Agile Approach to the Dissertation Process

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Abstract—**Collegiate students striving to earn their Doctorate degrees routinely would take between 4-10 years through conventional Doctorate programs that exist at hundreds of universities throughout the United States. Pace University implemented the Doctorate of Professional Studies (DPS) of Computing program in 2000, and has adopted the Agile Development Process for its doctorate program. The topics of graduate students' dissertations are an important focus point in the program and it's important to acknowledge the growth and diversity within the research topics as time has passed. Students have gone from business practices, patterns, computer science, and the internet as core research topics to artificial intelligence (AI), security, web services, and the Agile Development process. DPS students are earning the same research opportunities as conventional PhD students, but are completing their doctorate studies within an average of 3 years.**

I. INTRODUCTION

Pace University's Seidenberg School of Computer Science and Information Science uses an agile method to the dissertation procedure for their students in the Doctor of Professional Studies in Computing, or DPS, program. Research begins on day one and continues through the fifth semester. Idea papers, direct interaction with DPS professors, and an omnipresent dissertation notebook for annotating emerging thoughts are introduced in the first semester. That way, a path can be explored and abandoned if it doesn't yield a new and intriguing focus question. Selecting a dissertation thesis that sustains high interest is vital to a Doctoral candidate's successful completion.

A. Premises and Assumptions

The Pace University's DPS Program is designed to be completed in three years for any student. There is only one admission process per year. The admission process takes place before the start of the Fall semester of every academic year. Every DPS student starts the program in the Fall semester of their admittance year. A DPS student will officially graduate once he or she successfully presents, sustains, and defends a Research Dissertation. Dissertation defense can take place at any time during the program with approval from DPS faculty.

B. Hypothesis

Pace University's DPS program, using an agile approach, allows for students to earn their doctorate degrees within a shorter time frame in comparison with conventional doctorate programs.

II. LITERATURE REVIEW

The actual origins of the Doctoral Dissertation are obscure, but it is known that it originated within the Catholic Church during the medieval period. The first known doctoral defense was conducted in Paris in the year 1150 A.D. (Noble, 1994). These doctoral degrees focused on scriptural texts; students had to demonstrate their knowledge and mastery of canonical texts. This demonstration usually consisted of a combination of opponency, disputations, and lectures. Faculty would then critically attack an argument and the student had to defend his argument using his knowledge. The entire school would normally attend these "defenses" and use them as a valuable learning opportunity. The student defending their dissertation would also use the opportunity to gather prospective students once their dissertation was successful.

It was in 17th century Germany that the Doctoral Dissertation we are currently familiar with began to emerge. The educational system was loosely based on a type of apprentice to a guild formation. A student normally studied under a Master for a period of seven years before placing the knowledge they learned to the test, defending their abilities while being questioned or tested by Masters of that discipline. This also led to a movement away from the church and focused on scientific knowledge. The Germans created to Doctor of Philosophy using the original Greek meaning of the word philosophy, meaning Love of Wisdom. There also appeared, at this time, a division in the types of doctoral degrees.

With a shift to research-based education, doctoral programs led to two paths, the MD (Doctor of Medicine) and the Ph.D. (Doctor of Philosophy). The main difference between the two is that the MD degree revolved around the practice of applied knowledge. The Ph.D., however, revolved around the generation of knowledge.

The modern doctoral dissertation was modeled after the German model and first appeared in the United States at Kings College (now Columbia) in 1861. Being research-based, the Doctorate of Philosophy allowed for the mastery of a wide variety of subjects from literature and music to law and the sciences. There are now multiple doctoral degrees available in a variety of disciplines, each offering a student a chance to master. The requirements for a doctoral degree vary from country to country and discipline to discipline. In general, a candidate must present a dissertation or a thesis that consists of original academic research, that is worthy of publication in a peer-reviewed context and that they must defend their work before a panel of experts. This panel, selected by the university, will determine if the dissertation is passable and/or if there are any issues that must be addressed before the dissertation is accepted. (Dinham S. S., 2001)

A recent study of eight doctoral students who passed the research proposal review and volunteered to participate, shows the time it took to write-up and complete their theses. They used, and some were still using, a traditional process. (Lindsay, 2015) This group averaged approximately six years to complete their theses and viva voce examinations.

