PhD Progression: a micro-credentialing program motivates and supports PhD students' professional development at a US University

Bénédicte Gnangnon, Kuang Li, Dena Fatemeh Rezaei and Mishonne Maryann Marks

Professional Development and Postdoctoral Affairs, Boston University, Boston, Massachusetts, USA

Chrysanthos Dellarocas

Digital Learning and Innovation, Boston University, Boston, Massachusetts, USA, and

Sarah Chobot Hokanson and Sasha B. Goldman

Professional Development and Postdoctoral Affairs, Boston University, Boston, Massachusetts, USA

Abstract

Purpose – This study aims to present the evaluation of a competency-based online professional development training program, PhD Progression, tied to a digital badge system, created to support PhD students across fields.

Design/methodology/approach – This study took place at Boston University, a large, nonprofit, Carnegie Classified R1 research-intensive institution located in the northeastern region of the USA. Through internal campus collaborations, the authors developed a PhD core capacities framework. Building from this framework, the authors designed the first learning level of the program and ran a pilot study with PhD students from various fields and at different stages of their PhD. Using surveys and focus groups, the authors collected both quantitative and qualitative data to evaluate this program.

Findings – The quantitative and qualitative data show that the majority of the PhD student participants found the contents of the competency-based training program useful, appropriate for building skills and

knowledge and therefore relevant for both their degree progress and their future job. Gaining digital badges significantly increased their motivation to complete training modules.

Practical implications – This type of resource is scalable to other institutions that wish to provide self-paced professional development support to their PhD students while rewarding them for investing time in building professional skills and enabling them to showcase these skills to potential employers.

Originality/value – This study demonstrates, for the first time, that tying a digital badging system to a competency-based professional development program significantly motivates PhD students to set professional development goals and invest time in building skills.

Keywords Doctoral students, PhD students, Digital badges, Educational credentials, Skills-based learning, Self-paced training, Self-directed learning, Lifelong professional development, Core competencies, Program evaluation

Paper type Research paper

Introduction

Doctoral education in the USA has been on a shifting trajectory for several decades. The number of PhDs earned annually has been steadily increasing, remaining above 55,000 a year since 2018, with an annual average growth rate of 3.3% (Doctorate Recipients from U.S. Universities, 2018). Meanwhile, the percentage of tenured/tenure-track instructional faculty in postsecondary institutions has shrunk from 79% in 1969 to 33% in 2009 (Kezar *et al.*, 2014; Moore, 2019), while the demand for PhDs outside of academia has risen (Langin, 2019; Wendler *et al.*, 2012). PhD holders in life sciences, engineering and data science are now dominantly recruited in the private sector (Chikarmane, 2021). Compared to their counterparts in STEM, PhD recipients in humanities and social sciences have traditionally expressed a stronger commitment to working in academia but are increasingly seeking jobs in government, business/industry, non-profits and other sectors (American Academy of Arts and Sciences, 2022; Main *et al.*, 2019).

Because PhD degree recipients now pursue a variety of career paths outside of academia, including roles in industry, non-profits and government (Bloch *et al.*, 2015; Clair *et al.*, 2017; Thiry *et al.*, 2015), it is not surprising that the conventional approach of PhD training, which involves producing a thesis manuscript and completing relevant coursework, does not provide evidence of the full range of skills required to enter the workforce (Ashonibare, 2022; Heflinger and Doykos, 2016; Maki and Borkowski, 2006). To be successful in an increasingly diverse set of career pathways, PhD students must develop a broad array of skills during their PhD journey. This warrants a thorough examination of the necessary skills in the first place.

The established PhD training frameworks, such as the researcher development framework (Vitae, 2011), the researcher skill development framework (Willison *et al.*, 2018), the Eurodoc transferable skills and competences (Weber *et al.*, 2018) and the competence model for science, engineering and technology PhD students and graduates (Nikol and Lietzmann, 2019), all underscore the importance of acquiring discipline-specific knowledge and research skills. They also urge PhD students to develop other categories of skills, e.g. in communication, teaching and organizational skills. Similarly, throughout its multi-phase PhD Career Pathways project, the US Council of Graduate Schools investigated the career trajectories of doctoral students in various disciplines (see Garcia and Zhou, 2022; Johnson and Zhou, 2022; Okahana *et al.*, 2019; Okahana and Kinoshita, 2018), identifying key transferable skills supporting PhD career transitions, such as grant writing, digital literacy, independence and adaptability/flexibility. Furthermore, in their systematic review of 35 empirical studies on doctoral graduates' skill development, (Senekal *et al.*, 2022) extracted eight domains, in addition to research and

scholarship, in which PhD students should cultivate skills, including communication, interpersonal skills, organizational skills, professional reputation, higher order thinking, personal resourcefulness and active citizenship.

Our institution, Boston University – a member of the Association of American Universities and a Carnegie Classified R1 institution – places a high priority on supporting our ~2,400 PhD students. Drawing from the existing literature on PhD career paths, training frameworks from peer institutions [1] [2] [3] and experience working with PhD students, our University created a Task Force to identify and develop core capacities to support PhD education and professional development at our institution. Composed of faculty members, department chairs, administrators and representatives from our institution's Industry Engagement office, the Task Force developed seven PhD core capacities: communication, discipline-specific knowledge, teaching, management and leadership, research, self-awareness and career development. To comprehensively support PhD students in building skills across these areas, we created an online professional development program, PhD Progression, whose curricular structure is based on the seven-core capacity framework (Methods). Additionally, considering the many benefits of the use of micro-credentials on student learning, we tied our program to a digital badge system to provide PhD students with means of monitoring and communicating about their skill development.

The value of competency-based education tied to micro-credentialing has been demonstrated by a significant amount of literature to help students identify and leverage their skills toward future success (Abramovich, 2016; Pitt *et al.*, 2019; Singer, 2019). Many digital badges, which are a type of micro-credential, have been designed to align with the fundamental principles of self-directed learning (Gish-Lieberman *et al.*, 2021), which hold a central position in adult learning theories. These theories suggest that adult learners thrive in supportive environments where their learning is self-directed and scalable (Knowles *et al.*, 2015). Research has also shown that badges can be especially effective in motivating students when the content is tailored to the population and linked to career preparation and employment (Foli *et al.*, 2016; Gamrat *et al.*, 2014). For instance, Felton *et al.* (2023) documented how their public US institution, in collaboration with industry partners, created a pilot medical device industry badge to successfully help undergraduate students acquire skills required in the life sciences industry.

