other community members. Likewise, Earthworks interviewed Native American leaders to derive categories of community values and knowledge for their badges.

Eleven of the systems aligned their badges to external national or international standards. For example, the Planet Stewards, AQUAPONS, and Starlight Academy all proposed to align their badges to the Next Generation Science Standards. Five of the systems proposed to align their badges to both internal and external standards. For example, the Asia Society proposed to align their Pathways to Global Competence badges to both the Common Core State Standards and their own internal standards for global competence.\textsuperscript{52} This pairing proved to be challenging from the start, so they abandoned the CCSS standards to focus only on their internal standards.

Ultimately, two-thirds of the proposed badge systems aligned their badges with internal and/or external standards, generally reflecting the larger context of the proposed system. No particular patterns emerged in the findings. This leads to the rather self-evident conclusion that Badges work better... when aligned to internal and/or external standards as appropriate.

\textsuperscript{50} https://dmlcompetition.net/playlists-for-learning/
\textsuperscript{51} https://www.lrng.org/
\textsuperscript{52} http://asiasociety.org/education/global-competence
Have Experts Issue Badges

The DPD project struggled with these practices because they overlapped significantly with the corresponding assessment practices. However, given that expert involvement appears to be a popular and potentially challenging principle, both the recognition team and the assessment teams included these practices. The distinction is whether the experts lent their endorsement or actually carried out the assessment. Eight of the proposals’ badges were to be credentialled by experts from an external entity. For example, all three of the Gates Foundation’s Project Mastery badge systems (Level Up, Pathways to Global Competence, and Youth Filmmakers) proposed ambitious plans to include experts (from Duke University, the international affairs community, and local filmmakers, respectively). However, all three badge systems abandoned these practices early on in their efforts because they were unable to secure commitments from the experts. On the other hand, the Computer Science Student Network was able to secure commitments for outside experts (by certifying educators who were not part of the network), as was the Intel science fair badges (by using their existing network of judges). Notably, the PBS Student Reporting Labs did not initially propose to ask outside experts to award badges. However, as described above, the team eventually formalized a streamlined system whereby producers at the local PBS affiliates would be asked to endorse student projects, but only after they had been endorsed by the classroom teacher.

Four of the proposed badge systems intended to have badges credentialled by the community, wherein the community itself serves as the "experts." These included successfully enacted community badges at Mouse Inc., Who Built America, and Design for America badge systems. Notably, in each of the badge systems, these community networks were already established. Earthworks Rising succeeded in establishing an advisory board Native American experts to issue badges, but the badge system was not operationalized.

Five of the badge systems intended to have badges credentialled by both an external entity and the community. This proved to be particularly difficult. Supporter to Reporter intended to have experts from the BBC and from the community endorse the badges, but they abandoned the external endorsers from the start; Starlight Academy intended to have community-awarded badges and outside experts from NASA, as well as teachers from within their network, but none of the practices were formalized. However, the Providence After School Alliance and Cooper-Hewitt Design Prep both succeeded in formalizing these practices; both already had networks of experts and a community of learners in place before they began building their badge systems.

In summary, many badge systems tried to enact this principle, both with outside experts, and with the leaders inside of the learning community serving as experts. This is not surprising as it seems like an obvious way to add value to badges. However, it appears that all of the teams that needed to establish the community or network of experts as part of their badge design effort failed to enact this principle. This leads to the conclusion that badges work better... when communities of peer endorsers and networks of expert endorsers are already established.

Seek External Backing

This principle is closely related to the previous principle, and appears equally as important. Seeking external backing emerged across two overlapping practices.

External endorsement. Eleven of the badge systems intended to enact this principle by securing formal endorsement of their badges by external organizations. Only five of the badge systems were judged to have formalized this practice. Four of the five did so by drawing on existing relationships. These included the Computer Science Student Network (via a tech
industry association), the 4-H badges (via the USDA), Intel Science Fair (via the Society for Science in Public and the National Association of Secondary School Principals), and NatureBadges (via the Smithsonian and its partners). Planet Stewards did succeed in reaching out to the National Oceanic and Atmospheric Administration; NOAA allowed them to use their acronym on their badge (after extensive review by NOAA education staffers), but refused to allow them to use the official NOAA logo.

Seven of the eleven badge systems that intended to secure external endorsements for their badges failed to enact or formalize this practice. This was primarily because they were unable to establish these (frankly ambitious) relationships. These included Youth Film Makers (the Philly Film Festival), BuzzMath (the Common Core State Standard initiative), Girl Scouts (NASA), Starlight Academy (several robotics organizations, 4-H, Girl Scouts, Boys and Girls Club), Supporter to Reporter (the BBC), and Who Built America (the National Council for the Social Studies, National History Education Clearinghouse, and Stanford History Education Group).

The fact that only one of eleven badge systems managed to establish the relationship needed to gain an external endorsement appears to be an important caution. This leads to the conclusion that badges work better… when external endorsements are based on existing institutional relationships. However, several of the badge systems provide reasons to be optimistic. The Who Built America, Supporter to Reporter, and Youth Film Maker badge systems all reported that the external organizations simply did not appreciate or even comprehend digital badges when they approached those organizations in 2012. It seems possible that external organizations will now be more receptive given the broader recognition of badges in the ensuing years. Additionally, it seems possible that using the more formal label "digital micro-credentials" will overcome concerns about the term "badges" that some believe trivializes the credentials.

**External value.** Going beyond basic endorsement, eight of the badge systems sought to secure external value by building relationships and securing commitments that might lead to internships, employment, and admissions. Only one of the badge systems succeeded in doing so. While the Student Reporting Labs proposal did not originally intend to ask staffers at the local PBS affiliate to endorse badges, this relationship emerged as the badge system unfolded.53 Thanks to a well-designed approval and notification system, staff members at the affiliate office are notified when students have earned the "career ready" badges, which have reportedly led to dozens of internships, some leading to subsequent employment.

The other seven badge systems failed to formalize relationships with external organizations that would add value. These included 4-H (study abroad organizations), Cooper-Hewitt Design Prep (art school admissions officers), Intel Science Fair and Planet Stewards (college admission officers), Manufacturers Institute and AQUAPONS (employer associations), and S2R and PBS Student Reporting Labs (the BBC, PBS affiliates, and other potentials sources of internships and employment).

As with external recognition, it seems possible that the situation might have changed in the ensuing years, or might have been different using a more official-sounding label for their badges.54 Perhaps more importantly, S2R project director Lucy Neale helped the DPD project

53 This practice is currently NOT included in the DPD appendix or database

54 The term micro-credential is favored by many who worry that badge sounds too informal. For example, Digital Promise has insistently used this term for the professional development efforts and has studiously avoided using the term badge. However, such a term may be most appropriate for competency-based badges and may might not be appropriate for systems that award “meta-badges” for demonstration of broad competencies, demonstrated expertise, or completion of entire courses.
appreciate what seems like a crucial aspect of securing external value. It seems that many of the badge system proposals and nearly all of the external organizations did not appreciate the fact that badges themselves can contain evidence and links to additional evidence supporting claims. Put differently, many of the proposals naturally approached their badge systems and efforts to secure endorsement and value from a very conventional perspective of accreditation, formal transcripts, etc. Given the very social and networked nature of the S2R badge system, that team reported abandoning efforts to secure external value from the start. Like Mouse Inc. and PBS, the S2R team invested extensive effort to ensure that their badges contained claims of meaningful competencies and compelling evidence supporting those claims. All three of the teams provided evidence that these badges helped earners gain valued internships and admissions. This leads us to the conclusion that badges work better… as informal evidence-rich credentials that speak for themselves rather than formal credentials whose value is rooted in conventional accreditation systems.

The S2R team ultimately succeeded in taking advantage of one of the most far-reaching (but least understood) features of digital badges: the possibility of gaining endorsements after the badge is issued. Because the S2R badges exist within an active interest-driven digital network, the students who generated artifacts and badges could readily gain comments and endorsement after earners earned them. Importantly, because of the openness of the network, the badges also had the potential of earning negative endorsements. Lucy Lewis describes how the insights gained in the S2R badge system design had been formally incorporated in their new Open Badge Academy platform:

Unlike LinkedIn, Open Badge Academy is about getting endorsements after you have earned a badge. People can come and add endorsements to the evidence. For example, one of the ways you can earn a badge is for an internship. You earn the badge on completing the internship. You can add that you thought it went well. The employer can also add an endorsement, adding additional feedback; your peers can do that, too. The idea is building trust via multipoint validation. We like to use the eBay comparison when we talk about badges…building an endorsement of your learning and achievement from lots of different points. It can be from an expert, it can be from an educator, from peers, and so on. These things together create a rich and credible credential that you can use in lots of different ways. Arguably, this is more valuable from an employer’s perspective because it is like getting a CV with the reference and the evidence built in, versus a qualification that does not have all of that context around it.

This leads to an admittedly speculative conclusion that badges probably work better… when they can be endorsed by multiple stakeholders after they are issued, based on the evidence contained in the badge.

Recognize Diverse Learning

This principle is related to the Learning Trajectories principle above. Nine of the teams intended to implement a system that appeared to take advantage of the unique affordances of

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55 While Facebook does not have a "dislike" button, the site has a well-earned reputation for allowing negative comments that effectively undermine claims and assertions made by members. More significantly, the public nature of the network and the potential for such negative claims proleptically discourages members from making claims and assertions that are likely to be questioned or dismissed by other members.
badges for recognizing diverse forms of learning. For example, the Intel badges were specifically intended to bring together recognition of both face-to-face accomplishments in science fairs as well as individual accomplishments on digital artifacts. Both Planet Stewards and YALSA articulated detailed plans for "weaving in" more specific skills into more general career-oriented badges; Mouse Inc. specifically aimed to integrate both "hard" and "soft" skills in their badges. Five of the six teams that implemented their badge system formalized this practice; Nature Badges had intended to use its badge system to expand the ages of learners that their program served, but that goal was postponed for programmatic reasons. These findings provide evidence that badges work better... when used to recognize diverse types of learning.

Use Badges as a Means of Externally Communicating Learning

As with the previous principle, this principle gets at a core function of digital badges. In order to advance this function, the DPD project identified thirteen specific practices for doing so that appeared distinctive. Perhaps the most notable efforts were the aforementioned systems developed for the Student Reporting Lab and Supporter to Reporter badge systems. Also noteworthy were the sophisticated portfolios developed for the Intel Science Fair badges. Other badge systems (Who Built America, CS2N, Planet Stewards, and YALSA) managed to overcome the significant challenges that Mozilla's digital backpack presented for displaying badges. The YALSA open badges website nicely captured this crucial function of open badges:

By displaying these badges in these virtual spaces you will be able to easily and visually inform colleagues, employers, potential employers, and others about your teen services skills and knowledge. You can also point colleagues in and outside of teen services to the badges so that they too can learn how to best work with teens.56

Notably, NatureBadges collaborated successfully with the startup Credly, Inc. to successfully allow earners to readily display their badges. However, two teams who implemented badge systems were unable to formalize this practice: Buzzmath elected not to use open badges because of privacy concerns and instead kept all of their badges contained in their website.57 The Cooper-Hewitt Design Prep program was still struggling to implement open badges in 2014. Nonetheless, the evidence appears to warrant the conclusion that badges work better... when used to communicate learning to external audiences.

Determine Lifespan of Badges

The expiration date feature is one of two optional fields of the eight meta-data fields that make up the Open Badge Instructure standards. The expiration date feature points to two badge design practices that were important to the DPD project and the community. The first is ensuring that the web-enabled evidence that supports the claims in digital badges is forever available in badges that were not given an expiration date. Seven proposals articulated specific plans or concerns to ensure that this was so and were able to formalize those plans (Who Built America, 4-H, Buzzmath, Planet Stewards, Starlight Academy, and S2R); Digital On Ramps articulated plans but the badge system was never implemented.