Table 1. Participant details.

| Name	Status	TTC	TTWU	Funded?	In employment during thesis write-up?
Jennifer	FT	4 years	9 months	Self-funded	No
Tom	FT	10 years	5 years	Self and department	Full-time employment for 5 years
Natasha	FT then PT	6 years	N/A as writing continuously	Self and department	Part-time employment for 6 years
Evan	FT	4 years	8 months	Self-funded	Part time employment for 3 years
Lilly	FT	4 years	8 months	Self-funded	Part time employment for 3 years
Samantha	PT	7 years[a]	2 years[a]	Self-funded	No
Sofia	FT then PT	7 years[a]	N/A as writing continuously[a]	Self-funded	No
Luke	PT	7 years	7 months	Self-funded	Part-time employment for 7 years

FT, full-time; PT, part-time; TTC, time to completion (from start of Ph.D. until *viva voce* examination); TTWU, time taken to write-up thesis; N/A, not applicable.
[a]Indicates still writing thesis during time of interview.

Chart Lindsay, Sian, *Teaching in Higher Education*. Feb2015, Vol. 20 Issue 2.

Attached is a workbook consolidating the latest available data. The assumption is made that since the DPS program is a three year program, then someone listed in the Class of 2003 who graduated in 2004 spent 4 years in the program. With this assumption in mind, the duration in the program for all graduates was calculated; a small pivot table along with a stacked column for durations by class has also been inputted. Certainly, more analysis is possible.

Sum of Count Class Of	0	3	4	5	6	7	8	9	10	11	13	15	Grand Total
2002	5	12	1	1	1								20
2003	8	2	1	2	2				1		1		17
2004	4	9	2						1				16
2005	5	8	4				1		1				19
2006	8	4			1	2			1				16
2007	8	3	1	3	1	1	1						18
2008	8	3	1	1	1	1				1			16
2009	10		4	2					2				18
2010	7	1	1			2	1						12
2011	8	2	3										13
2012	4	2	1	3	2								12
2013	9						5						14
2014	7		2	2									11
2015	10	1	5										16
2016	10	4											14
Grand Total	**111**	**51**	**24**	**16**	**14**	**4**	**3**	**1**	**5**	**1**	**1**	**1**	**232**
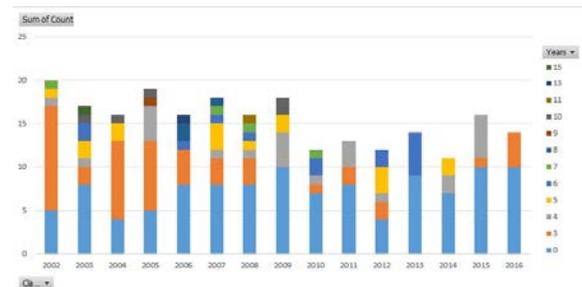
Pivot Table and Stacked Column Chart, Dan Evans, Pace DPS 2019

A. Analysis of Topics

We have analyzed Pace DPS data sets for DPS dissertations using the Pace University DPS Dissertations database at *https://vulcan.seidenberg.pace/edu/~f15-cs691-dps/dps/#/subjects* . This analysis was performed for topics the student dissertations were aligned with (in some cases one dissertation qualified for multiple topics at the same time) as well as IT

industry trends and patterns between 2002 and 2016. We have analyzed 15 topics, which are: Agile, AI, Computer Science, Computer Education, Mathematics, Natural Language Recognition, Network, Patterns, pervasive, Security, Statistical Methods, SW Development, Web-Internet, and Web Services.

1) First 5 years: 2002-2006

During the first 5 years of DPS dissertations, the research focus predominately pertained to Business, Computer Science, Patterns, and the Web/Internet. These 4 areas consolidated practically 25 dissertations (around 20%) within the first 5 years. Intense creativity characterizes this period, as represented on the creativity index chart #2. The impact of these 4 areas diminished substantially over the next 10 years, but interestingly all 4 areas of study persisted with about 5% of total research topic interest. After the initial five years, the doctorate students continue to diversify their research into new IT areas.
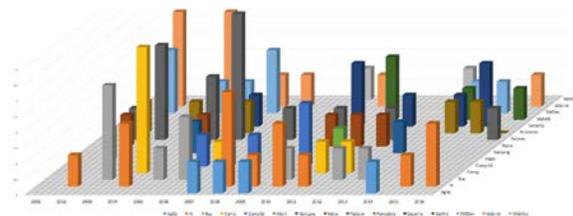