Skills have been shown to further gain value as stakeholders (students, educational institutions, employers) share or demonstrate them in a verified form, such as digital badges, to document and demonstrate learning achievements that employers can directly evaluate (Blumenstyk, 2019; Everhart, 2018; Felton *et al.*, 2023). Additionally, employers increasingly perceive micro-credentials positively; for instance, (Fong *et al.*, 2023) reported that among 500 executives, supervisors and human resources professionals surveyed across different sectors, 80% recognized the value of the micro-credentials for employee development, over 70% perceived them as credible and 68% expressed interest in co-developing micro-credentials with universities.

Given the growing interest and perceived credibility of digital badges by a wide range of stakeholders, we propose, for the first time, to incorporate them in doctoral education and professional development. The literature review suggests that providing PhD students with a self-paced professional development program tied to digital badges can help accommodate their demanding schedules, motivate learning and enable them to effectively communicate about their skills. This study aims to answer the following research question:

RQ1. To what extent does our training program, PhD Progression, support PhD student engagement and motivation and is perceived as useful for their degree progress and their career and professional development?

Methods

After defining the PhD core capacities and creating PhD Progression, we ran a pilot study through a mixed-methods approach (Creswell and Guetterman, 2019; Tashakkori and Teddlie, 2010; Yin, 2017), whereby PhD students from various fields and at different stages of their PhD programs were asked to complete two learning pathways over the course of a summer. The study took place between May and September 2021 at Boston University and was approved by the Boston University Charles River IRB.

PhD Progression pilot

PhD Progression is an online professional development program that provides training modules to support PhD students across all fields throughout their doctoral journey. Modules are designed to assist PhD students in gaining skills in seven core capacities:

(1) Communication;

(2) Management and leadership;

(3) Discipline-specific knowledge;

(4) Teaching;

(5) Research;

(6) Self-awareness; and

(7) Career development.

In addition, training modules are organized into three levels of learning: skill exploration (Level 1, L1), skill development (L2) and skill application (L3) (Figure 1). The training modules are hosted and connected with one another on a digital badging platform called Canvas Credentials (formerly BadgrPro), creating learning pathways; there is one pathway per core capacity and per level of learning. PhD Progression allows PhD students to gain a digital badge for each module completed.

Our pilot study focused on the seven L1 learning pathways (one per core capacity). We created 67 modules, spread throughout the seven L1 pathways (6–13 modules per pathway; Appendix 1). Each module was designed to take 60–90 min to complete, thus being equivalent to a professional development workshop. Each module starts with an overview and a list of learning objectives, and its embedded contents and learning activities are then available in a variety of mediums to appeal to different types of learners (read, watch, or listen). Upon exploring the module content and completing its activities, students are given a module completion survey for formative and summative assessment of learning, delivered via our institution's central Qualtrics account. Badges are awarded after our team carefully reviews the survey answers and approves of their quality.

Participants

We used "purposeful qualitative sampling" to recruit students "who can best help us understand our phenomenon" (Creswell and Guetterman, 2019, p. 206), and we emphasized the need for a diverse group of student participants. During the recruitment process, we considered multiple characteristics of students, including their academic disciplines, gender, race and progress in the PhD program. We recognize that additional attributes such as socioeconomic or first-generation status could further enhance the diversity of our participants, but our institution does not typically gather this kind of information. With these considerations in mind, our search led us to the Graduate School of Arts and Sciences (GRS), which has the largest number of doctoral students (1,401 out
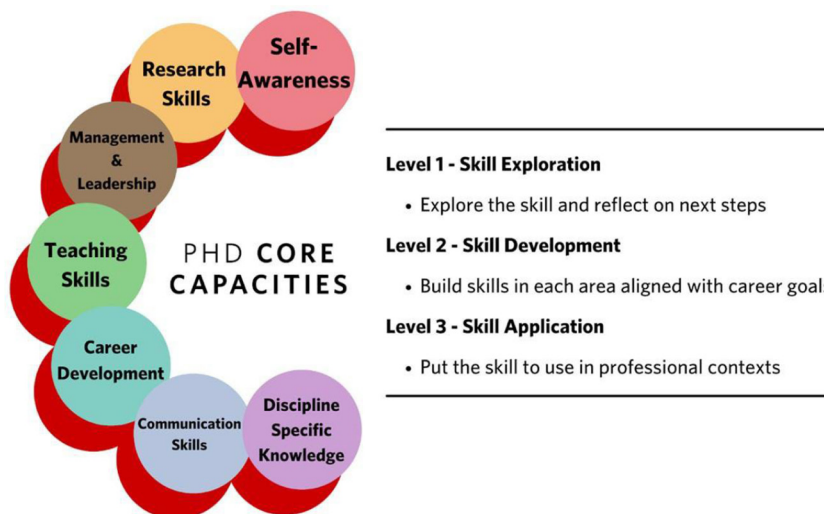
Source: Created by authors

of 2,376 PhD students in total) and the broadest disciplinary spectrum (e.g. natural sciences, humanities and social sciences) among our 14 PhD-granting schools and colleges. We anticipated that GRS students would offer valuable insights on PhD Progression, allowing us to track and monitor the program's effectiveness across diverse academic backgrounds and career interests.

GRS students participated in this study either through self-nomination or by nomination from their program. Throughout the recruitment process, we made intentional efforts to recruit participants at different stages of their doctoral degree progress. This approach was undertaken to facilitate a comprehensive assessment of L1 learning pathways' applicability and effectiveness at different phases of the students' PhD journey. We also actively sought the participation of male and racial minority PhD students from the GRS, hoping to align our sample with the PhD population demographics at the GRS and nationwide.

In total, 53 GRS PhD students agreed to participate in our study, 50 completed at least one pathway and 45 completed the pilot evaluation survey after the completion of the pilot program. Each participant received $500 for their participation in the pilot study. Despite our efforts and the voluntary nature of participation, we acknowledge that our student sample in this pilot study is not fully representative of our PhD student population (Table 1). Future studies could expand the pool of participants to include PhD students from other schools and colleges, both within and outside our institution. This expansion, coupled with the inclusion of additional student characteristics (e.g. socioeconomic status and first-generation college student status), could further enhance the generalizability of the findings.

Data collection
Our pilot study took place in three phases.

