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# *Personalized workplace learning: An exploratory study on digital badging within a teacher professional development program*

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**Abstract**

To provide customized workplace learning opportunities, a digital badge system was designed by a university, governmental agency and national professional association to support teachers' implementation of professional development (PD). Teacher Learning Journeys (TLJ) is an approach that allows for teachers to customize their PD experience to their workplace and make decisions about what PD they need based on their expertise and interests. The digital badging provided and assessed experiences in online PD. Using a theoretical framework that focused on decision making and customization as part of personalization, researchers conducted a theory-driven thematic analysis on teachers' TLJ artifacts (goal statements, interviews and reflective activity logs). Data came from 36 teachers who completed 154 PD activities over a 3-month period. A case study was developed from an in-depth analysis of eight teachers' artifacts and interviews. Using TLJ as a PD tool, teachers made decisions when selecting learning goals they identified as personally relevant. Teachers customized the level of assessment and the specific content depth to personalize the PD training for workplace constraints. This project informs future research aiming to understand how personalized learning activities support teachers and other professional learners in a variety of workplaces.

Digital badges, also known as microcredentials, are online representations of learning experiences and activities that tell a story about the learner's education and skills. Frequently represented by a graphic or icon, badges offer a socially constructed and valued encapsulation of experiences through a variety of stored metadata, such as the issuer, description and evaluation criteria for learning. Through this rich metadata, digital badges offer transparency and depth into the learning and achievements of the learners which can then be reviewed by others (Abramovich, Schunn & Higashi, 2013; Halavais, 2012). While relatively new, badges are slowly gaining adoption in traditional educational structures. Abramovich *et al* (2013) studied the role digital badges played on motivation in primary school students and found impact on both intrinsic and extrinsic motivation. They also found that effects of digital badges varied across learner ability and badge design. Hickey and Soylu (2012) explored digital badges with higher education students, and their findings suggest digital badges can act as a valuable tool. Because badges

**Practitioners Notes**

What is already known about this topic

- Online teacher professional development is growing rapidly to meet diverse workplace needs.
- Successful professional development must meet the teachers' individual needs. It must be grade-level appropriate, local setting specific, adaptive to various teaching philosophies and pedagogies, and provide flexibility.
- Badging is a form of microcredentialing that has become popular to both incentivize learning and tie performance and achievement to observable tasks, activities and skills.
- Little research has been conducted to determine how personalization through badging can enhance online teacher professional development.

What this paper adds

- Online professional development can be personalized with opportunities for decision making and customization to help learners meet professional needs.
- Digital badges can capture and credential unique learning experiences as part of teacher professional development.
- Teachers customized their professional development to meet the opportunities and constraints of their workplaces and credentialing requirements.
- Customized assessment and online mentoring supported personalized professional learning.

Implications for practice and/or policy

- Offers digital badging as one solution for personalization in workplace learning to meet the needs of workers and employers.
- Provides an example of digital badges as a credential to assess personalized professional development.
- Extends workplace learning beyond on-the-job apprenticeships to include personalized independent study.

capture metadata, badges can act like a portfolio, documenting workplace learning and artifacts that can be shared with fellow colleagues and supervisors, or as repositories of content or reflection. In a study of professional development (PD) of teachers in a higher education course, Ching and Hursh (2014) argue that "teachers' attitudes, intents, and confidence are still the most powerful factors that influence technology integration . . . even in the most supportive environments, teacher decision making is still key" (p. 73). Consequently, our team is exploring digital badges as tools that support professionals' decision making within their own PD activities.

In this paper, we investigate the use of digital badging as a tool to support the needs of personalized professional learning and organizations with credentialing in a technologically enhanced workplace. We analyze the implementation of an online teacher PD system that addresses the unique workplace needs of American primary and secondary school teachers (Borko, 2004; McLoughlin & Lee, 2008) through employing a badging system. We see our study of badging as addressing two questions put forth by Dede, Ketelhut, Whitehouse, Breit and McCloskey (2009) in a literature review of online teacher PD research: How should PD be designed and what types of interactions should the PD support? These questions are important to answer because teachers must continue to develop skills and knowledge to meet regulatory credentialing and certification

as part of their workplace requirements. Although the educational sector has realized the potential for investing in online teacher PD, a one-size-fits-all approach to teacher PD cannot give ongoing support as teachers implement new tools and content into their own practice (Darling-Hammond, Porter, Garet, Yoon & Bransford, 2005). School teachers are professionals with a range of expertise and experience with the subjects they teach (Borko, 2004), and this is especially salient in the domain of science teaching given the ever-advancing content and technological tools.