56 http://www.ala.org/yalsa/badges-learning
57 Their targeted users were under the age of 13, at which point COPPA protections largely prevent the sharing of open badges that contain student email addresses.
The second badge design practice that the DPD project included was to require renewal or upgrading. However, none of the 30 badge systems intended this practice—this made sense given the kinds of learning being recognized. This practice is obviously more relevant to high-stakes formal credentials. However, given that this is such an important issue, it seems to warrant another conclusion: **Badges work better… when the web enabled evidence they contain is maintained.**

**Recognize Educator Learning**

Eight of the proposed badge systems intended to recognize learning by educators. Two of them, Who Built America and Microsoft's Partners in Learning, were specifically intended for educators and they formalized this practice; Starlight Academy and AQUAPONs reported that they were able to formalize the practice for using badges to recognize the learning of educators who were working with badge-earning students. However, four of the badge systems (CS2N, Intel Science Fair, PASA, and AQUAPONS) were unable to formalize their intentions to do so. Interestingly, three badge systems that did not intend to use badges to recognize educator learning successfully formalized practices for doing so. Planet Stewards, PBS Student Reporting Lab and S2R all successfully introduced them after participating teachers requested them. These and the other badge systems recognized that offering badges to teachers could (a) motivate teachers to learn to support students, (b) help teachers understand badges from a learner's perspective, and (c) let teachers model the use of badges for their students. These findings appear to warrant the tentative conclusion that **badges probably to work better… when awarded to both teachers and students.**

**Award Formal Academic Credit**

For many observers, this is an obvious way to add value to badges. However, it contradicts the conclusion in the previous section that badges should contain unique and non-redundant information. Six of the 30 proposed badge systems intended to associate badges with formal academic credit. Only one of them succeeded. The Providence After School Alliance already had a sophisticated attendance tracking system as well as formal portfolio assessment practices that made it possible for their teachers to award formal course credit for after school activities. However, a detailed ethnography of the program (Davis and Singh, 2015) confirmed the project director’s report that the activities associated with awarding of formal credit interfered with and undermined the value of the badges for the students; the entire PASA badge system was paused in 2014.

All three of the Gates-funded Project Mastery badge systems intended to associate badges with formal course credit; as described above, the practices for doing so proved overwhelmingly problematic; this was also the case at SA&FS. The Planet Stewards team was unable to arrange college transfer with its partner university; while Planet Stewards intended to allow teachers to award course credit for badges and to award continuing education credit for teachers who participated in workshops, the DPD project could not find evidence that this practice was ever formalized and the entire effort appears to have stalled in 2013. These findings lead to an even stronger conclusion than the one above: **Badges work better… when not offered for formal course credit.**

58 [https://planetstewards.wordpress.com/](https://planetstewards.wordpress.com/)
**Promote Discovery**

As discussed in the previous section and the first principle in this section, one of the fundamental functions of badges is helping learners discover opportunities to learn. Seven of the proposed badge systems intended specific strategies for doing so, and four of them (Girl Scouts, Partners in Learning, Planet Stewards, and YALSA) formalized those practices; S2R formalized practices for doing so that were not articulated in their proposal. However, AQUAPONS was unable to use the Ning social networking site to do so, Design for America was also unable to implement its plans, and SA&FS was never implemented. Given that the DPD project concluded that this practice was important enough to have warranted a separate category, it seems that an additional conclusion is also warranted: **Badges work better... when used to help learners discover opportunities to learn.**

Conversely, badges can also be used by providers to help them discover learners. The Girl Scouts, SA&FS, and AQUAPONS all intended specific practices for doing so, but were unable to formalize those practices for rather different reasons. However, this practice was central in helping the Badges for Vets badge system attract learners (even though the learners ended up doing very different things at the site). While the evidence from the four badge systems is mixed, the inherent value of this practice suggests that **badges work better... when used to help programs discover and connect with learners and grow learning communities.**
V. FINDING FOR ASSESSING LEARNING FOR DIGITAL BADGES

To reiterate, (a) any use of badges to recognize learning is almost certain to require some sort of assessment practice, (b) many of the ultimate functions of assessment are emergent and some are unintended and potentially negative, (c) the 30 proposed DML badge systems proposed a wide range of intended practices with varied degrees of specificity. Additionally, while there is substantial overlap between the recognition principles and the assessment principles, the specific practices in each area diverge.

The principles and practices uncovered by the DPD Project are as follows, presented in descending order of the frequencies with which the principle was used. These show that the assessment practices were indeed harder to categorize and synthesize, and did not lead as readily to conclusions about badge design practices.

Assessment Design Principles, Practices, and Conclusions

Use Leveled Assessments

This principle mirrors the corresponding recognition principle. Eleven of the proposed badge systems intended to assess at distinctly different levels of competency. Badges for Vets, Buzzmath, CS2N, Starlight Academy, S2R, and AQUAPONS were all able to formalize this practice, but in rather different ways that reflected both their content and their technology. For example, S2R had bronze, silver, and gold medals for increasingly comprehensive projects. Cooper-Hewitt, Planet Stewards, and 4-H were unable to formalize this practice, while the Wilderness Explorer and SA&FS proposed this practice but their badge systems were never implemented.

A different practice for using leveled assessments is with a "meta" badge that is earned by earning a set of smaller badges. Mouse Inc. and the Student Reporting Labs both successfully formalized fairly ambitious meta-badges (featuring "micro" and "macro" achievements); Planet Stewards successfully introduced meta-badges while the system design was underway and went on to formalize them. Partners in Learning, Youth Film Makers, and Pathways to Global Competency were unable to formalize ambitious plans for their meta-badges, while the Digital On Ramps badge system was never implemented.

A third type of practice for leveling assessments was deemed hierarchical assessment. For example, Design for America successfully formalized its plan to organize their badges in a hierarchy around three levels: understand, create, and implement; Nature Badges formalized an assessment hierarchy with four "tiers" of badges; the Girl Scouts formalized their assessment hierarchy around completing different levels of apps: elementary, complex, and independent.

One takeaway from these findings is the diversity of ways that this principle and the different practices were enacted; another is the amount of restructuring and rethinking that was needed to enact and formalize this principle. It seems that one conclusion that can be drawn from these findings is that badges work better... when leveled assessment practices are carefully designed and based on successful examples from the field. Badge system developers are encouraged to look very carefully at the more successful and less successful practices detailed in the appendices for each badge system on the DPD project website, and if possible follow-up with particularly relevant badge systems to discover their current status and more recent innovations.
Enhance Validity with Expert Judgement

This principle also mirrors a corresponding recognition principle. Thirteen of the proposed badge systems intended to use human experts to enhance the validity of the claim contained in badges; six of those badge systems formalized those practices: Who Built America, 4-H, Design for America, Intel, Mouse Inc., and AQUAPONS; Design Prep introduced this practice after the design was underway and then successfully formalized it. However, all of the teams struggled in different ways to establish and sustain their expert assessment practice. Two of the badge systems also intended to award badges to experts for participating in assessment; Intel formalized the practice while Pathways to Global Competency never implemented their badge system. Planet Stewards successfully introduced the practice after the project was underway and then formalized it.

Nine of the proposed badge systems intended to enhance validity with both computer-based and human expertise. Six of those teams formalized this practice, including BuzzMath, Mouse Inc., Manufacturer's Institute, PASA, Planet Stewards, and S2R. For example, BuzzMath included a sophisticated dashboard to help teachers track their student's progress through computer-assessed activities. One particularly promising combination was introduced after the Student Reporting Labs effort was underway: the first badge was automatically issued for simply posting a story and six brief reflections. This simple task unlocked the remaining badges which were all assessed by the teacher. Perhaps the most sophisticated assessment system across the badge systems was the use of artificially-intelligent tutors within the more routine computer-based assessments in the Computer Science Support Network. While the team struggled to formalize the tools by 2014, they laid the groundwork for much more sophisticated tutors developed for scaled-up use in the Cities of Learning initiative.

As introduced above, many of the 30 teams failed to formalize some of their intended expert and/or computer-based assessment practices but still implemented their badge systems (including Cooper-Hewitt, Girl Scouts, and Starlight). In other proposals, the failure to formalize these practices appears to have contributed to the failure to implement the badge systems as intended. This included Level Up, Pathways to Global Competence, Youth Film Maker, Earthworks, SA&FS, and (presumably) Disney Pixar. Given these struggles and the centrality of this assessment practice to most badge systems, the project extended the corresponding recognition principle to conclude that badges work better… when computer-based and expert assessment systems are carefully designed and based on successful examples from the field.

Align Assessments to Standards

This principle and the more specific practices directly mirrors the corresponding recognition principle and the more specific recognition practices, as well as the conclusion. As such, the findings are not repeated here.

Use e-Portfolio Assessment

Six of the badge system proposals outlined relatively ambitious plans to use e-portfolios to allow learners to display their work for others and to allow it to be assessed. Three of the systems (SA&FS, Pathways to Global Competence, and 4-H) intended for the e-portfolios to be private, while three of these systems (AQUAPONS, Student Reporting Labs, and S2R) intended for the e-portfolios to be open to the public. Additionally, Pathways for Global Competence, AQUAPONS, and S2R all intended specific practices to allow for learner discussion to occur around their portfolios.
The failure to formalize these practices appeared to be the central factor that kept two of the badge systems from being implemented. Pathways to Global Competence and SA&FS both attempted to create very sophisticated e-portfolio assessment platforms (Pathways with the start-up ShowEvidence and SA&FS using internally developed tools). While AQUAPONS and 4-H were able to at least partly implement their e-portfolios, they too struggled to do so, and these challenges appeared to undermine the broader uptake of their badge systems after 2014. In contrast, both Student Reporting Labs and S2R already had relatively sophisticated portfolio assessment practices in place. This allowed them to layer badges into the existing system. Both badge systems continued to refine their portfolio tools and practices; both practices used technology to streamline and minimize the workload for students, teachers, and experts. The fact that these two systems were among the most thriving badge systems in 2015 led to this conclusion: **Badges work better… when layered into an existing well-designed e-portfolio system that streamlined creation, curation, and assessment.**

**Use Formative Assessment**

Nine of the proposed badge systems intended to provide formative feedback from assessments to directly support learning, but only five of them ended up formalizing those practices. Five of the badge systems intended to do so using formative feedback from peer assessment: YALSA and DFA both formalized this practice, while Youth Film Maker, CS2N, and PASA did not. The Student Reporting Labs successfully formalized the expert formative assessment system described above. Who Built America and Cooper-Hewitt both successfully formalized practices using both peers and experts to provide formative feedback (though Cooper-Hewitt introduced them after the implementation was underway). However, SA&FS and Level Up both were unable to formalize ambitious plans for peer and expert formative feedback.

These findings reflect the conclusions from Pellegrino, et al. (2001) that summative assessment purposes often overwhelm or otherwise take precedence over formative assessment purposes. This was certainly the case for PASA and likely the case for CS2N. Two of the badge systems that successfully implemented their formative assessment practices (DFA and Cooper-Hewitt) were not convinced the feedback was useful and used by learners. These findings partly support the concerns raised by Hickey (2015) that many typical formative assessment practices are so problematic and narrowing that that they likely result in less learning than the activities that they supplant. These findings lead to the conclusion that **Badges work better… when formative feedback is both useful and used to support learning.**

**Use Rubrics for Assessment**

Twelve of the badge systems articulated clear intentions for using rubrics to score artifacts and assessments. Eight of them intended to use more specific rubrics for detailed competencies; all three of the proposed Gates Project Mastery badge systems intended to do so but their badge systems were never implemented beyond the pilots. Who Built America?, Intel, YALSA, S2R, and 4-H all successfully formalized specific rubrics within badge systems that were fully implemented. Four of the badge systems also included more general rubrics; Student Reporting Labs and PASA successfully formalized them, while Level Up and Digital On-Ramps did not. The findings for this principle largely mirror the findings for the corresponding recognition principles, and support the conclusion that **badges work better… when assessments are focused on broader projects and activities, rather than mastery of highly specific skills or competencies.**
Use Mastery Learning

Four of the proposed badge systems intended to use mastery-learning practices whereby learners demonstrate specific "component" skills in a carefully structured sequence before being allowed to move on. For example, the Youth Film Maker badges paired each after-school coach and users with an English teacher “manager” who could reject activity completion if he/she thought mastery was not demonstrated by the uploaded evidence. However, the badge system was not implemented beyond a single pilot. BuzzMath formalized mastery learning using computer-based assessment while YALSA formalized mastery-learning practices using human assessments, while CS2N formalized mastery learning using only computers. Thus, one of the badge systems that use mastery learning with human assessments was suspected while the other was existing, while the two badge systems that implemented mastery learning with computer-based assessments was thriving. This leads to the conclusion that **badges work better… when mastery learning is assessed by the computer rather than humans.**

Involve Students in Assessment at a Granular Level

Four of the proposed badge systems intended to involve students directly in the design of assessment practices. For example, both Level Up and SA&FS intended to give students significant latitude in the evidence that they included in their e-portfolios. Mouse Inc. began experimenting with similar practices but ran into significant technical and practical challenges. All three of these examples highlight the challenges that often emerge when giving learners control of the design of the systems that will be used to assess their learning.