During Phase 1 (May 2021), we hosted two meetings to evaluate students' prior knowledge of digital-badging-tied programs, as well as their needs and expectations from attending the pilot study (Appendix 2). Twenty out of 53 participants self-selected to attend

Participant type	Gender		Race		Discipline		Year in PhD	
	Female	Male	White	Non-White	STEM	Non-STEM	1–4	4+
GRS PhD students who agreed to participate in our study ($n = 53$)	43 (81.1%)	10 (18.9%)	24 (45.3%)	29 (54.7%)	21 (39.6%)	32 (60.4%)	36 (67.9%)	17 (32.1%)
GRS PhD students who completed at least one pathway during our study ($n = 50$)	41 (82%)	9 (18%)	23 (46%)	27 (54%)	20 (40%)	30 (60%)	34 (68%)	16 (32%)
GRS PhD students who completed our pilot evaluation survey ($n = 45$)	38 (84.4%)	7 (15.6%)	26 (57.8%)	19 (42.2%)	20 (44.4%)	25 (55.6%)	29 (64.4%)	16 (35.6%)
All PhD students within our institution ($n = 2,376$ for gender, discipline and year in PhD; $n = 1,324$ for race*)	1153 (48.5%)	1223 (51.5%)	972 (73.4%)	352 (26.6%)	1813 (76.3%)	563 (23.7%)	1755 (73.9%)	621 (26.1%)
Research doctorate recipients in the USA in 2021 ($n = 52,250$ for gender and discipline; $n = 31,674$ for race*) (National Center for Science and Engineering Statistics, 2022)	24,156 (46.2%)	28,082 (53.8%)	21,333 (67.4%)	10,341 (32.6%)	41,356 (79.2%)	10,894 (20.8%)	n/a	n/a

Notes: Race data is based on self-reported information. Some students opted not to disclose this information
Source: Created by the authors

Table 1.
Participant characteristics in comparison with institutional and national PhD populations

these meetings, with 9–11 students per group. Each meeting lasted approximately 90 min, and we made sure to answer all the students' questions about how to navigate the platform.

During Phase 2 (May–August 2021), our participants engaged with the L1 learning pathways. Students were asked to each complete at least two pathways. They had the flexibility to select any of the 7 L1 learning pathways available, based on their career interests and needs. The badging platform tracked the number of badges earned by each student, visible in each individual's "backpack," and collected data on the most awarded badges (Appendix 3) as well as those shared on social media such as LinkedIn.

During Phase 3 (September 2021), participants completed a program evaluation survey via Qualtrics (Evaluation Survey) and focus group interviews (Appendix 2). The survey primarily aimed to collect data on students' motivation and perceived usefulness of the L1 learning pathways. Out of the 53 participants, 45 completed this evaluation survey and self-selected to participate in post-pilot focus group interviews. We ran four 90-min focus group interviews, with 9–14 students per group. Students were given the opportunity to elaborate on their motivation and perceived usefulness of the L1 learning pathways during these interviews. We also collected their thoughts and feedback on various aspects of PhD Progression. All interviews were audio-recorded via Zoom, transcribed for data analysis and the transcripts deidentified.

Evaluation survey
To measure students' motivation toward the L1 learning pathways, we adapted the Instructional Materials Motivation Survey instrument (Keller, 2010; Huang and Hew, 2016) to our study. This instrument uses four subscales:

(1) Attention (using various tactics in module design to capture and maintain learners' attention – 12 questions);

(2) Relevance (ensuring that the module contents align with learners' past experiences, academic requirements and future career goals – 9 questions);

(3) Confidence (establishing an online learning environment that aids learners in developing a positive attitude and expectations for success – 8 questions); and

(4) Satisfaction (whether the modules contribute to learners' sense of accomplishment and overall satisfaction – 5 questions).

To measure students' perceived usefulness of the L1 learning pathways (as defined by Davis, 1989), we leveraged our experience with PhD students and consulted Graduate Education staff at our institution. We thus collaboratively developed six questions to assess whether the program met students' expectations, allowed them to learn new knowledge and skills and how applicable the skills learned would be to their current and future career stages.

Furthermore, because we offered students monetary compensation for their participation, we included one question to assess how retribution influenced their motivation. We also included one question to assess students' perceived importance of receiving a digital badge. All these 42 questions were measured on a five-point Likert scale, with 1 meaning "strongly disagree" and 5 "strongly agree."

Data analysis
We began data analysis immediately after completing data collection. We conducted a descriptive analysis of the data collected in Phase 2, by calculating the mean, minimum and maximum number of modules and badges earned by students (Table 2) and tracking the most awarded badges (Appendix 3). We then used SPSS29 to analyze the quantitative data collected during Phase 3. Specifically, we examined whether students' engagement, motivation and

Participant characteristic	No. of pathways completed			No. of modules completed				No. of badge awarded			
	One	Two	Three	Min	Max	Total	Mean	Min	Max	Total	Mean
By gender											
Female (*n* = 41)	2	39	0	6	22	665	16	6	26	757	18
Male (*n* = 9)	2	6	1	7	26	134	15	8	31	153	17
By race											
White (*n* = 27)	2	24	1	7	26	432	16	8	31	493	18
Non-White (*n* = 23)	2	21	0	6	22	367	16	6	26	417	18
By major											
STEM (*n* = 20)	1	19	0	6	22	317	16	6	26	359	18
Non-STEM (*n* = 30)	3	26	1	6	26	482	16	6	31	551	18
By year in PhD											
Years 1–4 (*n* = 34)	2	32	0	7	22	533	16	8	26	603	18
Year 4+ (*n* = 16)	2	13	1	6	26	266	17	6	31	307	19

Table 2.
Student engagement
in L1 learning
pathways (*n* = 50)

Source: Created by the authors

perceived usefulness of the L1 learning pathways differed by their gender, race, major and year in their PhD program through independent *t*-tests. We also ran a path analysis to examine how students' motivation, perceived importance of a digital badge and monetary compensation affected their perceived usefulness of the L1 learning pathways.