*Teacher Learning Journeys: the online PD and badging system*

The Teacher Learning Journeys (TLJ) badging system was designed collaboratively by three partners—Penn State University, the National Aeronautics and Space Administration (NASA) and National Science Teachers Association (NSTA)—dedicated to supporting implementation of personalized PD through microcredentialing. The TLJ partners sought to develop design principles and research findings about how digital badges can support transformative pedagogical practice in work environments. Each group informed the design from the perspective of educational theory, subject matter expertise and professional practice to provide a holistic approach to teacher professional learning. Penn State University partners were responsible for the overall design, implementation, content and instructional pedagogy suggested. NASA provided unique access to materials that could be integrated into the teachers' daily practices, including scientific data and new content. NSTA was involved in the design to help address regulatory, certification, national standard issues and emerging workplace trends.

The tripartite TLJ team came together because of concerns that workplace learning for educators was based on an outdated one-size-fits-all model of PD that does not meet the needs of primary and secondary school teachers who need to be viewed as professionals with a range of expertise and experience (Ball & Cohen, 1999; Borko, 2004; Granger, Morbey, Lotherington, Owston & Wideman, 2002). Expertise in teaching is dependent on flexible access to highly organized systems of knowledge (Putnam & Borko, 1997), and effective PD requires personalization (Garet, Porter, Desimone, Birman & Yoon, 2001; Guskey, 2008; Mazzarella, 1980; Penuel, Fishman, Yamaguchi & Gallagher, 2007). Moreover, the demands placed on teachers need to be balanced with their educational workplaces' economic and time constraints. Traditional PD also presents difficulties for assessment and evaluation by supervisors and other teaching staff (Desimone, 2009) leaving questions about the best PD experiences and how to track their effects over time. Through the use of digital badges, teachers can electronically display, share and revisit activities tied to their PD. This allows administrators to better understand and review a teacher's ongoing needs, and other teachers can view choices and feedback made by their colleagues in order to inform their own PD decisions.

*Research questions*

Within the research scope of technologically enhanced workplace learning, we conducted a collective case study (Stake, 1995) as an inquiry into personalized learning supported by the TLJ digital badging system. We investigated the following two questions:

- How do teachers use a digital badging system to personalize their experience in TLJ to meet their PD goals (decision making)?
- How do teachers personalize their PD activities within TLJ to support unique aspects of their workplace setting (customization)?

These research questions were examined across the full set of 36 teachers in our study as well as with an in-depth study of eight teachers' experiences. Through this approach, we developed research findings and suggest possible design principles for badges and flexible PD to advance the use of personalized educational technologies in workplace learning settings.

## Theoretical framework

To analyze workplace learning within the TLJ project, we adapted a theoretical framework from the educational technology personalization literature provided by Kearney, Schuck, Burden and Aubusson (2012). We use two components of Kearney and colleagues' model: *decision making* for personal interest and *customization* for workplace opportunities and constraints. Our focus on decision making and customization is motivated by a literature review of professional learning, where Stoll, Bolam, McMahon, Wallace and Thomas (2006) argue that "professional learning is widely believed to be more effective when it is based on self-development and work-based learning" (p. 232). In our study, we define decision making as learning related to personal self-development and customization as related to addressing learning related to workplace affordances and constraints.

### *Decision making*

Much of the discussion surrounding learning personalization focused on computer-based adaptive systems (Nedungadi & Raman, 2012; Song, Wong & Looi, 2012; Su, Tseng, Lin & Chen, 2011). However, we take a different approach to personalization through adapting Kearney *et al*'s (2012) framework of mobile learning which refers to personalization as learners' choices related to "just enough, just-in-time, just-for-me" educational opportunities where learners get to create their own "tailored learning journey" (p. 9). In Kearney and colleagues' model, agency is described as a subcomponent of personalization and is specified as the ability for individuals to make decisions about their learning, including subject matter, goals and delivery format (Kearney *et al*, 2012). Furthermore, in McLoughlin and Lee's (2008) discussion of learning as a means of participation, they describe decision making as central to "personally meaningful learning" and allow learners to decide how to "best meet their goals" (p. 17). Decision making is a key part of teacher participation in TLJ and furthers personalization by allowing learners to select their activities, when and in what format to engage in those activities. In this way, teachers make responsive decisions to focus on their personal needs and expertise (Ching & Hursh, 2014; Fuller, Hodkinson, Hodkinson & Unwin, 2005; Hew & Brush, 2007).

### *Customization*

McLoughlin and Lee's (2008) perspective on customization furthers understanding of personalization by allowing learners to choose what they need to meet their workplace goals and by adapting material to these goals. McLoughlin and Lee explain that workplace customization can be adapted to local regulatory contexts, individual expertise and desired assessment. Similarly, within the mobile learning literature, Kinshuk, Graf and Yang (2010) offered two approaches to customized learning: content specific to the learner's needs and content adapted to the learner's local work environment.