Chart #1 by Istvan Barbasi, Pace DPS 2019

2) Second period of 5 years: 2007-2011

Although somewhat present very early in 2002, Artificial Intelligence emerged very strong within the second period of 5 years, scoring a 5% share of total interest for this period. After 2011 a sudden interest in AI stopped and substantial number of dissertations focused on IT Infrastructure and Cloud Computing areas. A reason for the decline in AI focused research might be the fact that machine learning dissertations require more time and effort to create. A considerate amount of mathematical background is essential to success with AI research. Familiarity with models and its implementation, as well as access to the data are critical elements that are not commonplace for doctorate students and played a role in the disinterest of AI for students.

Agile topics are mainly present within this period. Total share of agile topics is only about 3%, which is unusually low. Activities in many areas can be performed in agile style and iteratively, including traditional areas such as supply chain management and operations as well. In the first help of this five-year period the creativity index suffered a substantial drop and was somewhat compensated by

dissertations with Agile topic. Seems that the DPS program needed to refocus on agile methods and practices to help drive an immediate up-peak in creativity for 2010.   This behavior actually re-occurred again later during the 2013-2014 period, showing that improving agile practices will drive subsequent positive impact and renewed creativity in delivering agile dissertations at Pace DPS.
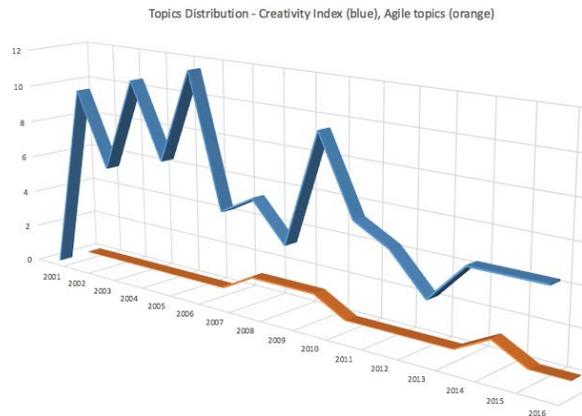

Chart #2 by Istvan Barbasi, Pace DPS 2019

A new dissertation topic emerged during this period, referred to as Computer Education (or Computer aided education), suddenly shifting away attention from Computer Science. The four main topic areas for this period were AI, Agile, Computer Education, and Patterns. It is also noted that these four main topics were less concentrated a versus we have seen earlier topics within the first period. At the end of this period we found AI being underpinned by strong presence of Statistical Methods and by one Math dissertation. It is important to note that Patterns continued maintain a strong presence from the earlier period, just at a smaller scale, like the mentioned drop in concentration.
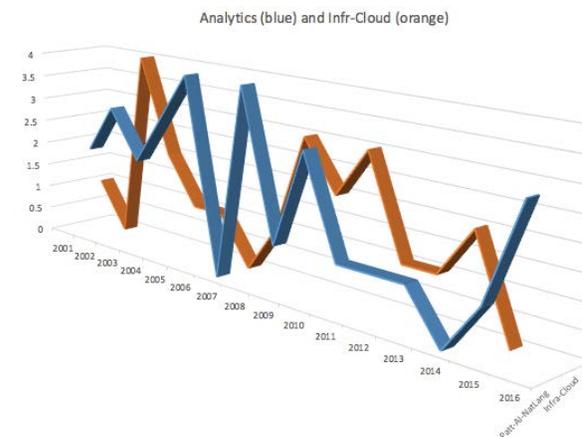

Chart #3 by Istvan Barbasi, Pace DPS 2019

Chart #3 shows another peak in 2012 for IT infrastructure and Cloud computing topics in alignment with the presence of network and security interest.