We also analyzed the qualitative data collected during Phase 3. After deidentifying the Zoom focus group interview transcripts, we imported them all into NVivo 12 and read through them multiple times. Our qualitative data analysis was driven by the data itself, where we used key terms or phrases that emerged from the transcripts. We applied open coding (Merriam and Tisdell, 2015) to any data unit reflecting students' motivation, feedback and the perceived usefulness of the L1 learning pathways. For instance, we assigned the open code "L1 modules can be irrelevant for late-stage PhD students" to comments made by a late-stage PhD student who described the L1 modules as "very basic to be honest" and expressed a desire for more in-depth material. Upon reviewing all the open codes, we assigned axial coding (Merriam and Tisdell, 2015) to categorize these codes into broader themes. For example, we aggregated related open codes such as "L1 modules can be irrelevant for late-stage PhD students," "Need more information about the time needed to complete modules" and "Provide a variety of resource types." These were then synthesized into a larger theme, for which we assigned the axial code "Constructive feedback on the L1 learning pathways." We coded the data separately and then compared our codes as a team. Four major themes were identified from the interview transcripts, which included "motivation," "the importance of gaining a digital badge," "the perceived usefulness of the program" and "constructive feedback on the L1 learning pathways." The triangulation of multiple data sources and the careful peer examination of our coding enhanced the trustworthiness of our study (Merriam and Tisdell, 2015; Nowell *et al.*, 2017; Table 4).

Results
Evaluating student engagement
Among the 50 participants who completed at least one pathway, the range of modules completed varied from a minimum of 6 or 7 to a maximum of 22 or 26 (Table 2). On average, each student completed 16 modules and earned 18 badges (this difference in counts is because of some badges being earned for completing modules, and others being

automatically awarded for reaching milestones, such as completing part of or a whole pathway). In total, 50 participants completed 799 modules and earned 910 badges, demonstrating adequate engagement with the L1 learning pathways. Furthermore, 46 participants fulfilled the minimum study requirement by completing at least 2 pathways.

In terms of the students' motivation, our analyses showed no significant differences based on gender, race, major and year of PhD. Likewise, there was no significant difference in students' perceived usefulness of the L1 learning pathways by gender, race, major and year of PhD (Table 3) [4].

Student motivation and perceived usefulness of the L1 learning pathways
To examine how monetary compensation, students' perceived importance of digital badges and motivation would affect their perceived usefulness of the L1 learning pathways, we ran a path analysis (Figure 2A). In this full model, we ran two multiple regressions: with motivation as the criterion, and monetary compensation and importance of digital badges as the predictors, and with perceived usefulness of L1 learning pathways as the criterion, and monetary compensation, motivation and importance of digital badges as the predictors. As the results showed, students' motivation significantly influenced their perceived usefulness of L1 learning pathways ($p < 0.001$). While both monetary compensation ($p = 0.452$) and the importance of digital badges ($p = 0.232$) had no direct significant influence on the perceived usefulness of L1 learning pathways, the results suggested that they may indirectly affect students' perceived usefulness through motivation.

We then created a reduced model (Figure 2B), by removing the two non-significant paths and re-running the regressions. The reduced model fit the data as well as the full model ($F = 1.063$, df $= 2$, $p = 0.355$), and suggested that students' motivation has a direct and significant effect on their perceived usefulness of L1 learning pathways. In sum, the path analysis suggests both monetary compensation and the importance of digital badges have a direct and significant effect on students' motivation, with digital badges having a more important impact ($\beta = 0.397$) than monetary compensation ($\beta = 0.359$).

Focus group interview findings
Focus group interviews enabled us to collect qualitative data that complements the quantitative data presented above. Participants shared both positive and constructive feedback on the pilot version of PhD Progression. Themes elicited from the interview transcripts were respectively categorized into four categories:

(1) motivation;
(2) the importance of gaining a digital badge;
(3) the perceived usefulness of the program; and
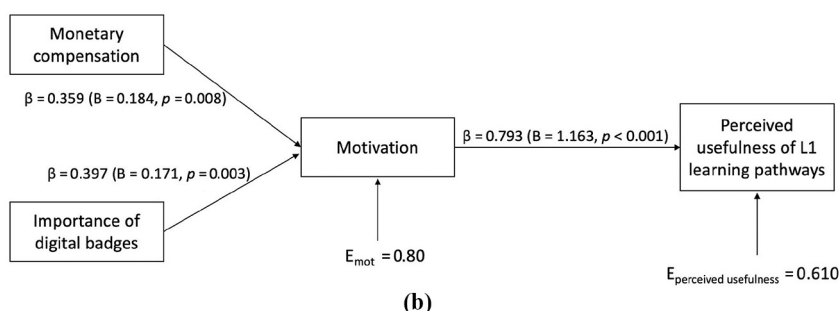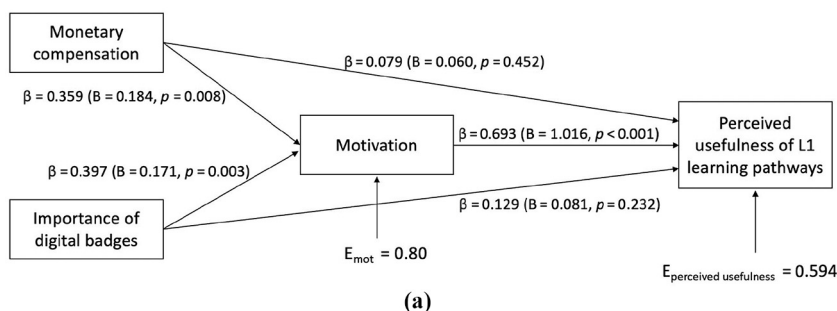(4) constructive feedback on the L1 learning pathways (Table 4).

In alignment with the quantitative data presented above, the qualitative data showed that participants were motivated to complete learning modules because they received digital badges and monetary compensation. Interestingly, love of learning new things also surfaced as a key motivator, sometimes above monetary compensation (Table 4). This love of learning new skills and tools supporting PhD degree progress and professional development seemed to drive the perceived usefulness of the program. Gaining badges was rewarding for some students, helped them broaden their skill vocabulary and boosted their confidence in communicating about their skills.