We argue that customization through technology-enhanced workplace learning is important to learner empowerment. Tynjälä, Häkkinen, and Hämäläinen (2014) examine social media tools to support affordances for capturing personalized experiences in the workplace. They elaborate that while social media tools were not designed to support learning, these technological tools can help to organize workplace learning because "technology in the workplace can be helpful in empowering workers and organisations to engage in innovative and transformative forms of learning" (p. 8).

Customization can be applied to workplace communities as well individuals. In a case study analysis of workplace learning research studies, Fuller *et al* (2005) examined learning communities (in three businesses in the steel industry and in two secondary schools) through the lens of communities of practice (Lave & Wenger, 1991). Across the studies analyzed, Fuller and Unwin (2002) noted that individuals' experiences, interests and professional responsibilities varied with

regard to the need for training and their participation in teaching others. Fuller and Unwin's analysis found that community of practice forms of apprenticeship was only one kind of successful workplace learning; peer teaching and structured learning situations (such as courses) were also important in school-based and industrial-based workplace learning. Based on this finding that structured educational opportunities are effectively used in workplaces across employment types, especially when employees are in a new workplace environments or changing positions, we posit that one can design technologically enhanced workplace tools that can enhance how learners customize navigation and track personally relevant PD. In our analysis, we consider TLJ to empower customization when learners modify their PD experience to reflect constraints and opportunities in their local or regional workplace.

## Method

We examined the experiences of 36 teachers using TLJ to understand how TLJ's badging system afforded personalized PD. To understand how teachers learned with and in TLJ, we adopted a collective case study method (Stake, 1995), examining deeply each teacher's experience to compare and contrast experiences within the group.

### *Technological setting: TLJ*

TLJ was built as an online PD website that uses digital badging to provide and capture "real-time, ongoing, work-embedded support" through the use of online teacher PD (Dede *et al*, 2009, p. 9). Each participant's experience with TLJ began with writing a personal learning goal statement (see Figure 1), in alignment with McLoughlin and Lee's (2008) views on personalization.

TLJ offered teachers a set of 63 PD activities related to skills and content knowledge for science teachers focused on weather and climate science, engineering, and the solar system. TLJ's 63 activities within three science content areas provided teachers a chance to customize their learning based on workplace goals and to choose activities based on their interests and expertise. The PD activities included collaborative learning opportunities (ie, synchronous webinars, online discussions) and individual learning opportunities (ie, archived webinars, reading materials, tutorials). Once a teacher had participated in a PD activity, he or she could receive recognition for completion in the form of microcredentials by submitting a reflective activity log. Expert practitioners were paid by the TLJ partners to serve as mentors to assess the teachers' professional

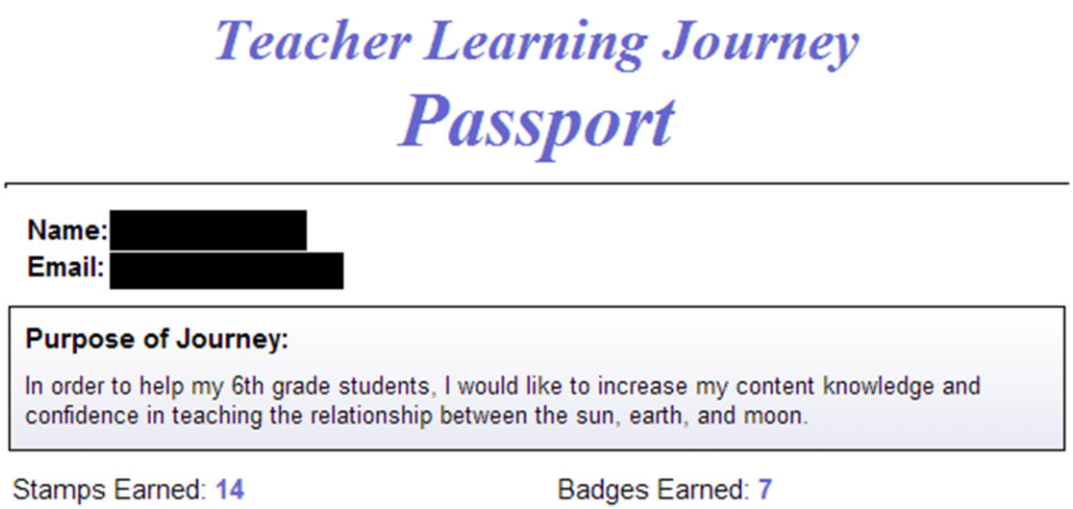


*Figure 1: Teacher learning journeys' purpose statement page offers an interface to set and reflect on professional development (PD) goals*