3) Third period of 5 years: 2012-2016

This period we see a strong and renewed interest towards AI and security. Together with AI, we found new Patterns dissertation as well, reinforcing the sudden uptick in Analytics related topics in 2016, as shown in Chart #3. Seems AI is correlated and is skewed extensively towards security. We found renewed focus for Software Development, Web Services, and Agile Development Processes. It also appears that web services evolution, such as micro services, was involved in all these three areas. We see renewed interest towards pervasive computing, statistical methods, and models. Seems these two topics have emerging elements with security, such as using pervasive methods for authentication and applying various models to analyze security data. We have to underline a medium only creativity index during this period, which represents a medium only velocity in agile delivery of the DPS dissertations. This is really stands in contrast to the very high creativity and velocity of DPS dissertations within the first 5-year period analyzed.
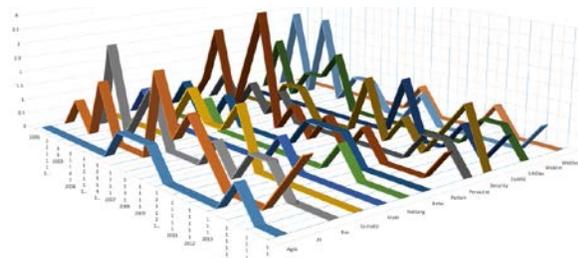

Chart #3 by Istvan Barbasi, Pace DPS 2019

Summarizing the last two-year dissertation topics, as shown in Chart #4, we can conclude strong presence of analytics (AI, Patterns, Statistics methods) together with Pervasive technology topics, somewhat high interest in security and medium only interest in Cloud Infrastructure, software development and Web.

Concluding the topics based analysis, we find that the Pace DPS Program must improve the velocity in getting DPS Dissertations finalized and promote new topics and areas of interest which have strong relationships with Analytics, Artificial Intelligence, next generation of Web/ Internet topics, including Social Computing, Security, and Pervasive computing (IoT and others).
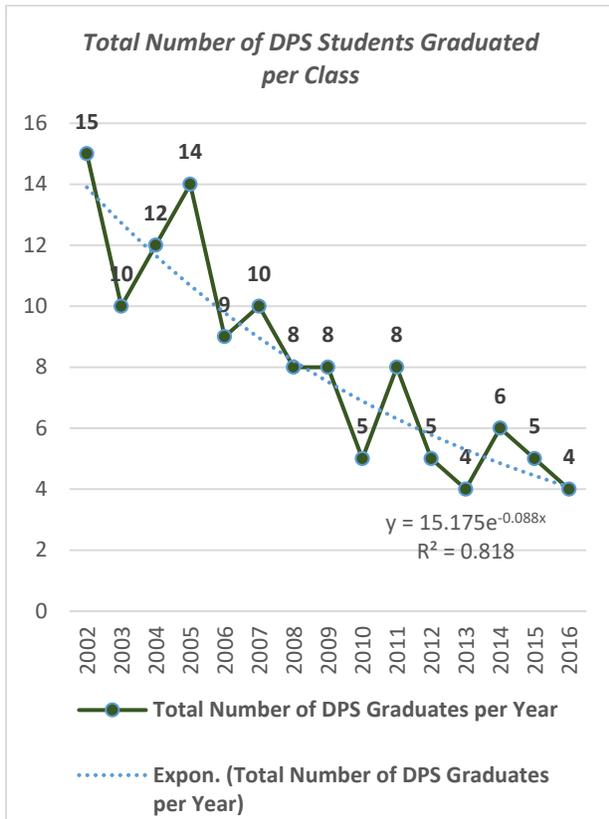
There have been 123 DPS students who graduated from the program during a 15-year time period (available data from Class 2002 to 2016). Based on the data available, the shortest tenure in the program was approximately of 930 days (roughly 2 Years, 6 Months, and 20 Days). Based on the data available, the longest tenure in the program was approximately of 5,477 days (roughly 15 Years, 0 Months, and 2 Days). We factored that some students completed their degree within 925 days annotated that as the lower range and 5,482 days as the higher range, and creating segments of 365 days in between. "Tenure in the Program" should be read as the time frame which began with the first day of classes in the program and the date when the Research Dissertation was defended successfully. The results follow.