The challenges in involving students in assessment design at the granular level is perhaps best illustrated the experience at Cooper-Hewitt. They intended for students to design the badges and “badge structures” (pathways) that they would work toward earning. However, they discovered that students needed better understanding of what digital badges were and how they would be valuable. Team member Halima Johnson noted, that “they understood the idea of a badge, but they didn’t understand why digital badges… How is it going to be used, who is looking at it, why should they be invested in it?” Given that none of the practices were formalized, the project concluded that **badges work better… when student involvement in the design of assessment practices is done carefully and judiciously.**
VI. FINDINGS FOR MOTIVATING LEARNING WITH BADGES

To reiterate, choices made in recognizing and assessing learning are almost certain to have consequences for motivation. While all 30 of the badge system proposals referenced the motivational potential of their badge system, these references varied along several dimensions. Some of the intended motivational practices were quite explicit, mostly involving a range of incentives, including competitions, internships, and prizes.

However, many of the motivation practices were more implicit. Many of these practices were identified when the DPD team applied their assumptions about the likely motivational consequences of the other recognitions and assessments included in the badge systems. Identifying the implicit motivational practices turned out to be quite complex. As pointed out by Abramovich and Wardrip (2016, p. 53) “motivation to learn is an intricate concept and is not an implied foundation or automatic result of any educational intervention, including badges.”

Appreciating the potential consequences of the explicit motivational practices and inferring the potential consequences of the implicit practices required consideration of different theories of motivation and what that means for badges.

Motivation Theory and Digital Badges

Each of the three perspectives on knowing and learning used in Section II to categorize the 30 badge systems have fairly direct implications for motivation. Specifically, assumptions about the nature of knowledge and (therefore) the nature of learning lead fairly directly to assumptions about what motivates individuals to engage in that learning. These assumptions about motivation have profound (but conflicting) implications for motivational practices. Put differently, the ideal educational practices for motivating learning depend on what one assumes it means to be engaged in learning.

Motivation in Associationist Theories of Learning

Associationist theories of cognition assume that knowledge consists of many specific associations (concepts, procedures, facts, etc.) that are organized into hierarchies or networks. When knowledge is broken down this way, the primary motivation concern becomes engaging students in the routines of practice that build and strengthen those associations and the relationships between them. As long as individuals are engaging in the routines that create the desired associations and relationships, they are learning. Thus, motivating learning is primarily about getting learners to engage in those routines and keep practicing them.

This approach to motivation was readily apparent in BuzzMath where the digital badges essentially served as a point system in a “gamified” learning system that primarily intended to motivate students by having them compete to earn more badges than their peers. Indeed, proponents of gamification of education were some of the strongest initial proponents of digital badges (e.g., Buckingham, 2014; Mallon, 2013). Such badges are not necessarily related to the actual learning, and could be substituted for some other way of keeping track of a score such as point systems. Such incentives for learning are said to be “exogenous” (Rieber, 1996) because they are “outside” or “extrinsic” of the learner. As such, they often need to have some additional incentive associated with them (e.g., grades and competition) to motivate engagement. Among behaviorists, such practices are assumed to be helpful and necessary in many situations, particularly when motivating initial engagement in challenging topics (Chance, 1992).

As shown below, the leaders of BuzzMath struggled with their intentions of associating their badges with more explicitly extrinsic rewards. Likewise, the competency-based badge
systems struggled in designing the more explicitly motivational aspects of their badge systems; while most intended to associate their badges with course credit, few intended to associate their badges with truly extrinsic rewards. Regardless, those badge systems generally embraced the associationist assumption that many small continual successes can support continued engagement in learning. However, the DPD project struggled to reconcile the motivational potential of including extensive evidence of competency inside of badges with associationist theories of knowing and learning.

**Motivation in Constructivist Theories of Learning**

Predictably, the emergence of open badges rekindled the enduring debate over the use of extrinsic rewards to motivate learning. In one widely cited blog post, the director of the MIT Media Lab, Mitchell Resnick, stated that he was “still a badge skeptic” for precisely these reasons:

I worry that students will focus on accumulating badges rather than making connections with the ideas and material associated with the badges – the same way that students too often focus on grades in a class rather than the material in the class, or the points in an educational game rather than the ideas in the game. Simply engaging students is not enough. They need to be engaged for the right reasons (Resnick, 2012).

Likewise, the media theorist Henry Jenkins (who had been quite influential in MacArthur’s Digital Media and Learning initiative) expressed similar concerns:

Badges run the risk of becoming “gamification” by another name — that is, a system which does not trust the power of intrinsic motivation and feels the need to add a layer of extrinsic motivation…. some forms of gamification rely so heavily on points schemes that there is far less effort to make the activities meaningful in and of themselves, and it can be easy to replace learning with “playing the game” (Jenkins, 2012).

These concerns emerge quite naturally from constructivist theories of learning that focus on learning via inquiry and problem solving. Reflecting the core assumptions of constructivist perspectives, many assume that extrinsic incentives undermine intrinsically motivated learning because they “overjustify” engagement (Lepper & Malone, 1987). Indeed, hundreds of studies have shown that exogenous extrinsic rewards undermine self-regulated learning and intrinsic motivation, and reduced free-choice engagement when incentives are no longer offered (Deci, Koestner, Ryan, 1999).

Some of the strongest critiques of digital badges so far (e.g., Kohn, 2014) draw from self-determination theory (SDT; Ryan & Deci, 2002); SDT is perhaps the most influential of a number of theories of motivation that emerged alongside constructivist models of learning following the cognitive revolution in 1970s. When applied to education, SDT focuses on the way that feedback, assessment, and displays of achievement (i.e., core functions of badges) have a profound impact on learners’ efforts, sense of agency, and commitment. (i.e., core elements of

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59 Conversely, behaviorists have analyzed the same corpus of research to reach the conclusion that the negative consequences of such incentives are limited to a small set of easily avoidable practices (Cameron, Banko, & Pierce, 2001). This enduring debate illustrates how the antithetical nature of associationist and constructivist perspectives means that the disagreements about the practices that follow from them cannot be resolved empirically.
Specifically, SDT assumes that human well-being in general and motivated activity in specific settings is a function of three universal psychological needs: **competence** (desire to control outcomes and experience mastery), **autonomy** (control over one’s life and ability to act in harmony with one’s view of one’s self), and **relatedness** (to interact with others and be connected and caring with others).

Because of its obvious implications for educational practices such as grading, feedback, and competition, SDT has been extensively by educational psychologist. However, many of the most influential studies of SDT educational practices were carried out in (or in light of) very traditional classrooms; much of this research was carried out in response to behaviorally-inspired practices such as punishment and competition that were common in the 1970s. Via extensive research and popular books written for parents, educators, and managers, the central concerns of SDT became widely embraced. However, none of that research or discussion considered the unique affordances of digital badges. Given that feedback, assessment, and public displays of achievement are central functions of digital badges, it seems that such a consideration is now called for.

Consider for example, Kohn’s (2014) concerns about public displays of achievement and competition—practices that are likely to accompany digital badges. Such concerns seem quite warranted in very traditional classrooms that are slim on meaningful formative feedback and opportunities to improve. But, such concerns offer new ways of making learning meaningful that were not considered in the prior research. This possibility was raised by Abramovich and Wardrip (2016), who also introduced a potentially crucial distinction:

Applied to badges, there is a valid concern that badges could negatively impact learners’ motivation if they are seen as disconnected from the learning. However, if learners are able to connect their badges to their learning, then badges could support their motivation to learn by reinforcing their intrinsic motivation. That badge would act as an external motivator but not an extrinsic one (p. 57, emphasis added).

The point here is that digital badges might be external to the learner but intrinsically related to the learning process. Likewise, giving earners control over how their badges are curated and annotated, and allowing those badges to gain “likes” and comments in social networks seems likely to enhance feelings of competence, autonomy, and relatedness. As elaborated below, many of the proposed badge systems intended to include evidence and other information in badges to make them more meaningful, as well as associate badges with other valuable opportunities that were intrinsically related the learning recognized by the badges.

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60 The titles of Alfie Kohn’s many widely read books captures these concerns quite nicely: *No Contest: The Case against Competition* (1992), *Punished by Rewards: The Trouble with Gold Stars, Incentive Plans, A’s, Praise, and other Bribes* (1999), and *Beyond Discipline: From Compliance to Community* (2008). More recently, these perspectives have found an even wider audience via authors such as Daniel Pink (e.g. *Drive: The Surprising Truth about what Motivates us*, 2011) and Ken Robinson (e.g., *Creative Schools: The Grassroots Revolution that’s Transforming Education*, 2016). In particular, these ideas have gained wide exposure via recorded TED Talks, including Pink’s *The Puzzle of Motivation* (2009; 17 million views) and Robinson’s *Do Schools Kill Creativity?* (2006; 43 million views).
Motivation and Sociocultural Theories of Learning

The DPD project also considered the likely motivational consequence of the 30 proposed badge systems in light of the models of motivation that follow from the situative and sociocultural theories of knowing and learning discussed in Section II. As articulated above, these theories of knowing and learning were influential in the MacArthur Foundations’ Digital Media and Learning initiative from which the Badges for Lifelong Learning initiative emerged. While the motivational implications of these theories are still being debated, these theories seem to offer a way to transcend some of the tensions between the two prior perspectives. Consider, for example, the discussion of competition in a groundbreaking chapter on cognitive apprenticeship. Collins, Brown, and Newman (1989) suggested that:

One of the factors that makes competition seem problematic is that under many forms of teaching, students lack the means in the form of an understanding of the underlying process, strategies, and heuristics involved in solving problems, to improve their performance. (p. 38)

To varying degrees, most of the proposed badge systems included some elements of the cognitive apprenticeship framework that introduced many observers to situative theories (i.e., modeling, coaching, scaffolding, articulation, reflection, and exploration).

In the ensuing years, a number of scholars have explored the implications of situative and sociocultural theories for motivation. Some of these considerations reflect a heightened concern with the influence of sociocultural factors on conventional individually-oriented motivational constructs like expectancy (e.g., Anderman, et al., 2002), goals (e.g., Linnenbrink & Pintrich, 2001) and interest (e.g., Pressick-Kilborn & Walker, 2002). But others have gone further, focusing beyond the individual to new, largely cultural conceptualizations of motivation such as co-regulated learning (i.e., McCaslin, 2009), socially-shared regulation (i.e., Hadwin, Järvelä, & Miller (2011), identity (i.e., Nolen, Horn, & Ward, 2015), and engaged participation (i.e., Hickey, 2003). These latter perspectives emphasize the desires of individuals to participate in the activities of sociocultural groups and the desire of sociocultural groups to help particular individuals participate successfully in their activities.

Rather than specific associations or conceptual knowledge of academic or professional disciplines, these perspectives focus on the more contextual practices that experts enact appropriate in contexts that give those practices meaning. This shift from “knowledge” to “knowing” is perhaps best illustrated in Vygotsky’s (1980) now-familiar zone of proximal development whereby increasingly successful participation in disciplinary practices is scaffolded by more experienced peers and adults. One of the primary implications of these perspectives is that individual motivation cannot overcome the challenges presented if the larger group (e.g., a classroom in a school, a professional discipline, etc.) does not or will not provide that scaffolding.