learning. These expert practitioners were senior educators who were familiar with individual state credentialing requirements and local professional standards; this localization allowed for regionalized feedback. The TLJ mentors reviewed each completed reflective activity log to see if the teacher had developed with the new content or skill as specified by each badge requirement. TLJ issued two types of microcredentials—*stamps* and *badges*—for each PD activity which represented the level at which they were assessed on the specific skills or content covered in the activity. Stamps represented a lower level of achievement for completing activities, which required teachers to write a short reflective statement. Badges represented a higher level of achievement requiring a work plan on how they would integrate new skills or knowledge into their job. To earn the microcredential, teachers had to apply concepts within the stamp or badge to their workplaces: they wrote plans that focused on content, technology integration or sharing the content with coworkers. The team embedded informational metadata into stamps and badges in order for microcredentials to carry meaning to those outside of TLJ and to integrate within the larger Open Badges ecosystem. This metadata included the following: (1) a description of the tasks required by each PD activity, (2) the evidence of the learner's mastery, and (3) feedback provided by the expert practitioner. Additionally, to share information with their supervisor, teachers used TLJ to generate an exportable assessment report.

*Participants*

Participants were teachers at all levels of their careers. Teachers were recruited via email rosters from partnering educational organizations. The criterion for inclusion was status as an educator with science teaching responsibility. A total of 36 teachers signed up for our exploratory study of workplace learning supported by digital badging. To understand the in-depth professional learning experience, we created a collective case study that focused on eight of the 36 teachers. Within the case study teachers, balance was sought between primary and secondary school teachers and years of teaching experience (0–5, 6–15 and over 15 years of work experience). Teachers were excluded as cases if they did not complete all research tasks (although this did not exclude them from participating in the TLJ project). The eight case study participants completed all interviews, a goal statement and at least one PD activity. The study's recruitment strategy had two known limitations: all but one of the 36 research participants were female, and Internet access was required to participate.

*Data collection*

Data were collected from 36 teachers between June and August 2012. Data included (1) system-generated records from all 36 teachers for each awarded a stamp or a badge, (2) the PD activity logs from eight case study teachers (they completed a total of 61 activities), (3) eight purpose statements from the case study teachers, and (4) pre- and post-TLJ intervention interviews with eight case study teachers conducted by phone or online chat with the first author.

*Data analysis*

We approached the collective case study data with a theory-driven thematic analysis (Glesne, 2011) to investigate how teachers personalized their use of TLJ to support their PD goals. Our analyses focused on customization and decision making to address the critiques by Borko (2004) of ineffective PD. We began by coding each teacher's data and created an analytical memo to deeply understand each teacher. These memos were also used to compare across the group for the codes shown in Table 1. The analytical coding scheme in Table 1 focused on components of personalization identified in the theoretical framework. Interviews, purpose statements and activity reflections were all coded with regard to personalized, professional learning.

## Findings

We organize our findings into three sections. First, we describe how all 36 teachers made decisions and customized their assessment and content using the digital badging system to support

*Table 1: Low-level stamp versus high-level badge microcredentials earned by content area*

| | *Stamps* | *Badges* | *Total activities* |
|---|---|---|---|
| Engineering | 36 | 6 | 42 |
| Weather and climate | 39 | 14 | 53 |
| Solar system | 58 | 1 | 59 |
| Total awards | 133 | 21 | 154 |

*Table 2: Thematic codes and subcodes used for data analysis*

| *Codes* | *Subcodes* |
|---|---|
| Content | Pedagogy |
| | Objectives |
| | Evaluation |
| | Assessment |
| | Cross-curricular application |
| Student support | Student concerns |
| | Student adaptations |
| | Student learning |
| Workplace | Curriculum, school district |
| | Standards |
| | Textbook |
| | Administration |
| Technology integration | Technology |
| | Tools |
| Personal goals | Teacher meta-cognition |
| | Personal growth |
| | Philosophy of teaching, ethics |
| | Professional growth |

their PD goals. Second, we demonstrate how the eight case study teachers customized their PD goals to support unique and developing aspects of their workplace settings. Third, we describe the role of expert feedback for the eight case study teachers as they progressed through their individualized workplace learning.

*Choosing level of assessment and content exploration allowed for personalization*

The primary advantage of TLJ from the teachers' perspective was the ability to make decisions about the level of assessment for the PD activities to be relevant to teachers' existing expertise and about the content of PD activities customized to workplace needs.

Assessment

With regard to decisions about the level of assessment, teachers had two choices. First, stamps represented a lower level of achievement, while badges represented a higher level of achievement. Badges required teachers to complete additional reflection and work to connect PD activity content to their workplace. In our dataset, teachers typically made the decision to seek the stamp microcredential (the lower achievement) rather than a badge (the higher level) as shown in Table 2. Across the 36 participants, teachers earned 133 stamps (86.4%) and 21 badges (13.6%). This was also true among the eight case studies teachers, all completing more stamps than badges. The case study teachers completed 61 PD activities (average = 7.6, standard deviation = 4.0), with 49 stamps (80.3%) and 12 badges (19.7%). We posit that providing teachers the

ability to make decisions about their assessment provided them the flexibility to personalize their PD to align with their existing and desired expertise needed for their workplace.

