

**The Education Technology Ecosystem at Penn State University
By Bart Pursel, Jimmy Xie and Cole Camplese**

The Schreyer Institute for Teaching Excellence
The Pennsylvania State University

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Introduction

Penn State is in a fortunate position to have a rich technology ecosystem for faculty, staff and students. Through partnerships with Apple, Moveable Type and other organizations, a wide variety of tools and platforms have been implemented to support institutional goals. To date, a limited amount of data has been reported on the usage of these tools and platforms. This document attempts to paint a deeper picture of how Penn State students and faculty leverage available technologies.

This report is, and will be for the foreseeable future, a work in progress. As more technologies are deployed, and as more faculty and students adopt various technologies, these numbers will inevitably change. Once the current data on the technology ecosystems are analyzed, this document will likely receive periodic updates.

The data in this report are generated from specific technology tools (for instance, the Moveable Type blog platform) joined with institutional data from Penn State's data warehouse, Enterprise Information System and Fact Book. The data warehouse, much like various software products, provides the user multiple methods for answering research questions and gathering specific data. In this report methodology sections are provided with details on how data was extracted from the data warehouse. Suggestions are always welcome (pursel@psu.edu) to help improve methodologies.

This report is a DRAFT. The next version of the report will include data from iTunesU (<http://itunes.psu.edu>) in addition to wikispaces and blog usage data. The iTunes data is currently being extracted and will then be analyzed and added to this report for release at a future date.

Structure of document

This document is structured into sections based on each platform. Each section begins with an executive summary, outlining the dataset, methodology, and major findings and interpretations. The bulk of each section is represented by tables and figures. Each section also contains a conclusion, outlining potential future directions for the research and other areas for exploration.

Should you have any questions, comments or ideas, please do not hesitate to email Bart Pursel (pursel@psu.edu). Also, do not hesitate to email Bart if you have ideas for collaboration around this project. The research team currently consists of members of the Schreyer Institute for Teaching Excellence and Education Technology Services.

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Wikispaces Executive Summary

Wikispaces (wikispaces.psu.edu) originates from Penn State's Emerging Technologies group, who began experimenting with wiki software in 2005-06. Originally, only ITS employees could access and utilize wikispaces, but others outside of ITS were slowly granted access to continue to test the software. On August 2, 2008, wikispaces became a service for anyone with a valid Penn State userID and password.

The College of Science ranks as the highest College in terms of student use of wikispaces. This is primarily due to the Biology Department. Faculty are using wikispaces in Biology to collaboratively author Biology 110, a core course for nearly all College of Science majors. Faculty from the College of Science and Liberal Arts represent the largest faculty users of wikispaces. The Psychology department appears to be investing heavily in wikispaces as an elearning platform for an online degree program that recently launched.

In terms of student activity (in the form of students making edits to wiki pages), the College of IST has the highest percentage of students making edits with just under 50%. The majority of students using wikispaces, approximately 85%, do not make any edits.

When examining faculty use of wikispaces, Professors, Associate Professors, and Assistant Professors represent nearly 50% of instructor wikispace usage. The College of IST has the largest percent of faculty with wikispaces accounts at 72%, followed by Liberal Arts (53.8%) and the College of Science (53.2%).

Three distinct pedagogies emerged when examining the data. The first is the use of wikispaces as an information dissemination platform, exemplified by the Biology 110 wikispace for course content. The second use of wikispaces is more for collaboration and knowledge generation, exemplified by IST's use where student teams leverage wikispaces to create inter-related research portals. The third use of wikispaces is for an elearning platform or online course hub, exemplified by Psychology. This use involves posting of syllabi, assignments, resources, and other course-centric materials within an instance of wikispaces for a course. This might be considered using wikispaces as an elearning design, development and implementation platform.

This report refers to "active wikispaces users". This simply refers to any PSU user that logged in at least once to wikispaces from 8/2/08 to 4/12/10, leaving a footprint in the system.

Methodology

The dataset analyzed from Wikispaces is somewhat small in comparison to the datasets from the blog and iTunes platforms. Special thanks to Chris Hubing of Emerging Technologies who provided a spreadsheet containing accessIDs in conjunction with number of edits per each access ID. We then linked this information to the datawarehouse, specifically the `dbo_uf_student_sem`, `dbo_uf_student_bio_all` and the `uf_instructor_bio` tables in the student database.

When identifying samples (two samples are presented in this report: instructors and students), only individuals with an active semester of summer 2008 through Fall 2009 were selected. The data export from wikispaces was received on 4/12/2010. GPA and semester-sensitive data from the spring 2010 semester was omitted because the semester was still in progress when data analysis began.

The following method was used to identify samples in this study. Users were identified as students if they have an active semester between summer 2008 and fall 2009¹. Users were identified as instructors if they taught courses in summer (session 2) 2008 or beyond. The leftover users were labeled as "other" category. The researchers do not have access to a general human resource table in the data warehouse to verify the classification of the cases that represent the 'other' classification. The assumption is that the majority of these users are staff or administrators based on no matches found in the instructor or student warehouse database tables.