When applied to badges, these perspectives suggest focusing on their motivational functions as part of the broader sociocultural ecosystems in which those badges are used. Consider for example, a comment that badges proponent Barry Joseph posted on Mitch Resnick’s (2012) aforementioned blog post:

I do have a similar concern when I hear some people describe what they want to do with badges; these folks have the idea that badges in and of themselves are what provides the
increased motivation, not the social systems surrounding the badges and other forms of alternative assessment that fill them with meaning and value. So my concern is less that learners will get distracted from the learning itself - that previously intrinsic motivation gets replaced with extrinsic motivation - but that those developing badging systems will force the new paradigm into the old box, replacing grades or certifications with badges, and be disappointed when nothing miraculous occurs.

It is possible that these sources of motivation are more powerful than typical extrinsic incentives or intrinsic motivators such as self-determination or curiosity. If so, then the social nature of digital badges likely lend themselves well to these perspectives. In particular, it seemed worth exploring the argument articulated in Hickey (2003; Hickey & Granade, 2004) that a stridently situative perspective makes it possible to use Greeno’s (1998) situative synthesis to resolve the enduring debate over extrinsic incentives.

Motivation Principles, Practices, and Conclusions

Even with explicit motivational practices, it was still difficult to for the DPD project to determine whether a team successfully enacted or formalized a particular practice. This is because it was impossible for the project to determine whether the practice actually succeeded in motivating learning or learners. The DPD project did not have consent to interact with learners and was not designed to support such research. While the DPD project asked about the specific practices that made up each of the principles during interviews, project leaders and staff were generally uncertain about the actual impact on motivation. Nonetheless, it seemed appropriate to assume that the motivational practices that were formalized were more successful at motivating learning than the practices that were never implemented or suspended (or part of a suspended badge system). Furthermore, it seemed appropriate to assume that systems that succeeded in motivating individuals to earn their badges without associating those badges with course credit had, by definition, implemented motivational practice successfully.

The principles for motivating learning with digital badges uncovered by the DPD project are presented below. They are presented in order of similarity in order to facilitate coherent discussion.

Motivate with Extrinsic Incentives

Three of the proposed badge systems associated some sort of prizes with their badges. Just one of them formalized this practice:

- Who Built America offers teachers who earn all five of their community badges a set of WBA documentary films for their school library. While this prize was not an “arbitrary” reward that was unrelated to the learning, it seemed “extrinsic” to the learning activities associated with earning the community badges. However, no teachers had claimed this prize in 2016, suggesting that incentive was not sufficiently appealing given the work it would take to earn the five badges.
- Gift certificates from Amazon.com for top scorers were featured prominently in BuzzMath’s proposal. But in the follow-up interview, Jean-Philippe Choiniere stated that

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61 The project did however obtain permission from a human subjects committee and interview badge earners at Mouse, Inc. The resulting findings are presented in O’Byrne, Schenke, Willis, & Hickey (2015)
they decided they did not want to “bring extrinsic motivation to the forefront, like contests with prizes,” but they would like to be able to offer gift certificates in the future “for the enjoyment of students on the side of their more serious progress through the badge system.”

- Starlight Robotics proposed NASA certificates and other prizes for top scorers in their games, but these were never implemented.

In summary, only one of the badge systems that proposed to associate their badges with extrinsic prizes ended up implementing that practice. But, that prize did not appear sufficiently attractive to motivate learners to earn it. Given the substantial controversy over extrinsic incentives, the motivational appeal of the prizes that were enacted seems worthy of further investigation. This supports the tentative conclusion that badges probably work better… when associated with intrinsically meaningful rewards rather than extrinsic incentives.

Motivate Learning by Associating Badges with Course Credit

Similar to extrinsic incentives, another likely motivational practice is associating badges with formal course credit. Five of the proposed badge systems intended to do so. This practice was discussed extensively above as a learning recognition practice. To reiterate, while PASA implemented this practice, it proved problematic. Of the teachers and potential earners who were aware of the badges, some saw them as redundant precisely because the badges were tied to grades. Davis and Signh’s (2015) extended ethnographic study of the badge system provided additional support for this observation:

all students were aware that they would receive high school credit for their successful participation in the afterschool program. Indeed, students identified the prospect of earning course credit as the primary motivation for taking part in afterschool activities. They did not see any connection between digital badges and course credit. Commented one student: What’s the point of the badge if you just get a grade?’ (p. 76)

The 4-H badge system never implement this principle. The difficulty of equating badges with course credit was a central factor in the suspension of all three Gates-Funded Project Mastery efforts (Global Competency, Level-Up, and Youth Film Maker). These findings lead to a conclusion that compliments the conclusion from the parallel recognition practice: Badges work better… when learning is not motivated by formal course credit.

Stimulate Competition between Learners

Somewhat related to the two previous principles, another principle uncovered for motivating learning is using badges to fostering competition. One way of accomplishing this is by offering badges that are scarce and hard to earn. The thriving S2R badge system included bronze, silver, and gold badges, where the gold badges were actually quite rare and hard to earn. The privileges associated with these badges were quite valuable (e.g., access to opportunities to report from the sidelines of high-profile matches). Apparently, the gold badges were quite successful at motivating earners to try to earn them (even though few ultimately did). Likewise, the PBS Student Reporting Labs badge system added their SRL All Star badges after their initial badge system had already been implemented. Project Director Leah Clapman described them as “super-motivators” and asserted that they create a healthy form of competition: “Teachers know
that not all kids will be nominated for an All Star badge. They know that there will be about one special kid who stands out in each class and teachers are unable to nominate too many.” Given that the All Star badges qualified students to compete for a chance to travel to the PBS headquarters in Washington, DC, and the fact that the badge system had issued over 200 of them by 2016, this seemed to be an effective motivational practice. The proposed Level Up badge system intended to include “competitive awards…in which select few or only one will be awarded.” However, these badges were not included in the system that was piloted and then suspended.

Another way of stimulating competition is with point systems. As with videogames, such systems might have learners competing with “the system” (i.e., competing against themselves and their highest score) or they may have learners competing with each other via leaderboards; some systems might have both. Who Built America successfully introduced a point system whereby any learner who accrued enough points for posting in the discussion forum earned the I ♡ Community badge. Like a videogame, the badges in BuzzMath were designed to motivate learners to earn as many badges as they could to progress through the various levels, but were also intended to motivate learners to compete to progress through more levels than their peers. Given that BuzzMath managed to motivate young people to engage extensively in their drill and practice routines to earn those badges, it seems that this competition was successful. While some of the other badge systems such as YALSA and Computer Science Student Network did not explicitly intend for learners to compete with each other, it seemed likely that such competition might emerge quite naturally around earning the most badges. The proposed Youth Film Maker badge system included a “leaderboard” that was intended to allow students and coaches to compare progress across learners. But, it was unclear whether that leaderboard was even used in the initial pilot.

The DPD project struggled to reach any firm conclusions regarding this important but controversial practice. Because Open Badges, by definition, foster public display of achievement, they are likely to foster competition. As such, observers who are opposed to all forms of competition between learners are likely to remain skeptical of badges. Conversely, behaviorists and proponents of gamifications would likely argue that such concerns are overstated. Consider, for example, the case of BuzzMath. The prevalence of extrinsically motivated drill and practice activities in typical elementary and middle school mathematics classrooms suggest that it is indeed difficult to motivate continued engagement and build mathematical fluency. Such fluency is needed to explore some of the more interesting (and potentially intrinsically motivating) aspects of mathematics. The risk, of course, is that competitive gamification might orient learners to the gamified knowledge in a way that undermines such engagement in the future. Clearly, this is a fertile area for future research.

It also seems worth noting that only one of the constructivist inquiry-oriented badge systems implemented any sort of point scheme (Who Built America) and that this scheme was associated with a particularly social activity. Similarly, the seemingly successful competition schemes at S2R and PBS SRL revolved around a participation-based badge system. This means that this competition was likely based on “crowdsourced” evidence of accomplishment. While this also calls for future investigation, the point is that those earners were presumably competing to create learning artifacts that were the most meaningful and (therefore) most valued by the nascent professional community that was emerging around those artifacts. After extensive deliberation and further consideration of the various theories of motivation above, the DPD
project ultimately concluded that **badges probably work better… when competition concerns basic skills or participation in social practices, rather than learning from inquiry.**

In other words, it seems likely that explicit competition between learners is more likely to be problematic when used with inquiry-based or project-based learning because intrinsically-motivated learning is so central to such learning. Clearly, research is need that explores the consequences of the more tacit competition that follows from the public displays of accomplishment in inquiry-based badges.

**Motivate Learning by Displaying Badges Publicly**

The public display of claims and evidence using Open Badges has obvious motivational potential. As introduced above, some may find doing so problematic in light of modern constructivist theories of motivation—yet giving earners control over how their badges are curated and annotated seems likely to enhance their feeling of competence, autonomy, and relatedness, the three central constructs in self-determination theory that lead to intrinsically motivated activity. Nine of the proposed badge systems intended to display badges to the public and let learners choose who to share their badges with. PBS Student Reporting Labs, Girl Scouts, Microsoft Partners in Learning, YALSA, and S2R all succeeded in allowing earners to display their badges to the public, primarily on badge system websites; Pathways to Global Competence, Digital On-Ramps, SA&FS, and Youth Film Makers all intended to do so but never implemented their badge systems. NatureBadges implemented a version of a “field notebook” on their website where earners could display their badges but suspended that practice. Given that the badge systems that successfully implemented this practice (and applied the tenets of SDT discussed above) were among the most successful, the DPD project concluded that **badges work better…when learners control how their badges are displayed publically.**

**Motivate Learning with External Opportunities**

Somewhat related to extrinsic incentives discussed above, eleven of proposed systems intended to associate earning their badges with a range of opportunities. However, because these opportunities were related to the badged learning, they were judged to be *external* rather than *extrinsic*. Five of proposed badge systems did not implement those intentions:

- Cooper Hewitt proposed the ambitious *Cooper-Hewitt Scholars Program* which was described as “a rigorous program for an intimate group of students to concentrate on design as a profession and secure design internships.” However, they had yet to implement that aspect of their program in 2014.
- PASA’s proposal outlined ambitious plans for using privileges to motivate engagement. They proposed that “As 8th graders and high schoolers attain certain badges they would receive special privileges—8th grade-only programming, paid internships through The Hub, personalized tutoring, etc. As the badge ecosystem develops, opportunities and privileges would expand significantly, supporting healthy behaviors, college access, leadership development and more.” In 2014, they had not implemented these incentive practices and subsequently paused their badge system.
- The Youth Film Maker badge system proposed to motivate students by associating badges with opportunities to screen their films for the parents and peers at an art house theatre. However, the proposed badge system never progressed beyond a single pilot.
The Starlight Astronaut Academy proposed that they would offer students a chance to win prizes for their badges and intended to motivate students by using their badges to get internships at NASA and elsewhere. However, at the time of the follow-up interview in 2014, neither the prizes nor the internships had been established.

Pathways to Global Competency proposed associating its badges with scholarships and presentations, though their primary intended motivational incentive was college admission. While they were unable to implement the proposed badges and e-portfolio system, many teachers are reportedly using the Asia Society’s curriculum with "gPortfolios" using Google docs; college readiness and admission is clearly a central theme in their programming. It seems certain that some of these students are motivated by this and include their portfolios in their college applications.

In contrast, S2R and PBS Student Report Labs succeeded in formalizing similar incentive practices, but followed a rather different route.

S2R reached out early to the British Broadcasting Company in an effort to secure internships for their earners. Project leaders reported that they realized that any sort of formal arrangement would be impossible. Instead they redoubled their efforts to ensure that successful participants would have sufficient evidence in their badges that would make a difference in subsequent efforts to secure internship and college admissions. They also associated their top level badges with exclusive access to opportunities to report from the sidelines of professional sporting events. The many anecdotal accounts they provided in their final report and the earners featured in their videos provided evidence that their badges were indeed useful in applying for internships and admissions, so it seems quite likely that this practice was motivating for students. And given that the system was thriving outside of formal school contexts (mostly in youth sports clubs), the badge system was motivating learning.