Content

In addition to selecting their level of assessment, the TLJ teachers customized their PD with regard to the content they needed to be successful in their workplaces as shown in Table 2. Given new information about worldwide climate change and the confusion about the difference between weather and climate that many learners have, we posit many teachers were interested in this content. In addition in the USA, teachers are increasingly responsible for integrating engineering activities into science or mathematics classes, and therefore, we posit that many teachers were interested in the engineering design process (EDP) badges for this reason.

For example, Barbara and Sally (all names are pseudonyms) each specialized their content selection, completing PD in a single topic related to a specific workplace goal. Barbara worked on solar system activities to enhance her understanding of planets because she had a new teaching assignment. Sally focused her PD to weather and climate activities because of her school's new weather station. Sally described how she connected the lessons to her school: "We have just purchased a weather station and will be installing it this school year . . . Using our weather station we will include all the optional measurements and submit them online." Sally's alignment of her activities to weather demonstrated how TLJ allowed individuals to customize their training to larger workplace considerations, such as large technological infrastructure investment. When asked if the PD activities completed increased her confidence in teaching the subject, Sally responded that previously she did not have the necessary background training. However, after being empowered by her own decisions on the TLJ activities that were most relevant to her workplace responsibilities, Sally expressed feeling more prepared to lead with this new content. Similarly, Erin completed several EDP activities because this was a new curriculum requirement for her school district. Given her new responsibility for this content and PD trainer for her own school's focus on science, technology, engineering and mathematics (STEM), Erin customized her PD to this near-term workplace goal. We found that teachers were very responsive to workplace goals and needs when considering their PD.

Teachers also customized their content selection and activity logs based on their recognition of the requirements and facilities of their school buildings, local resources, school culture and supervisory context. The participants represent different grade levels, experience levels and regions in the USA. By federal law in the USA, each state runs its own local educational system, for which each state has developed a specialized curriculum, assessment materials and credentialing requirements. The teachers customized the available TLJ resources to meet the requirements set by their local districts and states. In particular, they also frequently mentioned customizing TLJ to meet education standards and the goals of their workplace. Erin's goals were very community oriented and included helping her students and colleagues become "world citizens" by motivating them to "learn more and do more for the world we live in." Consequently, she customized her activities to involve citizen science websites. Through the badging process, Erin, who was responsible for organizing her own school's PD, was put in touch with another online PD program. Her application of TLJ to support her leadership role in her school was evidenced by earning five badges (focused, high-level activities) and 12 stamps (general activities). In terms of McLoughlin and Lee (2008), Erin's customization can be seen in light of her individual interests as within larger community issues. We assert that effective PD must support individual teachers as well as the larger learning community (Borko, 2004; Ching & Hursh, 2014). We found that TLJ supported teachers in this way by empowering them to make decisions throughout their learning journey about the content, reflections and level of assessment that could help customize PD to attend to local and regional issues.

*Teachers used TLJ system flexibility to set personalized PD goals*

Teachers whose purpose statements included a specific reference to a topic (four of eight case study teachers) completed only activities that were mentioned as the goal topic. We found that teachers who did not include a specific topic in their purpose statement explored at least two different science topics. For example, Sally wrote: "[I want] to expand my knowledge of weather and climate to [*sic*] I can assist my students in understanding of how the cycling of matter in and out of the atmosphere relates to Earth's atmosphere, weather, climate, and the effects of the atmosphere on humans and find new activities which will actively engage my students and promote mastery of the essential standard." She focused on weather and climate, completing seven activities in that topic. We found that decision making in the form of initial goal setting can help enhance productivity and be useful in making future decisions on how to approach their professional learning that lead to the fulfillment of teachers' goals.

Purpose statements guided PD activities

The TLJ system included flexibility for teachers to write specific objectives for their PD through a dedicated space for goal setting. All but one participant used this feature to develop a purpose statement. Statements included references to students, pedagogy, content knowledge, local school and regional requirements. For example, Erin wrote the most detailed purpose statement where she discussed content, pedagogy, collaboration with colleagues, preparing students for the future and her philosophy of teaching as a profession. Barbara wrote that she wanted "to learn new and innovative approaches to teaching the solar system to my sixth grade students which will allow them to become more interested and excited." Sally said that she wanted "to expand my knowledge of weather and climate so I can assist my students in understanding of how the cycling of matter in and out of the atmosphere relates." During interviews after their TLJ experience, both Sally and Barbara commented that writing purpose statements helped them to focus on finding the PD they needed to meet their professional learning goals. In Barbara's case, she sometimes started an activity, but before completing she became "disinterested;" with TLJ, she made decisions to change her PD choices to stay with professional learning options that were more immediately useful to her work responsibilities.