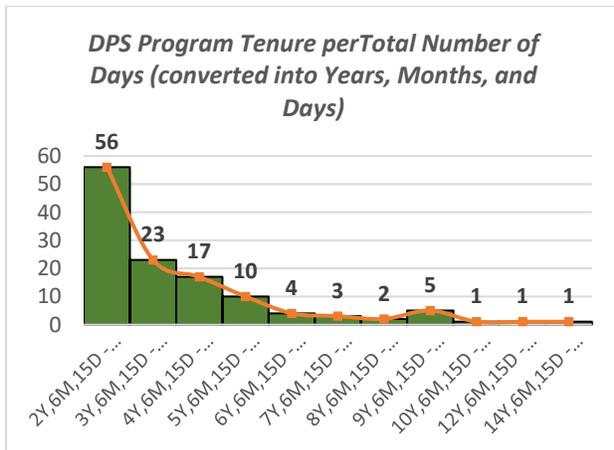| Tenure	Percentage	Students	
2Y,6M,15D - 3Y,6M,14D	45.53%	56	student(s) graduated
3Y,6M,15D - 4Y,6M,14D	18.70%	23	student(s) graduated
4Y,6M,15D - 5Y,6M,14D	13.82%	17	student(s) graduated
5Y,6M,15D - 6Y,6M,14D	8.13%	10	student(s) graduated
6Y,6M,15D - 7Y,6M,14D	3.25%	4	student(s) graduated
7Y,6M,15D - 8Y,6M,14D	2.44%	3	student(s) graduated
8Y,6M,15D - 9Y,6M,14D	1.63%	2	student(s) graduated
9Y,6M,15D - 10Y,6M,14D	4.07%	5	student(s) graduated
10Y,6M,15D - 11Y,6M,14D	0.81%	1	student(s) graduated
12Y,6M,15D - 13Y,6M,14D	0.81%	1	student(s) graduated
14Y,6M,15D - 15Y,6M,14D	0.81%	1	student(s) graduated
	100.00%	123	student(s) graduated

Chart by Hjalmar Delaude, Pace DPS 2019

39.02% (48 students) of the total graduated DPS students finished the program between 2 and 3 years. Based on the data available, the total number per Class of graduated DPS students is decreasing, as the following graph shows.
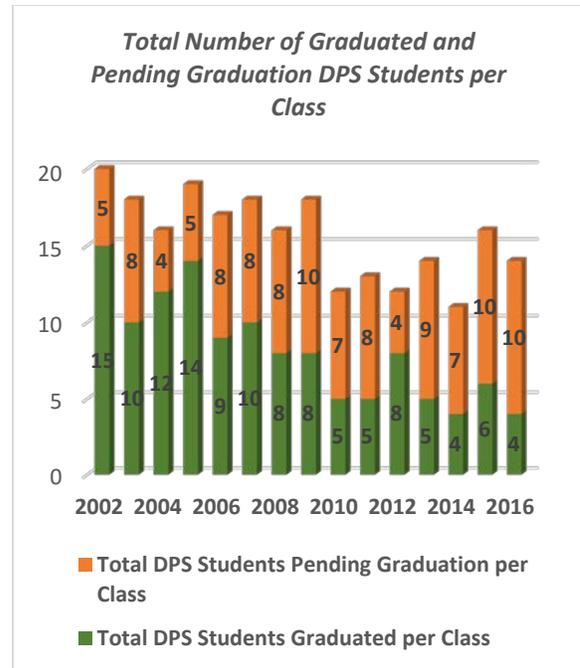
Total Number of DPS Students Graduated per Class

y = 15.175e$^{-0.088x}$
R² = 0.818

Legend:
— Total Number of DPS Graduates per Year
······ Expon. (Total Number of DPS Graduates per Year)

Based on the data available, the rate of students graduating in the DPS program has a general average of 51.14%

**DPS Program Tenure perTotal Number of Days (converted into Years, Months, and Days)**

Values: 56, 23, 17, 10, 4, 3, 2, 5, 1, 1, 1

Categories: 2Y,6M,15D --- ; 3Y,6M,15D --- ; 4Y,6M,15D --- ; 5Y,6M,15D --- ; 6Y,6M,15D --- ; 7Y,6M,15D --- ; 8Y,6M,15D --- ; 9Y,6M,15D --- ; 10Y,6M,15D --- ; 12Y,6M,15D --- ; 14Y,6M,15D ---

Total Number of Graduated and Pending Graduation DPS Students per Class

Legend:
■ Total DPS Students Pending Graduation per Class
■ Total DPS Students Graduated per Class

In a simple comparison between Pace DPS and Conventional PhD programs, the following can be determined (assuming both data are approximately from same period of time): Pace University DPS Program has its pick in the interval > 2 Years and <= 3 Years - Positively (right) skewed distribution. Other conventional PhD Programs have their pick in the interval >= 10 Years - Negatively (left) skewed distribution. The point of intersection is between 5 to 6 years tenure and 10% to 15% of total graduated students.