The PBS SRL badges were designed to lead to internships and employment opportunities, primarily with their local PBS affiliates. However, these opportunities were not formally negotiated in advance. Rather, they ensured that earners knew their work was being viewed by producers at the local PBS affiliate stations, and worked to include convincing evidence of career readiness in their badges. Additionally, the badge system automatically emailed producers at the PBS affiliates a list of “career-ready” participants each semester.

While it was not included in their proposal, PBS introduced the SRL All Star badges, which bestowed the title "student ambassador" and a chance to compete for one of five all-expenses paid trips to Washington DC for a workshop and other prestigious opportunities (e.g., a video chat with News Hour host Gwen Ifel). Given that over 200 All Star badges had been awarded by 2016, this practice appeared to motivate student engagement and persistence.

These findings support a conclusion about motivating with badges that complements a similar recognition practice: badges work better… when they motivate learning by containing

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62 http://asiasociety.org/graduation-performance-system
63 https://studentreportinglabs.org/article/education/do-you-have-what-it-takes-be-all-star/
claims and evidence that will help earners secure opportunities and internships. It is worth noting that PBS SRL did manage to arrange a formal association of their badges with an extremely attractive opportunity. However, this was likely made possible because their badge system was responsive to an existing educational program where a formal association already existed. As with the corresponding recognition practices for external endorsement, negotiating such opportunities as part of designing a badge system and creating the corresponding educational program is likely to be quite challenging.

Four of the proposed badge system intended to offer additional opportunities within the badged educational context, reflecting a common practice associated with video game incentives:

- BuzzMath formalized their intended practice in offering earners additional games to play based on their initial success.
- The Planet Stewards badge system opened up later badge quests based on the completion of prerequisite badges. The new activities progress from simple introductory activities to more interesting and involved quests, including some that use NOAA data. In the quest map for the Coastal Manager badge, for instance, students start with NOAA video content to get them familiar with estuaries, and move to analyzing real-time data from NOAA’s estuary data collection sites.
- The Girl Scouts badges were not as “gamified” but they formalized their intentions to offer privileges “on a progressive basis through their badge work and outreach into their communities. Apps extend these opportunities and privileges by connecting girls to each other through a shared experience via technologies.”
- As described above, earning the first badge in the PBS SRL badge system “unlocked” all of the remaining badges.

This supports another tentative conclusion that badges work better... when they provide additional opportunities within the environment where the badges are issued. These motivational practices are particularly noteworthy in light of the constructivist concerns that incentives will undermine self-determination. As documented empirically with badges in educational videogames by Filsecker and Hickey (2014), it seems unlikely that badges that give earners new opportunities or authority would simultaneously undermine intrinsic motivation or interest in the discipline.

Motivate Learning with External Endorsements

Somewhat similar to external opportunities, an obvious way to make badges more valuable and motivational is by securing external endorsements of those badges by third parties. Six of the proposed badge systems articulated specific motivational intentions for this practice; the DPD project asked team members about the intended and actual motivational impact of these practices during interviews.

Stacy Kruse of Pragmatic Solutions led the design and programming of the technology for the three PBS American Graduate badge systems. In her initial interview she articulated the theory of action that drove her design and refinement of those systems:

Putting a shiny object someplace is only going to attract somebody one or two times. The shiny object has to have meaning. There has to be a reason for them to come there, a reason they want to share, a reason the badges are meaningful. Once the novelty of new
technology wears off, there has to be a sustained value or reason that keeps students engaged in their learning experience… [t]he ultimate goal is that a student that comes into any program that is affiliated with American Graduate…and begins to earn badges will also be plugged into a recommendation system that refers them to other content and resources that may be of value to them…What’s the ultimate goal of the badges? The ultimate goal of the badge is to motivate and engage students enough that they are more likely to graduate from high school.

In her follow up interview, Kruze summarized the importance of getting these motivational practices right when working with at-risk students in underserved schools who have endured a lifetime of disappointment: "Rather than seeing the light at the end of the tunnel, they are waiting for employers to bring the light at the end of the tunnel to them. You have one chance to make an empty promise.” As described above, hundreds of learners have since earned the SRL All Star badge, it seems that the American Graduate program succeed in building value around the SRL badges by creating a larger ecosystem in which those badges were viewed by professionals and affiliated PBS stations and allowed some earners to participate in a trip to Washington, DC (The American Graduate initiative proposed similar practices for the Story Corps and Road Trip Nation badge systems that were both suspended).

The Intel Science Fair was already strongly associated with increased opportunities to attend college; their badge system proposed to further incentivize that aspect of their program:

A key goal of an Intel/SSP badge system is to provide an incentive for engagement and participation in independent research and science fair competition for middle school and high school student researchers, teachers, mentors, judges, volunteers and the community at-large…This will provide the added value of encouraging the natural curiosity and interest in science and engineering of younger students.

The project director later articulated that “for a lot of our students, winning the Science Talent Search can get you into any kind of college that you want to go to. So, having some kind of evidence that they’ve even gone down the road is valuable to them.” The key point here is that Intel and the Society for Science in the Public Interest had already “endorsed” the Science Fair, so the new badges were already “endorsed” by those organizations.

The new Intel badge system badges gave the ultimate winners new ways of displaying their success while allowing many more students who accomplished smaller success to do so as well. In the follow-up interview, the project director expressed satisfaction with the Intel Science Fair badge system, but concluded, “I believe it is too early to tell whether earning a badge is serving as an incentive to get involved in independent research. We believe that it can only aid in rewarding this process, but we have not had the opportunity available long enough for us to be able to determine this.”

The Cooper-Hewitt team proposed ambitious goals for having their badges recognized by members of the Association of Independent Colleges of Art and Design (AICAD). They collaborated with AICAD in the design of their badge systems and the system was implemented (albeit with substantial redesign from the intended badges). In 2014, the project director reported that they were still working on the technology and network necessary for those badges to readily connect learners with opportunities and for institutions to readily connect with promising applicants.
The Badges for Vets team proposed to create a badge system that would build value by readily allowing veterans to translate their military service into employable skills. The team had proposed to build a system whereby the badges could be endorsed by the Veterans Administration and other veterans’ organizations. Even though the team leaders worked at the VA, they reported finding it impossible to establish even informal endorsements or cooperation with the VA or other non-governmental organizations that served veterans.64

The USDA/4-H Badges team proposed that “An endorsement, approval, or acceptance by a government agency such as USDA, NASA (and partners), and others would provide greater credibility to badges. Further, criteria for earning badges would likely be developed by a partner institution such as a land grant university which would then be approved by partner agencies.” Ultimately, their badges were only endorsed by 4-H and only implicitly by the USDA.

The Providence after School Alliance team had proposed the PASA administrators would be the primary entity awarding badges. But they also proposed that they would build in the capacity for their after school providers and participating young people to award badges, including some sort of criteria by which they would decide who could issue those badges. However, the team never managed to build in the capacity for others to issue PASA badges or determine who was qualified to do so. PASA Director Alex Molina expressed frustration with their ability to communicate the value of badges to earners in his follow-up interview:

We’re learning that badges are a cool thing for us adults or those who work with technology, but for a lot of urban youth, it’s not there. How do you convince young people that a badge has a currency when they’re facing other issues—when they’re at a failing school, when they’re competing for jobs with adults? And until a badge gives them a job or really gets them to college, it has no value to them, especially for urban youth, the value is engaging in high quality experiences with an adult that cares…Young people sign up for programs not because they’re going to get a badge. They sign up for programs, because they get to work with a cool adult. They get to participate in something that school’s not giving them.

Davis and Signh’s (2015) interviews of PASA students, educators, and community members highlighted the many challenges that PASA faced in this regard. They identified the same "chicken and egg" problem that the Manufacturing Institute faced in trying to establish credibility for the badges by employers in advance. Many PASA teachers and students and potential consumers were still unfamiliar with badges when they conducted the interviews in 2013-2014. While PASA successfully formalized its badge system, it was suspended in 2015. The Manufacturing Institute, Level-Up, and SA&FS all faced similar challenges in securing endorsements to add value to their badges. The inability to do so appeared to contribute to the suspension of those efforts. These findings lead to a conclusion that extends the corresponding conclusion in Section III: badges work better… when they motivate as informal evidence-rich credentials that speak for themselves.

64 This appeared to have nothing to do with badges but rather it turns out that both the VA and the various Veterans Service Organizations compete quite directly with each other for funding, philanthropy, members, and political capitol.
Motivate Learning with Entry-Level Badges for Initial Accomplishments

The aforementioned practice of offering an introductory badge that is easy to earn has obvious motivational potential.

- As described above, the first badge in the PBS SRL badge system was automatically awarded by the website when students uploaded their first story and posted six reflections; that first badge “unlocked” all of the other badges. Thus, without requiring any teacher review, the students on their own were introduced to the project website and the concept of badges, and experienced an initial success that gave them access to additional opportunities.
- While they did not include it in their proposal, Who Built America successfully implemented the WBA Member badge that was awarded for simply signing up for the system. This badge appeared to present a very low barrier to entry to what many teachers were likely to find to be a rather different kind of professional development, and one that would call for significant levels of motivation.

Five of the proposed badge systems (Mouse, Intel, Buzzmath, S2R Medals, Computer Science Student Network, and Intel Science Fair) succeeded in implementing similar entry-level badges as part of a their overall trajectory. PASA proposed such a practice but did not implement it; Road Trip Nation proposed such a practice but did not implement their badge system. This appears to support another conclusion about motivating learning that also complements a similar recognition practice: Badges work better… when initial badges are easy to earn and provide access to more advanced badges.

Motivate Learners by helping them Set Goals

This principle is closely related to and extends the previous principle. A central function of badges is helping learners set goals and follow through with them. As discussed above, helping learners set (and accomplish) goals has substantial implications for motivation. The 30 proposed badge systems included a variety of goal setting practices and some articulated motivational functions for those practices. Three of the eight proposals articulated specific practices for displaying goal trajectories:

- For PBS SRL, these trajectories took the form of checklists where there were clear sequences of steps. Project Director Leah Clapman described the goal setting process as follows: "The process itself has lots of obvious opportunities to set goals, from the process of coming up with a news story, what is newsworthy, working with a mentor. The mentor helps you get from that story idea to a finished report, and there are goals all along the way. The whole process of news reporting is about setting goals and then hitting them." However, the team dropped some of the smaller badges along the way and emphasized the finished report and the overall badges.
- BuzzMath succeed in implementing a sophisticated system for displaying multiple levels of badges. They had proposed that "content knowledge badges will be awarded in a progressive manner. Students will first earn a bronze badge that will later be upgraded to silver and then gold as they demonstrate an increased knowledge of each concept."
- The Starlite Academy succeeded in implementing a system that displayed each learner’s progress on a learning trajectory.
CS2N, Design for America, and PASA were unable to include their proposed practices for displaying goal trajectories in their implemented badge systems; Road Trip Nation and Disney-Pixar included such practices in their proposed systems that were not implemented.

Four proposed badge systems intended to allow users to define their own goals in order to help motivate engagement and all four succeeded in enacting and formalizing those practices:

- In Design for America, learner-defined goals and badges were particularly distinctive in the proposed badge system. They had proposed "crowd-sourced badges as taking responsibility (and pressure) away from issuers to create badges that are relevant to their students, represent diverse student skills and achievements, and are constantly motivating students to achieve diverse learning outcomes." While they reported significantly reworking their intended practices, they appear to have successfully implemented this practice.
- PASA successfully included students extensively in the design of the logos and branding of their badges, including a badge design competition and working with a professional designer. Project Director, Alex Molina, reported "young people are the customers; like any organization you are going to listen to your customers to inform product design and delivery.”
- Planet Stewards succeeding in allowing learners to choose which career path they wanted to explore and then define the trajectory within that career path by selecting the activities and badges that they wished to pursue.
- PBS SRL gave students substantial leeway in which badges the sought and the order in which they completed activities on the checklists.

Cooper-Hewitt did not formalize its proposed learner defined badges, while Level-UP, SA&FS, Roadtrip Nation, and Disney-Pixar included learner defined badges in their proposed badge systems that were not implemented. Given that the badge systems that were thriving in 2015 were well represented in those that succeed in enacting their proposed goal setting practices, another tentative conclusion is that badges probably work better... when motivational goal setting practices are carefully designed and based on successful examples from the field.