Our analysis suggests that the reflective purpose statements provided most teachers support in identifying and managing their own learning goals. This type of organic needs assessment has proven much more effective than traditional PD and even other types of online training (Davis, Preston & Sahin, 2009). Our work here with digital badging to support teacher PD indicates that organic self-assessment is relevant in online microcredentialing environments as well.

Emergent goal setting

Lily was the one teacher who did not engage in goal setting prior to her PD experience. Lily's counterexample is significant because some professionals may have more general or unspecified interests at the start of their PD experiences. Lily only wrote two words in her purpose statement: "professional development." During her interview, Lily stated that she wished that she had spent more time on her purpose statement because it would have been beneficial to her PD planning. While Lily did not create a purpose statement, she engaged in the reflection during her PD experience. Lily found her badges as visual reminders of her accomplishments that provided her feedback on where she had been professionally and provide direction for her next steps. Lily wrote that she intended to revisit her reflections shared online later using the logs as both practitioner notes and personal journal. It is possible there are other employees like Lily, especially newly hired workers, who want to learn more generally about professional practice. They may want a more exploratory experience, and goal setting in the middle of their PD journey may be more suited to their needs rather than up-front decision making given their lack of workplace experience. Thus,

badging PD offers learners flexibility to pursue the experiences that they value and supports both specific and exploratory goal setting.

*Expert feedback on reflections increased teachers' customizations to their workplace*

As part of earning a badge, teachers received expert feedback on the completed activity logs from a regionally located mentor. In the logs, teachers reflected on what they learned and articulated their new understandings. Veteran teacher Erin appreciated the amount of feedback stating, "it felt like I had a coach." This is aligned to McLoughlin and Lee's (2008) concept of dialogue-fostered collaboration to support customization. Thoughtful discussion with an expert practitioner is a key activity building toward collaborative personalized PD (Tynjälä & Häkkinen, 2005). Ball and Cohen (1999) reinforced the need for discourse by describing how it is essential in order for all other parts of PD to be effective: "Continuing thoughtful discussion among learners and teachers is an essential element of any serious education, because it is the chief vehicle for analysis, criticism, and communication of ideas, practices, and values" (p. 13). Across the dataset, we found that the TLJ collaborative conversations with expert practitioners supported the participating teachers to customize their PD in ways that were sensitive to regional and local issues affecting their workplaces.

## Discussion

In this paper, we investigated how teachers used a digital badging system to personalize their experience in TLJ to meet their PD goals via decision making and how teachers personalized their PD activities within TLJ to support unique aspects of their workplace setting by customization of their content choices and level of assessments. To accomplish this work, we applied personalization as an analytical framework to analyze teachers' experiences. Returning to Dede *et al*'s (2009) questions to the field regarding the design of online PD for teachers, we identified ways in which personalization through badges supported workplace professional learning by providing learner customization and decision making.

*Designing flexible online PD using a digital badging system*

Borko (2004) asserts that teachers can benefit from flexibility within their PD due to their differing career trajectories and expertise. Consequently, we have developed design implications from our TLJ investigation regarding the utility of flexible PD. We categorize three themes related to flexible online PD: organization to allow for flexible goal setting, delivery of content and varied forms of assessment, and archiving and sharing PD artifacts for further learning and workplace advancement.

Organization to allow for flexible goal setting

First, TLJ provided for a flexible organization with regard to goal setting. Most teachers used the dedicated space for learners to articulate their workplace goals at the start of their PD experience. We found that initial planning served to focus the learners, which helped them articulate and assess their own needs. We also found a counterexample where a teacher (ie, Lily) did her goal making after participating in a few online PD sessions. Therefore, the flexibility to allow for both initial and emergent goal setting supported teachers' needs and expertise.

Delivery of content and varied forms of assessment

Second, TLJ delivered up-to-date content within PD activities that were relevant to teachers' workplaces in terms of needed disciplinary knowledge. For example, Sally had a new resource at work, a weather station. TLJ allowed her to customize her PD to focus on the disciplinary knowledge and up-to-date content that she needed to be successful in utilizing this new workplace tool. In another example, Erin had her workplace transform its mission and goals, and consequently the need to update her own skills. Erin was able to customize her PD to STEM content that was at

an appropriate level to her existing expertise and went much deeper in content and assessment given her new specialist role in the newly forming school organization. Given that Fuller and Unwin (2002) found that workers across employment sectors effectively use formal educational opportunities, design implications from our TLJ study suggest that delivering content that can be customized and assessed using targeted microcredentials is one possible formal PD tool. The TLJ badges for professional learners addressed the learners' varying expertise and met the needs of their changing workplace contexts. Because the teachers used TLJ to customize the content to their own workplace requirements, our evidence suggests that these customizations regarding content and assessment may be important for other workplace learning systems.