Comparison between Pace University DPS and Conventional PhD Programs - Program Completion Rates
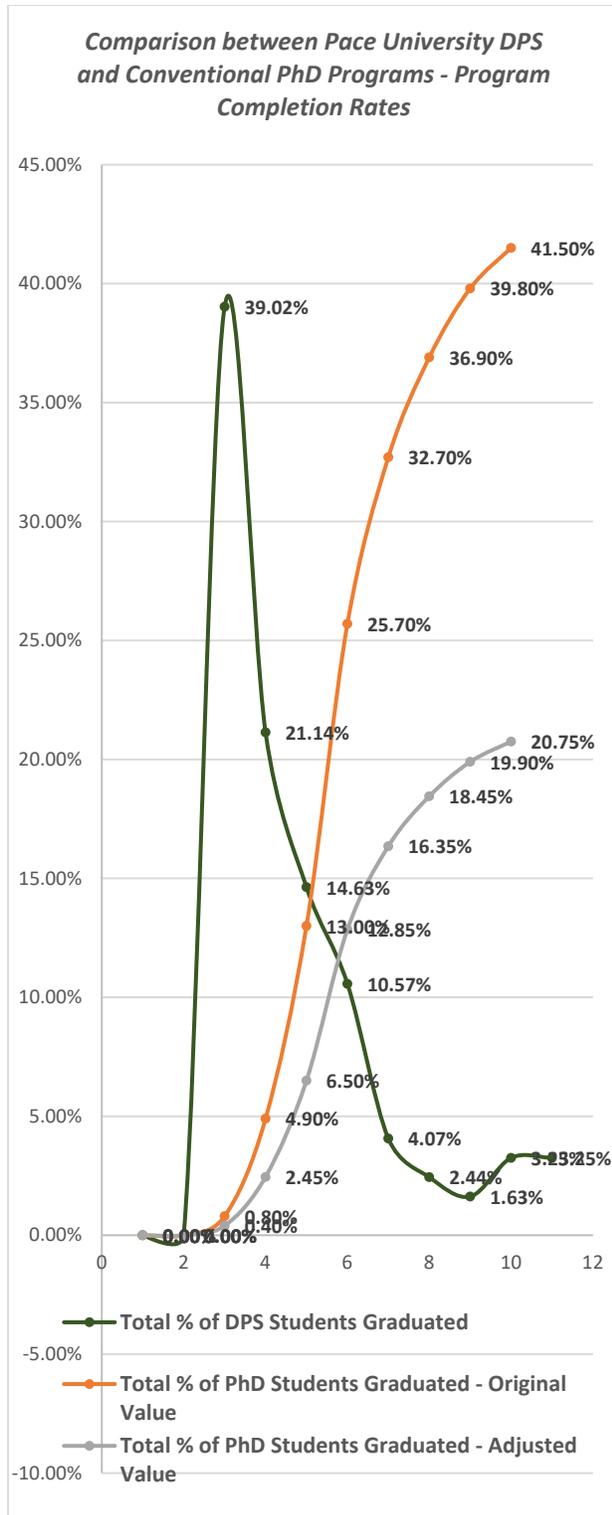
Graph by Hjalmar Delaude, Pace DPS 2019

The Agile Approach to doctorate studies implemented by Pace University has displayed over the last 15 years that graduate students can produce complex research studies and finish their doctorate within 3 years on average. The rigors of the program still exist which are solidified by the overall graduation rate of 51%. The student body is researching more diverse material every year. Future research pertaining to the matter could identify the diversity within conventional PhD programs in contrast with Pace DPS research topics. The DPS program is quite competitive and simply streamlines the entire doctorate program rather than extend the studies as is the case with conventional PhD programs.

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