Participants also provided constructive feedback about the program (Tables 4 and 5). Most of this feedback focused on the program structure and contents, as well as some technical considerations. Some participants mentioned that some of the training modules

Participant characteristic	Motivation				Usefulness of L1 learning pathways			
	Min	Max	Mean (sd)	Independent t-test	Min	Max	Mean (sd)	Independent t-test
By gender								
Female (n = 38)	2.94	4.68	3.96 (0.51)	$t = -1.172$, df $= 43$, $p = 0.248$	2	5	3.96 (0.75)	$t = -1.265$, df $= 43$, $p = 0.213$
Male (n = 7)	3.59	4.62	4.20 (0.34)		3.67	5	4.33 (0.47)	
By race								
White (n = 26)	2.94	4.62	3.88 (0.53)	$t = -1.980$, df $= 43$, $p = 0.054$	2	5	3.85 (0.80)	$t = -1.932$, df $= 43$, $p = 0.06$
Non-White (n = 19)	3.29	4.68	4.16 (0.40)		3.17	5	4.25 (0.53)	
By major								
STEM (n = 20)	2.97	4.68	4.13 (0.44)	$t = 1.594$, df $= 43$, $p = 0.118$	2.17	5	4.20 (0.72)	$t = 1.532$, df $= 43$, $p = 0.133$
Non-STEM (n = 25)	2.94	4.56	3.90 (0.52)		2	5	3.87 (0.71)	
By year in PhD								
Years 1–4 (n = 29)	2.94	4.68	4.06 (0.51)	$t = 1.119$, df $= 43$, $p = 0.269$	2.17	5	4.07 (0.67)	$t = 0.699$, df $= 43$, $p = 0.488$
Year 4+ (n = 16)	3.06	4.62	3.89 (0.44)		2	5	3.92 (0.83)	

Source: Created by the authors

Table 3.
Students' motivation and perceived usefulness of the L1 learning pathways by gender, race, major and year in PhD (n $\ge$ 45)

Notes: (a) Path Analysis Full Model; (b) path Analysis Reduced Model, resulting
from removing the non-significant paths from the full model
Source: Created by authors

Figure 2.
Students' motivation,
fueled by monetary
compensation and
even more by digital
badges, has a direct
impact on the
perceived usefulness
of L1 learning
pathways

were a collection of resources and that they would prefer these resources better organized, or
shared in workshops; in the same vein, others asked for the program resources to appeal to
different learning styles by balancing videos and readings. Others shared that they would
like the institution's resources to be given priority in the program, as a way to explore and
get to know them better. Some, already toward the end of their PhD studies, found the
content of some modules too basic and were looking forward to the next levels of learning,
as well as clear connections between the different levels of learning and concrete ways to
apply the skills learned with the modules. Finally, some students asked for more
opportunities to connect with other program participants via learning communities and
buddy groups, to support each other and work collaboratively on projects. We have
addressed most of these pieces of feedback since the end of the pilot study (Table 5).

Discussion
Competency-based curricula are becoming more and more popular across fields because
they allow educational systems to adapt swiftly to the changing needs of the workforce
(Ferguson *et al.*, 2017). This approach is especially relevant in the context of PhD programs,
which must prepare all students for successful careers in a wide range of sectors (Mumba
et al., 2023). In this study, we presented the design and evaluation of the first level of
learning of an online competency-based professional development program, PhD
Progression.

Themes	Subthemes	Representative comments
Motivation	Digital badges and the progress-tracking platform motivate learners to keep going	*I also liked getting the badges like everyone else. I thought it was exciting but also it would tell you the percentage of the way through the platform you were on. . . . It was very motivating to see the percentage as you got closer to a hundred*
	Getting a monetary compensation is partially motivating	*I was definitely motivated by the money. . . . At the same time, . . . I kept going through modules to see if maybe they would get to something that I didn't have in my tool belt already. So that was just something that motivated me*
	Learning new things is motivating	*Personally, my motivation wasn't the money just because I wanted to learn these things*
	The self-paced nature of the program is attractive	*One thing that I liked about it is not having the pressure to do things. I have so much pressure in so many other things that I have to complete. . . . And that is what draws me to it*
Importance of gaining a digital badge	Earning a digital badge feels rewarding	*I think it's very smart that you use the word badge. I just think from a psychological perspective it's motivating and this idea of 'oh this is something special that I have that no one else has'. And I can put it on my resume which is motivating as well*
	Digital badges support skill communication	*I have noticed that more and more people are putting their skills [on LinkedIn] and they want people to endorse them. This is a way of proving that you've put in the work. I see it as a positive because sometimes there's one little thing that's gonna make you stand out versus another applicant*
Perceived usefulness of the program	Gaining management skills that support PhD degree progress	*The time management and the stress management badge[s] specifically, I think those would be super helpful in helping me manage my PhD and getting me through. I've already started applying some of those techniques and they're super helpful*
	Increased knowledge of tools and techniques that support PhD activities	*I'm [about] to start my dissertation and my research. It was really great to know about the different platforms that I could use in order to just organize my data and . . . my presentations. I think that really helped and I'll definitely be using [them], especially the [on-campus] resources I did not know about*
	Gaining and honing specific skills (e.g. teaching)	*. . . understanding how students learn, particularly young adults that are right out of high school, was really, really useful. It's just made me more aware of different learning styles and . . . ways to participate . . . . I think my students are having a much better experience than if I hadn't become aware of [these]*
	Improving one's ability to communicate about their skills	*After completing this program, I could say that what I learned actually helped to use my skills, . . . present my skills . . . in a useful and productive way . . . . So I really appreciate learning this language in learning how to actually value my own capacity*
	Intentionally planning one's career	*. . . having opportunities to really spend time engaging with the individual development plan this summer was helpful. And now I've built in time every semester to continue to go back and revise that based on the skills that I learned through this program*

(*continued*)

Table 4.
Themes and subthemes used for qualitative data analysis

Themes	Subthemes	Representative comments
Constructive feedback on the L1 learning pathways	L1 modules can be irrelevant for late-stage PhD students	*With regard to the management one, I was excited about it but then when I was going through it, I found it very basic to be honest. The concepts that I was reading about were more on the superficial level rather than going into depth*
	Need more information about the time needed to complete modules	*. . . when people in the future are completing these pathways on their own time, they might want to roughly know how long it might take them to complete a pathway. I know that's probably why you asked us at the end to give some feedback on how long it took us*
	Provide a variety of resource types	*I think it would be great if in every module there was a balance between stuff you read and stuff you do. Because what I noticed is that some modules have a lot of articles. You just keep reading and reading and reading. . .*
	Need to better connect knowledge and practical activities	*I started the communication pathway and then I changed my mind, and I stopped doing it but I thought, "how am I going to practice communication if I cannot really actually go and give a presentation or a talk?" It's a little difficult*

Source: Created by the authors

Table 4.