Archiving and sharing PD artifacts for further learning and workplace advancement

Teachers found the ability to archive and revisit their PD activity logs helpful. Erin used her logs to reflect on the PD she was creating for peers at her own workplace, noting which activities would be helpful to share with her colleagues. Also, Lily used her logs to keep track of her activities and intended to revisit her notes at a later time. We found that learners appreciate a centralized, cloud-based location that can be accessed at any time where they can revisit both content and personal notes. As evidenced by the teachers' eagerness to share resources with colleagues, we recommend that online PD afford ease of sharing.

*Expert mentors provided key supports for customization*

TLJ supported teacher interaction with paid, professional mentors who both led the PD activities and assessed their activity logs to earn either a badge (high level of achievement) or stamp (low level of achievement). As evidenced by Erin's case, successful online PD within a mentored relationship supported for learners to make decisions to meet their needs. One role of the expert mentor was providing access to resources and practices valued by the community of educators that these teachers belonged. Halavais (2012) argues that badges "can serve as a clear way of expressing what is valued by a community, they encourage participation by those interested in the badges, they provide the means to identify more closely with the learning experience" (p. 371). The TLJ teachers, as Halavais (2012) suggested, found that the interactive nature of the learner–mentor relationship was important for teachers to make connections to an expert member of their community to provide key feedback and guidance as the TLJ teachers continued to pursue their workplace learning goals.

*Overall implications for technologically enhanced workplace learning using badging*

As described earlier, Dede *et al* (2009) ask what types of technology should be included in PD. This project informs future research aiming to understand how personalized learning activities support teachers and other professional learners in a variety of workplaces. Additionally, this paper helps future utilization of a digital badging system within the context of professional learning and what design considerations aid in the development of similar systems for professional and personal learning interests. TLJ was designed to support teachers engaging in personalized PD by allowing the participants to set their own learning goals, select learning activities that aligned with these goals, and respond to personal and professional schedules. We build on the Stoll *et al*'s (2006) study that asserts self-development is an important aspect of work-based learning by providing additional empirical evidence that empowering professional learners to make decisions was key to TLJ's success. Our finding suggests that other workplace online training providing a wide library of PD experiences that vary in terms of content and pacing may be a useful strategy. This paper's exploration of personalization with digital badges offers to extend Tynjälä, Häkkinen, and Hämäläinen's (2014) call for further research to enhance the understanding of individual characteristic's effects on technology-enhanced workplace learning. Based on our analysis presented in this paper, we suggest there is value in utilizing digital badging systems for workplace learning. Given the findings from our study suggest success with badging

for our study participants, additional research in the areas of the design of digital badging systems and their applications to learning in professional contexts is warranted.

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**References**

Abramovich, S., Schunn, C. & Higashi, R. M. (2013). Are badges useful in education?: it depends upon the type of badge and expertise of learner. *Educational Technology Research and Development*, *61*, 2, 217–232. doi: 10.1007/s11423-013-9289-2.

Ball, D. L. & Cohen, D. K. (1999). Developing practice, developing practitioners: toward a practice-based theory of professional education. *Teaching as the learning profession: Handbook of policy and practice*, *1*, 3–22.

Borko, H. (2004). Professional development and teacher learning: mapping the terrain. *Educational Researcher*, *33*, 8, 3–15. doi: 10.3102/0013189X033008003.

Ching, C. C. & Hursh, A. W. (2014). Peer modeling and innovation adoption among teachers in online professional development. *Computers & Education*, *73*, 72–82. doi: 10.1016/j.compedu.2013.12.011.

Darling-Hammond, L., Porter, A., Garet, M., Yoon, K. & Bransford, J. (2005). *Preparing teachers for a changing world: what teachers should learn and be able to do*. San Francisco, CA: Jossey-Bass.

Davis, N., Preston, C. & Sahin, I. (2009). Training teachers to use new technologies impacts multiple ecologies: evidence from a national initiative. *British Journal of Educational Technology*, *40*, 5, 861–878. doi: 10.1111/j.1467-8535.2008.00875.x.

Dede, C., Ketelhut, D. J., Whitehouse, P., Breit, L. & McCloskey, E. M. (2009). A research agenda for online teacher professional development. *Journal of Teacher Education*, *60*, 1, 8–19. doi: 10.1177/0022487108327554.

Desimone, L. M. (2009). Improving impact studies of teachers' professional development: toward better conceptualizations and measures. *Educational Researcher*, *38*, 3, 181–199. doi: 10.3102/0013189X08331140.