**Motivate with Assessments of Learning**

As introduced above, the DPD project assumed that various learning assessment practices proposed for the 30 badge systems most likely had significant consequences for motivation. As such the project searched for evidence that successfully implemented assessment practices had indeed served to motivate learning. These included peer assessments, computer-based assessment, and expert assessment.

**Peer assessment.** Of the eight proposed badge systems that intended to include peer assessments, three succeeded in enacting them:

- In the case of PASA, this took the form of peer comments on one another’s blogs on the badge system hub. However, they did not enact the feature of allowing peers to add a “+1” to endorse others’ comments or to allow peer assessment to unlock additional privileges.
Design for America’s proposal articulated a relatively sophisticated vision of the motivational impact of peer interaction and assessment. They proposed that a “badge system for storytelling or logging project milestones implemented on DFA’s knowledge management platform can encourage students to share more once it is apparent how beneficial their contributions are.” They ultimately wove peer assessment throughout the project and worked extensively with learners to define the actual badges. It seemed likely that these assessments were quite a powerful motivator for learners.

Mouse Inc. proposed to “build functionality for our Wins!Tracker and profile areas that enable youth- or peer-issued badges, with a goal of creating aspects of the system that place youth at the center of the assessment process.” They successfully implemented peer awarded Wins! for some achievements in early 2013. This thriving badge system viewed peer awarded badges as a particularly powerful motivator.

Thus, the three peer assessment practices that were formalized and that appeared likely to motivate engagement involved relatively informal assessments of completed projects or for serving roles (rather than more formal assessments of knowledge or competency).

The five badge systems that proposed peer assessment practices that were not implemented intended to have peers assess specific competencies or skills:

- SA&FS proposed that peers would be able to agree or disagree with the awarding of the highest-level "expert" badge and that peer assessment of portfolios would be very motivational. In the follow-up interview, SA&FS Project Director, Joanna Normoyle, articulated the vision that she had tried to implement: “Validation matters: seeing and being seen, and it matters differently to different people. But I think fundamentally that when people feel that they are being recognized as effective in what they’re doing by their community, there are very few things that match that as motivations for human beings. Whatever we can do to provide experiences for our students to tap into that deeper motivation, given them recognition for being effective, we’ve got to figure out how to do it.” However, as articulated above, the badge system never progressed beyond the pilot stage.
- The Youth Film Maker badge system proposed a sophisticated routine whereby peers would review each other’s badges for evidence of specific competencies, but the badge system never progressed beyond the initial pilot (which did not include this feature).
- Who Built America proposed an ambitious peer assessment system: “Full certification as a Master History Teacher necessitates a multi-step review process validated by history educators and master teachers. There is no self-accreditation in this system.” They also intended to allow peers to award smaller badges as well. However, challenges with their platform led them to move all peer interaction away from assessment and badges and into discussion forums
- Cooper Hewitt Design Prep proposed an ambitious peer feedback and assessment system but ultimately all peer feedback and interaction was provided informally in a face-to-face setting.
- The Girl Scouts proposed a peer assessment system that involved relatively formal summative assessment practices, but these practices were never implemented.
The finding that peer assessments were more successfully implemented when associated with informal (rather than formal) assessments suggest the following conclusion: **Badges work better… when learners are motivated by informal (rather than formal) peer assessments.**

**Computer-based assessment.** Eleven of the proposed badge systems intended to use computer-based assessment and some of the proposals explicitly referenced their motivational appeal. BuzzMath, Mouse Inc., NatureBadges, PASA, Starlite Academy, Planet Stewards, S2R, and CS2R all succeeded in implementing computer-based assessments. Given that these were among the more successful badge systems overall, these finding suggest that when computer-based assessments are successfully implemented they are likely to encourage student motivation. While further investigation is needed to examine the motivational impact of specific assessment practices, the fact that the badge systems that used computers to automate assessments were among the most successful leads to another conclusion: **Badges work better… when learners are motivated by computer-based assessments.**

**Expert assessment.** Six of the proposed badge systems intended expert assessment practices with explicit or implicit motivational functions. Three of them succeeded:

- BuzzMath formalized a practice whereby teachers could decide how to assess and award "process knowledge" badges in their own classrooms.
- Intel Science Fair formalized their badge system around a science fair that is essentially organized around expert assessment.
- Cooper Hewitt successfully formalized its system whereby student work was assessed by design experts, and ultimately set aside all of their other assessment practices.

Three of the proposed badge systems intended to implement expert assessment systems, but did not do so.

- Starlite Astronaut Academy proposed an ambitious expert assessment system whereby “classroom educators and youth group leaders will evaluate achievement levels by students involved in class or group activities. Individuals may be evaluated by ‘mentors,’ advanced students or educators who have achieved highly in that area.” In other words, the teams intended to develop a system for certifying experts to endorse badges. However, project leaders reported that they did not proceed in this direction. Rather, they reported adding in artificially intelligent mentors into their games, and peer mentoring via discussion boards.
- Digital On-Ramps proposed a sophisticated system whereby “when a learner completes something they get a star with a tint not solid, but it doesn’t become official until a teacher or expert approves it and it get visual recognition.” However this feature was never enacted and likely exceeded the technological capabilities of the Open Badges 1.0 Specifications.
- Earthworks proposed a particularly ambitious set of expert assessment practices involving experts from the Native American community and their proposed Native American Advisory Committee who would assess student artifacts. However, their curriculum and badge system were never enacted.
Given these mixed results, it is unclear whether these findings support any conclusions beyond the recognition conclusion above that **badges work better... when learners are motivated by peer endorsers identified in existing communities or networks.** To reiterate, third party endorsements are a key features of the new Open Badges 2.0 Specifications. The possibility that badge earners might be able to gain endorsements of experts *after* a badge is issued (presumably because the expert examines the claims and evidence in the badge) seems to have profound implications for motivating learners to carry out work in a way that an expert is likely to endorse.

**Self-assessment.** Three of the proposed badge systems intended to implement self-assessments as explicitly motivational practices in the form of reflections.

- **AQUAPONS** included self-assessments at multiple points in their badge system as self-reflections around portfolios. Project Director Emmanuel Pratt described the motivational function of their informal reflections: “I worked with a group of students from the Milwaukee schools. One of them rarely said a word; I saw this student four hours a week for twelve weeks and probably heard him say about twelve words in that span of time. On the last day, we were doing video reflections. During the video reflection, as soon as this guy was on camera and we were asking him to reflect on his learning, he was probably the most eloquent of all the students. That’s learning that he had internalized, but had not come out in the general course of things. When asked to reflect, his learning was not only exposed to others, but also realized to himself.”

- **4-H** Project Director Tony Cook described how their proposed portfolio system that featured self-reflection questions was expected to motivate learning: “One of the things we are thinking about—and we were prior to the badging concept coming out—was the idea of a portfolio of learning. You build your body of learning, your e-portfolio. On the one hand, you collect these evidences of things that you’ve learned because you’re interested in them, and then things that you learn that have value, developing your abilities and skills” The proposed portfolio assessment system was one of the many proposed features that 4-H was unable to implement.

- **The SA&FS** included self-reflections among many of the features of the sophisticated portfolio assessment system that SA&FS proposed which was not enacted beyond the design phase.

Thus, these findings are clouded by the challenges that many of the proposed badge systems faced in implementing e-portfolios as part of their badge systems. What seems particularly promising is asking learners to reflect on their *engagement* in learning rather than reflect on the *outcomes* of that learning (because focusing on the outcomes is likely to emphasize performance goals rather than learning goals). This idea of putting informal reflections on engagement in badges alongside completed student work was explored in Hickey & Uttamchandani (in press) who found it quite promising. These results together lead to a tentative conclusion regarding self-assessment: **Badges probably work better... when learners reflect on engagement in learning rather than the outcomes of that learning.**
Motivate with Opportunities to Mentor Peers.

Six of the proposed systems intended to associate their badges with opportunities to become peer mentors, and several of the proposals explicitly referenced the motivational potential of doing so.

- YALSA had proposed an ambitious system of levels, with participants reaching the most advanced level serving as peer mentors. While technology challenges led them to abandon the formal peer mentorship practice, a less formal peer mentoring function was possible in the system that was implemented.
- LevelUp proposed an ambitious series of “gates” that earners would pass through before becoming leaders and mentors. Central to their proposed assessment system was a scheme whereby an approved peer assessor would award badges to “practice evidence” that would then be more formally approved (or overridden) by teachers. While their badge system was implemented in a pilot, it was unclear if this practice was ever implemented in that pilot.
- Nature Badges proposed that participants who reached the most advanced tier would “have an opportunity to take part in mentorship at the museum and gain behind the scene access.” However this principle was not enacted in the formalized badge system.
- At Cooper Hewitt Design Prep, peer mentorship was a central feature of the proposed “Cooper-Hewitt Scholars” program for more advanced participants, but it was not enacted.
- BuzzMath proposed that their more advanced participants would serve as peer tutors. However, because their primary participants were under the age of thirteen, they concluded that doing so would violate the privacy stipulations of COPPA.
- Disney-Pixar proposed peer mentorship practices for their Wilderness Explorer badge system, but the system was never implemented.

In summary, motivating students with opportunities to become peer mentors proved to be a difficult practice to enact. However, it seems that this could indeed be a very motivational practice worthy of continued pursuit. In particular, the endorsement features included in the Open Badges 2.0 Specifications make it possible to award badges to individuals that specifically enable them to endorse badges earned by their peers. Thus we add the following tentative conclusion: **Badges probably work better... when they give earners opportunities to become peer mentors.**

Motivate Learners by Recognizing their Disciplinary Identities

In recent years, *identity* (e.g., Hand & Gresalfi, 2015) has emerged as an important construct in motivation research, and is central to newer sociocultural theories of motivation (e.g., Nolen, Horn, & Ward, 2015; Oyserman, 2014). Digital badges have obvious implications for identity development. It is particularly significant that badges give earners control over how they curate and display their accomplishments. Consider, for example, that identity-based motivation (IBM) theory assumes that identity is a “dynamic construction” and that:

rather than being stable, which identities come to mind and what they mean are dynamically constructed in context. People interpret situations and difficulties in ways
that are congruent with the currently active identities and prefer identity-congruent to identity-incongruent actions (Oyserman, 2014, p. 216).

The flexible learning pathways described above and the ability to choose when and how to display evidence of accomplishment are both assumed to let learners “try out” (i.e., “activate”) new identities in the moment. This is important for motivation because doing so allows learners to flexibly adopt behaviors, ways of thinking, and forms of participation that are congruent with those identities. Central to IBM is the assumption that these dynamically-constructed identities readily support action-readiness and self-efficacy towards challenging tasks.

In light of these perspectives, the DPD project concluded that at least thirteen of the proposed badge system intended to motivate engagement by using badges to help earners construct and project identities associated with a particular disciplinary community. Ten of the thirteen proposals that implemented their badge systems appeared to have succeeded in doing so: Who Built America, PBS SRL, Cooper-Hewitt, DFA, Mouse Inc., Girl Scouts, Microsoft PiLN, Starlight Academy, and S2R. In the DPD final interview, Marc Lesser from Mouse Inc. nicely articulated how taking on new identities can lead to action-readiness in a manner entirely consistent with identity-based theories of motivation:

Suddenly, for [youth] to be able to have cred for the things that they do well, at least our hunch, is a motivator for them to take themselves seriously. In part, it’s just an efficacy thing, if they’re taking themselves more seriously as part of the learning environment, they’ll be more likely to work harder at the things that they’re not naturally inclined to get cred for, or that their natural inclinations or skills are not being credited for.

In a subsequent blog post, Lesser responded to the concerns about badges being construed as extrinsic incentives by pointing to the potential for helping earners construct new identities:

But our thought at Mouse is that if we are careful about how digital credentials are introduced as an aspect of a programmatic context that is situated, and focused on cultivating “expert” identities, that credentials can play a vital role (especially for youth from non-dominant backgrounds) in shifting their confidence and owning their pathway. Indeed, we realize the risk of having badges become a kitschy gamification of the learning experience. But if the worst-case scenario is that only a portion of our participants use them to consider their identity-building pathway seriously, it still seems unquestionably worthwhile.65

This characterization of the Mouse badge system seems to directly embrace the IBM model introduced above and illustrates the usefulness of Greeno’s (1998) proposed situative synthesis by focusing primarily on more sociocultural motivational consequences while treating the consequences for individual behavior and “secondary” consequences or forces.