Our study participants found the contents of the L1 modules useful, appropriate for building skills and knowledge and therefore relevant for their degree progress and their future jobs. Most of the pilot study participants found the platforms chosen to host the program to be user-friendly and helpful in monitoring their progress. The results of our pilot program study also show that integrating professional development within a digital badge-awarding system is an effective way to support PhD students' skills-based learning. This aligns with the literature on digital badges, which demonstrates that they are a meaningful and appreciated way to reward learning and learner performance, as long as they account for learner motivation and promote goal setting (Carey and Stefaniak, 2018; Coleman, 2018; Park and Kim, 2019).

Some participants also highlighted that badges were a way to communicate about their achievements and served as a source of motivation to complete modules and gain skills, in accordance with studies conducted in other populations (Dyjur and Lindstrom, 2017; Gish-Lieberman *et al.*, 2021; Glover and Latif, 2013). Furthermore, because digital badges contain metadata about the learning materials, activities and assessments, they constitute a verifiable way for students to communicate their skills with potential employers. As digital badges are increasingly perceived by employers as proof of active efforts to round out one's skill set (Casilli and Hickey, 2016; Gallagher, 2018), this type of program could be used or developed by similar PhD Professional Development offices in US institutions and beyond as an effective tool for disseminating career development and skill-building content for PhD students.

Considerations for other institutions
Conducting a pilot study for our program allowed us to identify key success factors: the availability of asynchronous, self-paced training modules to enable PhD students to gain skills in a range of areas relevant to their degree progress and their personal and professional growth; a diversity of content and delivery modes appealing to various learning styles (training modules, workshops, learning communities); the selection of a learning

Constructive feedback subthemes	Representative comments	Changes made to PhD Progression to address the feedback
L1 modules can be irrelevant for late-stage PhD students	With regard to the management one, I was excited about it but then when I was going through it, I found it very basic to be honest. The concepts that I was reading about were more on the superficial level rather than going into depth	Since the end of the pilot study, we have created 115 additional online training modules at levels of learning L2 and L3, most of which are relevant for later-stage PhD students. We also created a timeline to highlight relevant modules for key stages of the US PhD training
Need more information about the time needed to complete modules	… when people in the future are completing these pathways on their own time, they might want to roughly know how long it might take them to complete a pathway…	In module completion surveys, we kept asking PhD students to share the time it took them to complete each module. We use this data to share an average completion time for each module once at least 50 people have completed it
Provide a variety of resource types	I think it would be great if in every module there was a balance between stuff you read and stuff you do. Because what I noticed is that some modules have a lot of articles. You just keep reading and reading and reading…	We incorporated that feedback while building L2 and L3 training modules, which each provides PhD students with a balance of institutional and external resources that can be read, watched, or listened to. We followed UDL guidelines to make these resources accessible to all
Need to better connect knowledge and practical activities	I started the communication pathway and then I changed my mind, and I stopped doing it but I thought, "how am I going to practice communication if I can't really actually go and give a presentation or a talk?" It's a little difficult	Whenever possible, we included short quizzes, conversation scenarios, and sorting games in training modules, to help students assess their level of understanding. We also included activities to be completed and submitted in the module completion survey in L2 and L3 modules, which focus on skill application

Source: Created by the authors

Table 5.
Changes made to PhD Progression to address study participants' constructive feedback

platform that allowed students to monitor their progress; communication about the university's resources that students can later use during their PhD; and gaining badges to reward learners for investing time in their professional development.

Reaching these key success factors was possible, however, because we had significant resources, more specifically staff effort and funding. We nevertheless think this type of resource is scalable to other institutions. Open badging systems such as Canvas Credentials allow individual institutions to create and issue badges for free. Career and professional development offices that cannot dedicate staff members to creating and launching such a program could start issuing badges for the programming they already offer, e.g. through in-person and/or virtual workshops, thus providing students with a tool to track and share their achievements and their institution with a mechanism for acknowledging the work done to support students in building professional skills. We are also open to collaborating with other institutions and allowing their PhD students to access PhD Progression content for their institutional badges.

Future directions

Besides accounting for student feedback, we have also been further developing our training program, by building badges for the second and third levels of learning (115 new badges were created, and 876 PhD students across fields have enrolled in PhD Progression since the end of the pilot study).

Another area for future expansion is to couple this online training program with Lightcast Skillsmatch, a skill assessment and job matching tool that allows individuals to make an inventory of the skills they have and the ones they wish to develop. The tool then matches this inventory with career areas and can be linked to training opportunities for users to further develop their skills and increase their marketability. Combining this tool with a professional development program like ours provides PhD students with an opportunity to evaluate their skillset, explore job opportunities and access ways to strategically round out their skill set, thus strengthening their career preparedness.

Conclusion

PhD degree recipients increasingly pursue a variety of career paths outside of academia. However, academic requirements and milestones, such as completing coursework or submitting a thesis manuscript, rarely showcase the vast range of technical and professional skills they have acquired during their PhD. In this paper, we present the design and evaluation of an online professional development training program created to support PhD students in a US education and research context in developing and communicating about their skills. This program offers self-paced modules to allow students to strengthen their skills in seven core capacities:

(1) Research;

(2) Teaching;

(3) Communication;

(4) Self-awareness;

(5) Management and leadership;

(6) Discipline-specific knowledge; and

(7) Career development.

It is also tied to a digital badging system, such that trainees earn a badge for each module completed. The results of a pilot study conducted to evaluate this program indicate that most participants found the content and format of the program helpful and useful for both their degree progress and preparation for their future jobs. They also indicated that gaining digital badges gave them a sense of accomplishment for the time and effort put into building skills and was a source of motivation to further invest in their professional development. We therefore conclude that this type of program could be implemented by other Professional Development offices as an effective tool for disseminating content and creating training opportunities for PhD students in the US and beyond.

Notes

1. www.upstate.edu/grad/curriculum/core-competencies.php

2. https://careerwell.unc.edu/professional-development-guide-2/core-competency-framework/

3. https://grad.berkeley.edu/professional-development/guide/

4. Our statistical analyses were based on the responses from the 45 students who completed our program evaluation survey, through which we measured their motivation and perceived usefulness of the L1 learning pathways. We measured all statistical results at a 95% confidence level ($p \leq 0.05$).