Fuller, A. & Unwin, L. (2002). Developing pedagogies for the contemporary workplace. Working to learn: transforming learning in the workplace, 95–111.

Fuller, A., Hodkinson, H., Hodkinson, P. & Unwin, L. (2005). Learning as peripheral participation in communities of practice: a reassessment of key concepts in workplace learning. *British Educational Research Journal*, *31*, 1, 49–68. doi: 10.1080/0141192052000310029.

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F. & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal*, *38*, 4, 915–945. doi: 10.3102/00028312038004915.

Glesne, C. (2011). *Becoming qualitative researchers: an introduction* (4th ed.). Boston: Pearson.

Granger, C. A., Morbey, M. L., Lotherington, H., Owston, R. D. & Wideman, H. H. (2002). Factors contributing to teachers' successful implementation of IT. *Journal of Computer Assisted Learning*, *18*, 4, 480–488. doi: 10.1046/j.0266-4909.2002.00259.doc.x.

Guskey, T. R. (2008). Development teacher change. *Educational Research*, *15*, 5, 5–12.

Halavais, A. M. (2012). A genealogy of badges: inherited meaning and monstrous moral hybrids. *Information, Communication & Society*, *15*, 3, 354–373. doi: 10.1080/1369118X.2011.641992.

Hew, K. F. & Brush, T. (2007). Integrating technology into K-12 teaching and learning: current knowledge gaps and recommendations for future research. *Educational Technology Research and Development*, 55, 3, 223–252. doi: 10.1007/s11423-006-9022-5.

Hickey, D. T. & Soylu, F. (2012). Wikifolios, reflections, and exams for online engagement, understanding, and achievement. *Journal of Teaching and Learning with Technology*, *1*, 1, 64–71.

Kearney, M., Schuck, S., Burden, K. & Aubusson, P. (2012). Viewing mobile learning from a pedagogical perspective. *Research in Learning Technology*, *20*(14406), 1–17. doi: 10.3402/rlt.v20i0/14406.

Kinshuk, M. C., Graf, S. & Yang, G. (2010). Adaptivity and personalization in mobile learning. *Technology, Instruction, Cognition and Learning (TICL)*, *8*, 163–174.

Lave, J. & Wenger, E. (1991). *Situated learning: legitimate peripheral participation*. Cambridge, UK: Cambridge University Press.

Mazzarella, J. A. (1980). Synthesis of research on staff development. *Educational Leadership*, *38*, 2, 182–185.

McLoughlin, C. & Lee, M. J. (2008). The three p's of pedagogy for the networked society: personalization, participation, and productivity. *International Journal of Teaching and Learning in Higher Education*, *20*, 1, 10–27.

Nedungadi, P. & Raman, R. (2012). A new approach to personalization: integrating e-learning and m-learning. *Educational Technology Research and Development*, *60*, 4, 659–678. doi: 10.1007/s11423-012-9250-9.

Penuel, W. R., Fishman, B. J., Yamaguchi, R. & Gallagher, L. P. (2007). What makes professional development effective? Strategies that foster curriculum implementation. *American Educational Research Journal*, *44*, 4, 921–958. doi: 10.3102/0002831207308221.

Putnam, R. T. & Borko, H., (1997). Teacher learning: implications of new views of cognition. In B. J. Biddle, T. L. Good, I. F. Goodson (Eds), *The international handbook of teachers and teaching* (pp. 1223–1296). Dordrecht, The Netherlands: Kluwer.

Song, Y., Wong, L. H. & Looi, C. K. (2012). Fostering personalized learning in science inquiry supported by mobile technologies. *Educational Technology Research and Development*, *60*, 4, 679–701. doi: 10.1007/s11423-012-9245-6.

Stake, R. E. (1995). *The art of case study research*. Thousand Oaks, CA: Sage Publishing.

Stoll, L., Bolam, R., McMahon, A., Wallace, M. & Thomas, S. (2006). Professional learning communities: a review of the literature. *Journal of Educational Change*, *7*, 4, 221–258. doi: 10.1007/s10833-006-0001-8.

Su, J.-M., Tseng, S.-S., Lin, H.-Y. & Chen, C.-H. (2011). A personalized learning content adaptation mechanism to meet diverse user needs in mobile learning environments. *User Modeling and User-adapted Interaction*, *21*, 1–2, 5–49. doi: 10.1007/s11257-010-9094-0.

Tynjälä, P. & Häkkinen, P. (2005). E-learning at work: theoretical underpinnings and pedagogical challenges. *Journal of Workplace Learning*, *17*, 5/6, 318–336. doi: 10.1108/13665620510606742.

Tynjälä, P., Häkkinen, P. & Hämäläinen, R. (2014). TEL@ work: toward integration of theory and practice. *British Journal of Educational Technology*. doi: 10.1111/bjet.1216.