Illustrating one particularly promising identity-shaping practice, the S2R badge pathways were named after the roles that young people take on when earning those same badges: journalist, producer, and coach, and then offering authentic opportunities associated with the roles when the earners completed the pathway. The proposed badge systems from Pathways to Global Competency, Youth Film Maker, and Disney-Pixar were also judged as intending to

motivate students by shaping their identities, but those systems were not implemented or were suspended before they were likely to have had such impact.

Another identity-related motivational practice that the DPD project identified was awarding badges associated with particular group. The badge systems implemented by the Girl Scout and Badges for Vets may have helped earners identify with their respective communities, and Earthworks proposed to do the same. The Manufacturing Institute, PBS, S2R, Digital On-Ramps, and Mouse Inc., all articulated specific strategies for helping at risk earners construct identities associated with career readiness; PBS and S2R both appear to have succeeded in doing so. This leads to the conclusion that badges work better… when used to help earners establish personal identities associated with disciplinary and professional communities.

**Motivate Learning by Engaging with the Communities**

One specific practice that is likely to also impact badge earners’ identities with communities is giving them opportunities to engage with those communities. Proposed badge systems intended to do so in the digital and local (i.e., face-to-face local communities). Of the seven proposed badge system that intended to use badges in ways that engaged earners with a digital community, four succeeded: Design for America, Intel Science Fair, Mouse Inc., and NASA Starlite Academy. Mouse Inc. was particularly successful in this regard via their Peer2Peer and Community Wins badges. LevelUp, Pathways to Global Competence, and Story Corps also intended to engage earners with a digital community but their badge systems were not implemented or were suspended before this practice was implemented. Badges for Vets did not intend to engage earners in a digital community, but as the ecosystem grew, veterans began interacting with one another on the platform; a digital community grew around the website, though that community was not organized around badges.

Three of the proposed systems (AQUAPONS, Disney-Pixar, and Manufacturing Institute) intended to engage badges earners with their local communities, but did not end up implementing their badge system or that practice. S2R had initially envisioned an internship model as possible privileges that could be opened up for badge earners, and they had targeted nationally known sports journalism organizations. When these more formal partnerships proved to be challenging to implement, S2R found local sports teams who turned out to be quite welcoming and productive communities that likely motivated engagement in learning. While this principle proved to be challenging to implement, it seems worthy of a final tentative conclusion about motivating learning with digital badges: Badges probably work better… when used to motivate engagement with disciplinary and professional communities.

**General Conclusions about Studying Motivation and Digital Badges**

Documenting the motivational practices and more general principles across the 30 badge systems proved to be quite challenging; analyzing those findings to derive firm conclusions was even harder. Ideally, we hope that these initial conclusions will spur more systematic investigations of these practices. We conclude with a caveat and a final tentative conclusion about studying motivation.

**Individual Difference and Motivational Practices**

Readers are cautioned that understanding the likely motivational consequences and documenting the actual consequences of motivational practices is complicated by the possible interactions of badge system designs with individual differences. Differences in enduring factors
like ability and goal orientation are relatively stable over time but differ across individuals. In one of the most sophisticated studies of badges and motivation to date, Abramovich, Schunn, and Higashi (2013) explored the extent to which individual difference influenced the motivational impact of Computer Sciences Student Network badges. They found that the CS2N badges could indeed enhance expectancy for success (an important motivational variable). But that effect was only found for higher performing students who were more oriented towards learning goals; the effect was opposite for lower performing students who were more oriented toward performance goals. This issue is further discussed in the next section.

Similar interactions with individual difference were reported in the Rand Corporation study of the three Gates Project Mastery efforts. While these studies looked at the larger competency-based education systems in which the proposed badge systems were embedded, their findings certainly seem relevant to the study of other competency-based badge systems and likely to badge systems more generally. They noticed that “educators at several sites observed that a competency-based approach may disproportionately favor highly motivated learners” (Steele et al., 2013, p. 49). This concern was further bolstered by teachers’ statements about the mastery-based grading practices associated with competency-based learning:

> When encountering mastery-based grading, in which students “don’t get credit for trying,” teachers noted that students responded in one of two ways: “The kids who get it and understand the system, they’re running with it. Kids who are willing to put in the extra work, they run with it. Kids who don’t want to do work—it’s a real struggle.” (Steele, et al, 2013, p. 50)

This raises a familiar problem when conducting research in authentic learning contexts. Individual differences in factors like achievement and motivation that are relevant when studying badge systems are certain to be correlated. In the absence of random assignment to different treatment conditions (e.g., different types of badges), many observed differences in engagement and learning will actually result in self-selection bias. This is where learners who choose to engage in a particular activity (e.g., earning badges) are systematically different from the learners who choose not to engage or choose to participate in some other activity. This is discussed in more detail in the next section.

The “Situative Synthesis” and the Study of Motivation

To reiterate, we encourage that designers and researchers keep in mind the different theories of motivation discussed above when designing badge systems. As illustrated by the results in Section III, it seems likely that many badge system designs will draw on practices consistent with a range of perspectives. This presents a fundamental challenge for researchers because they then have to choose which (potentially contradictory) outcomes they wish to prioritize when refining and evaluating badge systems. As illustrated by the dueling analyses of the same corpus of studies of extrinsic rewards, this seems particularly problematic when it comes to more controversial badging practices involving external/extrinsic incentives, competition, and public displays of accomplishment. Researchers are likely to struggle in balancing potential positive consequences for immediate behavioral engagement and longer term achievement with the potential negative consequences for intrinsically-motivated learning and longer term engagement, goal orientation, self-determination, and interest.
The aforementioned “situative synthesis” introduced in Greeno and Moore (1993) offers a potential way forward. It starts by acknowledging the historical relationship between the associationist and constructivist theories of learning:

Within the historical development of psychology, we see, in the present situation, a prospect of completing a dialectical cycle, in which stimulus-response theory was a thesis, symbolic information-processing theory was its antithesis, and situativity theory will be their synthesis (p. 57).

In other words, this synthesis starts by emphasizing that the initial associationist thesis of behaviorist perspectives was rejected by the antithetical thesis of constructivist information processing theories. It then advances situativity as a “higher order” synthesis of the two prior perspectives. As elaborated in Greeno (1998), this synthesis treats the way that humans behave and the way that humans think and process information as “special cases” of socially situated activity.

When applied to the study of motivation, this perspective suggests that researchers focus primarily on situated aspects of motivated learning (such as identity and engaged participation) and then focus secondarily on behavioral and cognitive aspects of motivated learning. When applied to badges and the study of the motivational practices by the DPD project, this perspective suggests the following tentative conclusion: **Badges probably work better... when the impact of extrinsic rewards and competition is studied and refined primarily in terms of its impact on engaged participation.**

Thus, when introducing or studying badging practices intended to motivate engagement, one should *first* look at the impact of competition in terms of participation in the social and cultural practices that define the particular academic or professional discipline. One should then look secondarily at the consequences of competition or incentives on immediate behavior and achievement *and on intrinsic motivation and longer term interest in the discipline and free-choice engagement.* This tentative conclusion will be explored more in the next section and builds on the arguments in Hickey (2003) and the research reported in Filsecker and Hickey (2013).

Consider, for example, the consequences of competition in BuzzMath. It appeared that the gamification elements of the badges were successful in fostering extended practice solving increasingly challenging mathematical problems. However, any discourse among players that was fostered by the competition may have had nothing whatsoever to do with arithmetic and everything to do with the game; the obvious risk is that the competition may have fostered discussions about how to win while bypassing the intended learning. Such an analysis might push designers to modify competitive aspects of the badged activities to foster more disciplinary discourse among learners. Arguably, the design of the competitive features at S2R and PBS SRL naturally followed such a course because their badges were associated with media artifacts that are inherently social; as such the designers were likely attuned to any negative consequences of that competition on participation in professional discourse. But they might have also explored the extent to which that competition impacted individual behavior (whether it motivated learners to work longer or harder on their projects) as well as their feelings about the discipline or their learning goals.
VII. FINDINGS FOR STUDYING DIGITAL BADGES

Research and evaluation are contentious topics in education. This is because people disagree on what counts as “evidence” and what methods count as “scientific.” A widely cited report by the US National Research Council argued that the “gold standard” for educational research is randomized experimental trials (NRC, 2002). But that same report also recognized that many of the most important ideas that might be tested in experimental research may not be discovered in experimental studies, and that many important questions require interpretive and qualitative methodologies. This seems certain to be the case with digital badges in education. Grant and Shawgo’s (2013) annotated bibliography provided a helpful summary of early digital badges research.

Perhaps half of the 30 badge system proposals studied by this project included references to intended research and evaluation practices. But, these intentions were not nearly as extensive as is typical of many proposals for funding the design of educational systems. To reiterate, the DML 2012 competition did not require that proposals include detailed evaluation plans. This seems like a wise decision. Requiring detailed evaluation plans may have led teams to prematurely search for “summative” evidence that badges “worked” before they had a chance to maximize the formative potential of digital badges to support learning. Case in point, the summative evaluation of the three Gates Project Mastery badge systems (Steele et al., 2013) may have been premature in that they may have convinced some observers that competency-based badge systems are unfeasible before the larger community of innovators in competency-based education had a chance to figure out how use digital badges.

Final interviews with all 30 teams in 2014 and follow up interviews with some of teams in 2015 revealed that many were starting to think quite seriously about the sorts of studies they might conduct of their badge systems. Meanwhile the larger community around digital badges was maturing and starting to think seriously about research and research designs. In order to help advance research of digital badges, this section of the report describes the research efforts reported by the 30 badge design teams. It also looks beyond those efforts to consider additional badge systems and badges research funded by MacArthur’s Digital Media and Learning Initiative, including the 2013 HASTAC Badges Research competition.

Useful Distinctions for Studying Digital Badges

Considering the range of possible research design for studying digital badges revealed three dimensions for organizing those designs: scope, purpose, and evidence. The first dimension, scope, concerns how broad the goals of the research are. Studies might focus quite narrowly on specific badges, looking at the features of badges (images, criteria, etc.) or comparing different types of badges (criterion-based vs. competitive). Or a study might consider the broader scope of the badge system to include the badged curriculum, assessments, website, etc. Even broader still are studies of the larger educational ecosystems in which the badge systems function or that emerge around a badge system.

The second dimension, purpose, follows from the distinction between summative studies “of badges” and formative studies “for badges.” Summative studies represent more naturalistic examination of the way something occurred or exists. Summative badges studies might attempt to objectively evaluate learning outcomes from the educational program or to gather evidence that supports generalizable conclusions that extend beyond the particular program. Formative studies are more interventionist efforts, typically carried out as part of iterative refinements to particular badges, systems, and ecosystems. While most summative studies are intended to
eventually have formative impact, that impact is much less direct and specific. As discussed below, the distinction between summative and formative studies has blurred in recent years with the introduction of design-based research (DBR, Cobb et al., 2003) which aims to build “local” theory in the context of iterative refinements of educational practice. Consistent with the Aristotelian notion of phronesis discussed in the introduction, local theories are “humble” in that they support design principles that are relatively contextual and specific, rather than broad scientific hypotheses.

A third dimension, evidence, is introduced by the unique opportunity that digital badges present for educational research. Badges can contain the actual evidence (or links to evidence such as artifacts produced by learners) to support particular claims of proficiency or accomplishment. There is usually a lot of negotiation involved in determining the criteria for issuing badges, how the evidence of meeting that criteria will be obtained, and how that evidence will be represented. As such, the evidence contained in badges are expected to embody the values of the program or organization that issued them. While few of the proposed badge systems intended to use the evidence in badges in their research and none had implemented those plans by 2014, this seems like a terribly important aspect of badges research going forward.

Research Designs for Considering Digital Badges

Crossing the dimension of purpose and evidence yielded the four research designs presented in Table 2. Within each of those four designs, the scope of that research can range from specific badges to broader badge-based ecosystems.