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Further reading

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Appendix 1. PhD Progression pathways included in the pilot program
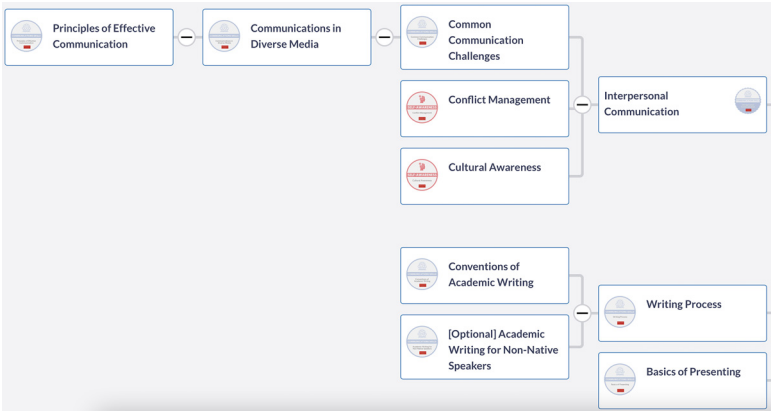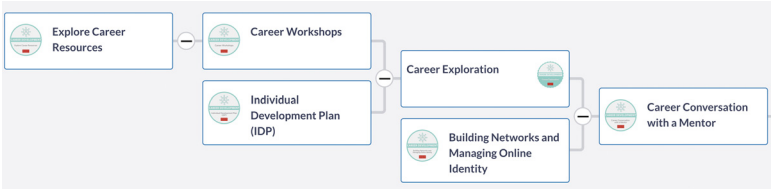

Figure A1.
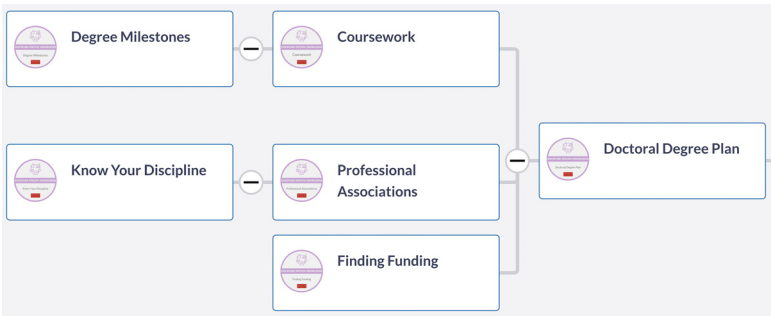Career development

Figure A2.
Communication

Figure A3.
Discipline-specific
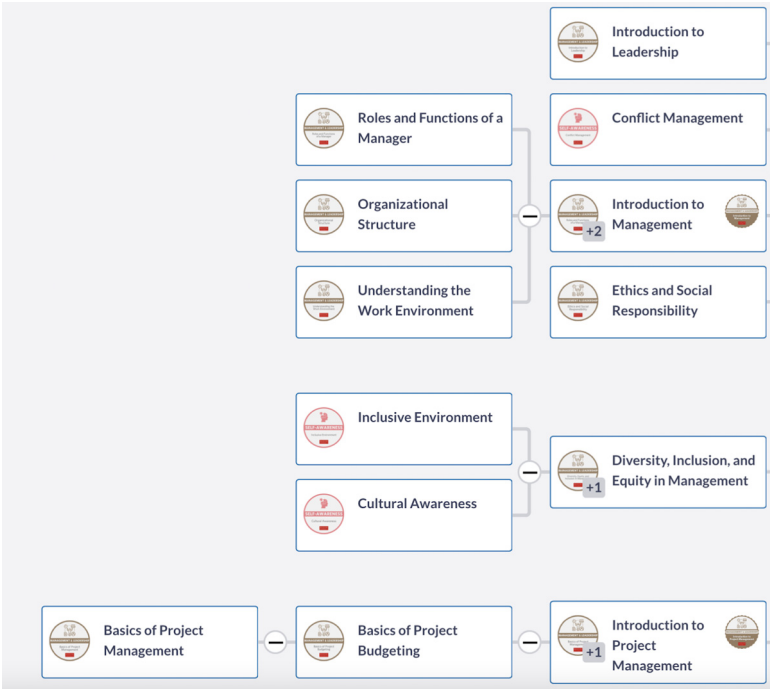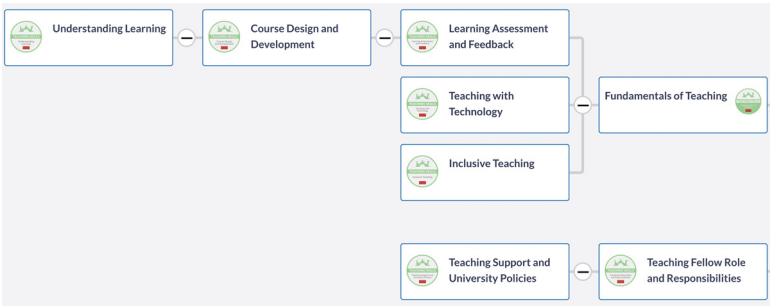knowledge
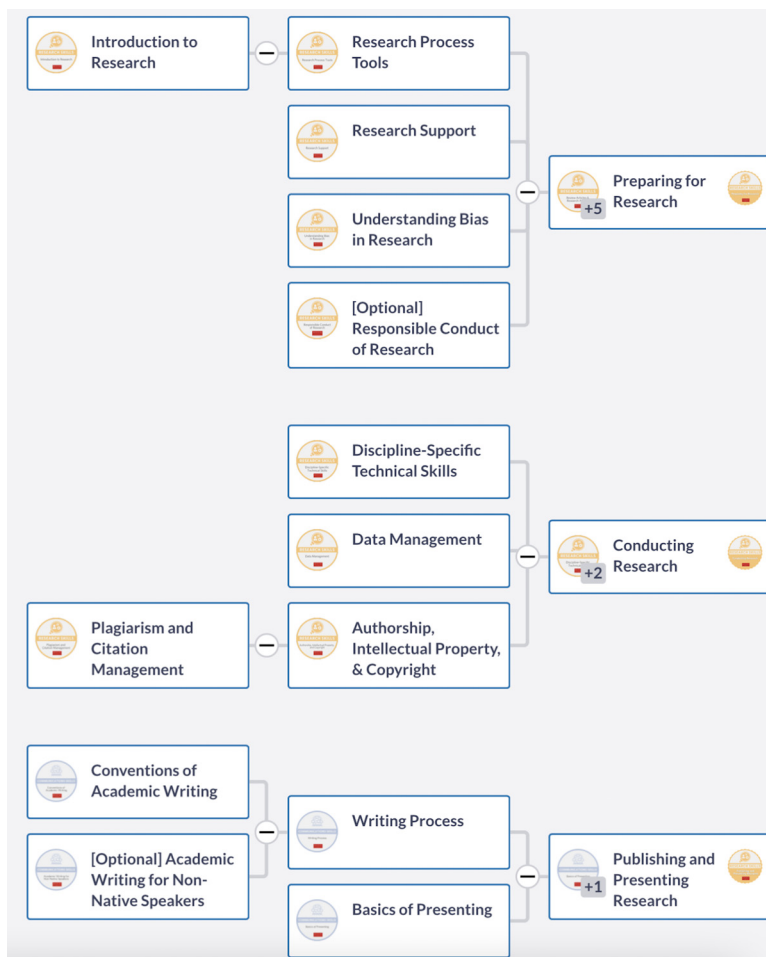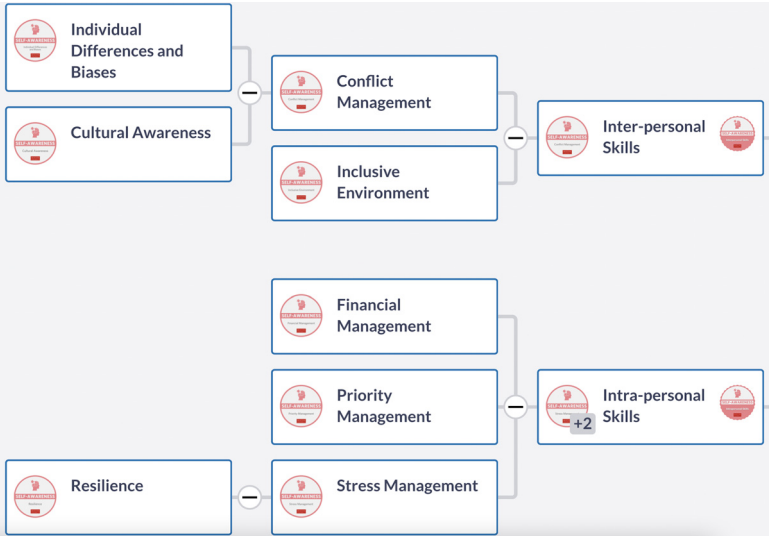
Figure A4.
Management and
Leadership

Figure A5.
Teaching

Source: Created by the authors

Appendix 2. Pre- and post-pilot focus group questions
Pre-pilot focus group questions are listed below:

- How did you learn about PhD Progression?
- What previous professional development opportunities have you taken advantage of at BU that are outside of your department? And, what professional development is offered by your department that you have taken advantage of or not but that you've heard of?
- What type of career development or professional development content would be helpful for you?
- How much do you know about the PhD Core Capacities? How much do you know about the different levels of the core capacities?
- Do you know what digital badging is? If so, does that have any influence on why you are participating in the summer pilot?
- Do you have any prior experience with micro-credentials or digital learning?
- What type of content or what type of activities do you expect to see on the platform?
- What type of assessment or product would you like to see?
- How might participating in the summer pilot help you achieve your career goals?

Post-pilot focus group questions are listed below:

- Which learning pathway(s) have you completed? How would you describe your experiences on the different pathways if you have completed more than one?
- How would you describe your experience with the content or activities on the platform? If they didn't meet your expectations, what else would you need to see in terms of content?
- How did the learning communities contribute to your learning experience?
- What about this program was most useful to you? If you could name one thing that was most useful to you, what would it be? Also, what about this program was the least useful to you?
- What is one thing that you would like to change to improve pathways and learning communities?
- How do you see yourself applying the strategies and skills you learned through the pathways?
- How would you describe your ability to assess the skills gained during the pathway? How are you able to apply those? How do you describe your ability to access your skills after being part of the program and completing the pathway?
- Do you think participating in the program at learning levels 2 and 3 will further help you achieve your career goals?
- Having access to learning pathways and being able to share and receive badges through the Canvas Credentials platform, how would you describe that as motivating you to complete the pathway?

Source: Created by the authors

Appendix 3

Badge list	N
Conflict Management	38
Cultural Awareness	37
Explore Career Resources	31
Principles of Effective Communication	31
Communications in Diverse Media	27
Career Workshops	26
Individual Development Plan (IDP)	25
Conventions of Academic Writing	24
Basics of Presenting	24
Common Communication Challenges	23
Writing Process	23
Understanding Learning	23
Building Networks and Managing Online Identity	22
Career Exploration	22
Individual Differences and Biases	22
Inclusive Environment	22
Career Conversation with a Mentor	21
Interpersonal Communication Skills	21
Course Design and Development	20
Career Development	20
Communication Skills	20
Interpersonal Skills	19
Resilience	19
Teaching with Technology	18
Inclusive Teaching	18
Learning Assessment and Feedback	18
Teaching Fellow Roles and Responsibilities	18
Teaching Support and University Policies	18
Fundamentals of Teaching	17
Teaching Skills	17
Financial Management	17
Priority Management	16
Stress Management	15
Intrapersonal Skills	15
Self-Awareness	15
Publishing and Presenting Research	14
Introduction to Research	14
Research Process Tools	14
Plagiarism and Citation Management	13
Research Support	12
Discipline-Specific Technical Skills	12
Understanding Bias in Research	11
Preparing for Research	11
Data Management	11
Roles and Functions of a Manager	10
Authorship, Intellectual Property and Copyright	10
Conducting Research	10
Basics of Project Budgeting	10
Research Skills	10
	(*continued*)

Table A1.
Number of badges awarded for each module in the pilot study

Badge list	N
Professional Associations	10
Degree Milestones	9
Coursework	9
Basics of Project Management	9
Understanding the Work Environment	9
Organizational Structure	9
Ethics and Social Responsibility	9
Doctoral Degree Plan	8
Know Your Discipline	8
Finding Funding	8
Introduction to Project Management	8
Introduction to Leadership	8
Diversity, Inclusion and Equity in Management	8
Management and Leadership	8
Introduction to Management	8
Discipline-Specific Knowledge	7

Source: Created by the authors

Table A1.

Corresponding author
Sasha B. Goldman can be contacted at: sbgold@bu.edu