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Evidence</th>
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<tbody>
<tr>
<td>Summative</td>
<td>Research of badges, systems, or ecosystems</td>
</tr>
<tr>
<td>Formative</td>
<td>Research for badges, systems, or ecosystems</td>
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Research of Badges, Systems, and Ecosystems

This first research design consists of summative studies using conventional evidence (i.e., not the evidence contained in badges).

Research of badges. One example involving research of specific badges is found in the work of HASTAC Badges Research awardee Jan Plass. One of the studies that Plass and his colleagues carried out involved a geometry game that was modified to examine the impact of two different types of badges. They randomly assigned students to different versions of a geometry game that featured mastery badges (based on players’ own progress mastering learning goals), performance badges (based on players’ performance relative to others), or no badges. They found that the more competitive performance badges led to significantly higher learning outcomes, particularly for the students who reported higher levels of interest in learning geometry (Biles & Plass, 2016).

Research of badge systems. While the aforementioned studies of the Computer Science Student Network compared different types of badges, those studies also made this comparison across multiple badges in the larger badge system. As reported in Abramovich, Schunn, &
Higashi (2013), the study compared the motivational consequences of *skill badges* (based on mastery of a specific skill) with *participatory badges* (awarded simply for completing activities). They found that the impact of the different types of badges on students’ self-reported goal orientation differed by level of prior knowledge, and that potentially negative consequences of participatory badges on goal orientation were found only for students with lower prior knowledge.

Among the 30 badge systems, Planet Stewards implemented some of their ambitious plan for using data logs to summatively capture evidence of learner engagement on their platform; this was in part motivated by the desire to present evidence to investors. Much of this was carried out using manually downloaded log files; in 2014, Planet Stewards lead Lisa Dawley described ambitious plans for creating a dashboard for the system.

**Research of ecosystems.** One example of a summative study of a larger badge ecosystem was the summative evaluation carried on the Support to Reporter proposal. The S2R team had just begun studying the impact of their badge system in 2014 when the final DPD interview was carried out. However, they carried out a much more extensive summative evaluation of their entire program in 2015 with additional funding. As described in their report, they used pre-post surveys for learners, parents, and teachers, interviews, school attendance and progression data, and other data sources to document satisfaction levels among learners, parents, and teachers and investigate the impact on enrollment, graduation, and achievement.

Another study of a badge-based ecosystem was the aforementioned study carried out of PASA by HASTAC Badges Research awardee Katie Davis. In this comprehensive study, Davis and colleagues used questionnaires, interviews, and observations to examine how students and teachers at PASA experienced the badges used in that afterschool program (Davis & Singh, 2015). Specific questions explored included (a) how badges fit in the academic and peer culture, (b) the role that badges play in motivation and achievement, and (c) whether badges connect in-school and after-school experience.

Another comprehensive summative study of badge ecosystems was the Rand Corporation’s external evaluation of the three Project Mastery badge systems (Pathways to Global Competence, Youth Film Maker, and Level Up). These systems were examined within Rand’s evaluation of larger efforts to introduce competency-based education into three school settings. The research involved multiple site visits, numerous interviews, classroom observations, student surveys, and access to student data regarding attendance, achievement, and promotion. As reported in Steele et al. (2013), the Rand study detected some positive consequences for Youth Digital Film Maker badge pilot on achievement, attendance, and promotion. Given the brevity of the badges pilot, it was significant that the students participating in the badged classes outperformed the students participating in the broader Project Mastery initiative.

The Rand study highlighted the challenges of the aforementioned self-selection bias that often confounds educational research where random assignment to conditions is not carried out. In the absence of random assignment, the researchers qualified their findings regarding positive consequences of participating in the badged classes:

> it may be that students who participated in at least 50 percent of the badges classes were simply more motivated students than those who did not, and that these motivational differences, rather than the badges program alone, at least partially accounted for differences in the other three outcomes. (Steele, et al., 2003, p. 91)

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While the study attempted to control for these differences using propensity score matching (e.g., Austin, 2011), the results showed how doing so is challenging and often still produces inconclusive results.

**Research for Badges, Systems, and Ecosystems**

This type of research systematically gathers conventional evidence that is used formatively to directly inform the design of badges, badge systems, and badge ecosystems.

**Research for badges.** While not reported in the paper referenced above, the Computer Science Student Network team reported conducting studies that randomly assigned badge earners to different conditions for earning and displaying particular badges. They reported that their findings were successfully used to help guide the design of those badges.

**Research for badge systems.** Two of the 30 badge systems design teams reported using surveys to gather data to improve their designs. PBS Student Reporting Labs reported collaborating with outside researchers to design and implement a formal survey to determine why some teachers who were using the SRL curriculum in their classrooms were not also electing to use the new digital badges; those findings were used to guide refinements to the badge system to make it easier to use. Similarly, Who Built America reported using surveys to get feedback from participants about badge design and attractiveness of incentives. In an interesting research innovation, the WBA proposal had originally intended to offer a badge for completing the survey, but they ultimately decided against doing so.

Two of the 30 badge systems design teams reported using evidence obtained by badge system to improve that system. The Intel Science Fair team reported successfully using data regarding the number of teachers who claimed badges that had been issued to them to guide refinements intended to encourage more teachers to use and claim their badges. Similarly, Planet Stewards leaders reported using their log file data to improve its badge system and the badged learning activities. They reported using data on popularity and ratings of badges quests as well as the amount of time it took to complete quests, to modify the requirements, contents, and descriptions of the quests.

**Research for ecosystems.** One early formative study of a badge ecosystem was found in a pilot study carried out by Global Kids with a grant from the MacArthur DML Initiative. Global Kids had partnered with Learning Times, Inc. (subsequently Credly, Inc.) to implement BadgeStack in Global Kids’ *Race to the White House* and *Virtual Video Project* programs. The report of the pilot study describes how the introduction of badges impacted the educational programs that Global Kids had already developed (Global Kids, 2012). For example, they found that their youth leaders received 48 confirmations that submitted work met the requirements of their program for badges, as well as 10 indications that the evidence did not meet their requirements. They pointed out that confirming both “took extra time—for the youth to submit the evidence and the GK staff to review and evaluate—but the goal of providing formative assessment was significantly advanced”. The report explained that this sort of assessment had never been carried out in the educational programs that Global Kids offer, and provided evidence that the introduction of a badge system had led to improvements in the educational ecosystem in which the system was introduced.

Mouse had already implemented a formative analytics system before implementing its badge system in 2012. In 2013, they added the *Kissmetric* commercial website analytics tools
that allowed them to conduct analytics in real time, including logins and activities completed. Marc Lesser reported using this data to make immediate refinement to the Mouse ecosystem:

For a given month, if I see tons of students in Chicago who are getting really into creative projects, I can actually blast those sites a note to say ‘you guys all have something in common here, and here’s how we can support that as a network.’ I have data that helps support our sites and provide support to educators. Surveys at end of year can’t be put into place until next school year. Now there’s the potential to have data that can be acted on quickly, in terms of our ability to deliver.

Lesser also reported anticipating using this data for long term improvements to their badge pathways and other aspects of their programs.

Another formative study of a badge ecosystem is represented by Jim Diamond’s extension of his design work on Who Built America with the support of a grant from HASTAC’s Badges Research initiative. Diamond’s study asked some of the same questions as Davis’ study of PASA. For example, Diamond asked about the role that WBA badges play in teacher professional development, and examined the ways that badge-related activities influence the development of an online teacher professional development community.

The difference between Davis’s study and Diamond’s study is that Diamond was asking these questions while directly participating in efforts to build the WBA badging system related to the online professional development resources. Diamond’s research highlights one of the central challenges of formative research of larger ecosystems: studying things while simultaneously modifying them quickly becomes complicated. And studying one’s own practice requires extra attention to ensure generalizability. Diamond responded to these challenges using design-based research (DBR) methods. As articulated by Cobb et al (2003), DBR builds “local” theories in the context of iterative refinements of practice. Generally speaking, DBR studies start with some relatively general design principles for getting from the current state of affairs to the desired state of affairs. The back and forth process of translating the general principles into specific features yields specific design principles. Importantly, this process also reveals the key aspects of the learning context that support the specific design principles.

**Research with Badges and of Badges, Systems, and Ecosystems**

Given that Open Badges are intended to contain evidence and links to evidence that supports the claims they make, they offer a potentially transformative new way of gathering evidence for conducting educational research. However, *evidence* (along with expiration data) is an “optional” metadata field in open badges. Most of the 30 badge systems struggled to figure out what evidence, if any, to include in their badges. As described in Section II, the proposed badge systems that succeeded in including compelling evidence of learning in their badges were most likely to result in a thriving ecosystem around the badges.

Particularly in the case of summative studies (that are likely to make strong claims of learning outcomes or badge system design), this raises obvious questions about the *validity* of the evidence for supporting those claims. As argued in Casilli and Hickey (2015), the open nature of digital badges requires educators to think beyond the traditional notions of validity associated with educational and psychological testing (i.e., AERA et al., 2014). This means that traditional dimensions of validity (e.g., generalizability and representativeness) and traditional methods used to validate evidence (e.g., studying concurrent or predictive validity), may be inappropriate
or insufficient to validate whether the evidence in digital badges supports the claims made in those badges. As a result, new methods may be needed to consider the validity of that same evidence for making broader claims about learning outcomes in a badged program or about badge system design.

One discovery revealed in the DPD interviews was that putting claims and evidence in badges that would then circulate in social networks led many of the badge design teams to scrutinize the claims, evidence, and assessment more carefully than they might had without badges. The teams intuitively appreciated Casilli’s (2012) argument that the web-enabled nature of digital badges means that the validity of the evidence in a particular badge for supporting the claims made by that badge may ultimately be crowdsourced. Compared to traditional credentials, it is much easier for observers to determine whether the evidence supports the claims made by the badge. Casilli argued that this means the researchers will have to look beyond existing validity theories to consider research about the credibility of information on the Internet. One promising example cited by Casilli is Fogg’s (2003) taxonomy of credibility, which includes presumed, surface, reputed, and earned credibility.

The aforementioned pilot study of badges at Global Kids (2012) provides an initial example of how programs can use the evidence in badges to study how learning occurs in their programs. Before Global Kids introduced badges, their primary evidence of learning in program evaluations were summaries of blog entries that students were asked (but not required) to make. These blog posts were the only evidence that Global Kids had of the learning outcomes from their programs; because they were optional, they under-represented program impact. After digital badges were introduced, the details of who earned what badges provided a more comprehensive picture of program impact that was simple to access. Examining the order in which badges were earned helped Global Kids document the path that each learners took through their programs. Given the challenges that many schools and programs face in evaluating and studying learning, the introduction of digital badges seems to offer enormous potential in this regard.

**Research with Badges and for Badges, Systems, and Ecosystems**

This final category of research design uses the evidence contained in digital badges to guide formative improvements of badges, badge systems, and badge ecosystems. Interviews with the 30 badge design teams uncovered some other promising efforts to use the evidence in badges to transform badging systems. The Planet Stewards design team used badges to connect educational content from the National Oceanic and Atmospheric Administration to the Next Generation Science Standards. One of their challenges was mapping the game-like curricular “quests” to the standards. Such mapping is notoriously difficult and a major obstacle to standards-based reform. Curricular activities naturally touch on multiple standards, and systems need redundancy so that students and teachers can select from multiple activities. Because badges can be more specific and because they contain actual evidence of learning, they provided the Planet Stewards team entirely new formative possibilities for mapping.

Eventually researchers are likely to begin using the evidence in digital badges to systematically study and improve entire learning ecosystems. In this way it seems possible that digital badges might ultimately transform the entire learning analytics movement. Stacy Kruse, Creative Director at Pragmatic Solutions, was responsible for the design of the website and many aspects of the thriving badge systems developed for PBS Student Reporting Labs. As Kruse put it in response to an interview question about badges research, “Before I started working with digital badges, I was working on learning analytics.” As Kruse explained, this trajectory left her
continually searching for ways to build learning analytics into the badge system in ways that would take advantage of the unique information in badges to guide continual refinements to that system and the broader educational ecosystem.
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