In an attempt to provide context, the numbers found in the wikispaces dataset are compared to more general PSU data, such as College or campus populations. These comparisons are not 100% accurate because our sample spans four semesters while the PSU population numbers typically represent a single semester snapshot. This population data was extracted from the Penn State Fact Book and simply used to provide the reader a better context for the data.

When analyzing instructor data to tie to a College, several instructors did not have valid departments or home Colleges. Using the Penn State directory (<http://www.psu.edu/ph>), users were assigned a home college or administrative area based on the "administrative area" field returned from the directory.

Dataset

The total Wikispaces dataset, from 8/2/2009 to 4/12/2010, represents 14,187 unique users. The majority of users are students (n=7371), followed by 'other (staff)' (n=4993) and instructors (n=1439). A remaining 384 users show up in the database as both students and instructors, most likely representing graduate students. These users were counted as students in the analysis of students, and instructors when analyzing instructors.

NOTE: we could not verify the 'other (staff)' userIDs due to not having access to those tables in the data warehouse. We assume, after verifying both student and instructor access IDs, the remainder are staff. We also noticed some 'test' accounts in the dataset that do not resemble the format of a Penn State userID, but these were very limited (<10).

The breakdown of wikispaces active users gives the impression that wikispaces is not only an important educational technology tool, but also a vital institutional workflow tool.

Table 1. Classification of wikispaces users

Classification	N	%
Student	7371	52.0
Instructor	1439	10.1
Student and Instructor	384	2.7
Other (Staff)	4993	35.2
Total	14187	100.0

¹ Students admitted in Spring 2010 were not identified as students because their records were not updated in data warehouse tables (i.e., student_sem) at the time of the data analysis. However, the number of those students is expected to be small.

Student Campus Distributions

University Park represents 76% of the students utilizing wikispaces, followed by the World Campus (7.7%), Harrisburg (3.6%), Erie (2%) and Altoona (1.6%). All five of these campuses have at least 100 students utilizing wikispaces.

Table 2. Campus distribution of students

Campus	<i>n</i>	%
University Park	5893	76.0
World Campus	601	7.7
Harrisburg	280	3.6
Erie	153	2.0
Altoona	126	1.6
Berks	96	1.2
Abington	75	1.0
New Kensington	72	0.9
Brandywine	66	0.9
York	40	0.5
Hazleton	38	0.5
Mont Alto	34	0.4
Fayette	31	0.4
Greater Allegheny	29	0.4
Worthington Scranton	29	0.4
Great Valley	26	0.3
Du Bois	24	0.3
Schuylkill	24	0.3
Beaver	23	0.3
Lehigh Valley	22	0.3
Shenango	20	0.3
Foreign Studies	19	0.2
Wilkes-Barre	16	0.2
Hershey Med Ctr	15	0.2
Carlisle	3	0.0
Total	7755	100.0

University Park Statistics

With 5893 students having wikispaces accounts, University Park represents the largest dataset of students. This section examines some of the characteristics of UP student wikispaces users, including gender, college distribution, performance indicators, scholars codes and edit patterns.

Gender

Of the 5895 students at UP using wikispaces, the gender split is nearly even, with males edging females by 1.6%. When analyzing average edits, males make .10 more edits than females, illustrating again that the split is nearly even. Examining average cumulative GPA, females utilizing wikispaces on average score .1 grade point above males. This trend is typical with PSU grade norms at University Park split by gender, where females typically show a higher cumulative GPA than males.

Table 3. University Park students by gender

Gender	N	%
Male	2992	50.8
Female	2901	49.2
Total	5893	100.0

Table 4. Average edits and GPA by gender

Gender	N	Avg. Edits	GPA
Male	2992	1.32	3.18
Female	2901	1.22	3.28

College Distribution

The College of Science represents the largest user base of students, where 1,154 students utilize wikispaces. In Fall of 2009, the College of Science's enrollment was 3,130. Assuming the College of Science population stayed relatively stable from Fall 2008 to Fall 2009, approximately one third of Science students utilized wikispaces. The College of Information Sciences and Technology ranks sixth when looking at active users of wikispaces, but first when calculating percent of users within a specific College, with 40.7% of IST students utilizing wikispaces.

Table 5. College distribution of students

College	n	%	FA09 College Population	College %
Science	1154	19.6	3130	36.9
Health and Human Development	698	11.8	4630	15.1
Liberal Arts	666	11.3	5035	13.2
Engineering	592	10.0	5937	10
Agricultural Sciences	487	8.3	1713	28.4
Information Sciences and Technology	414	7.0	1017	40.7
Business	335	5.7	5773	5.8
Division of Undergraduate Studies	294	5.0	2553	11.5
Education	287	4.9	1896	15.1
Undergraduate Non-Degree	246	4.2		
Communications	207	3.5	2897	7.1
Earth and Mineral Sciences	164	2.8	1319	12.4
Arts and Architecture	119	2.0	1471	8.1
Graduate Non-Degree	112	1.9		
Interdisciplinary Graduate Programs	71	1.2		
School of Nursing	33	0.6		
Altoona College	6	0.1		
Dickinson School Of Law	4	0.1		
School Of International Affairs	4	0.1		
Total	5893	100.0		

**Norms retrieved from the Penn State Fact Book, representing populations for the major Colleges at University Park*

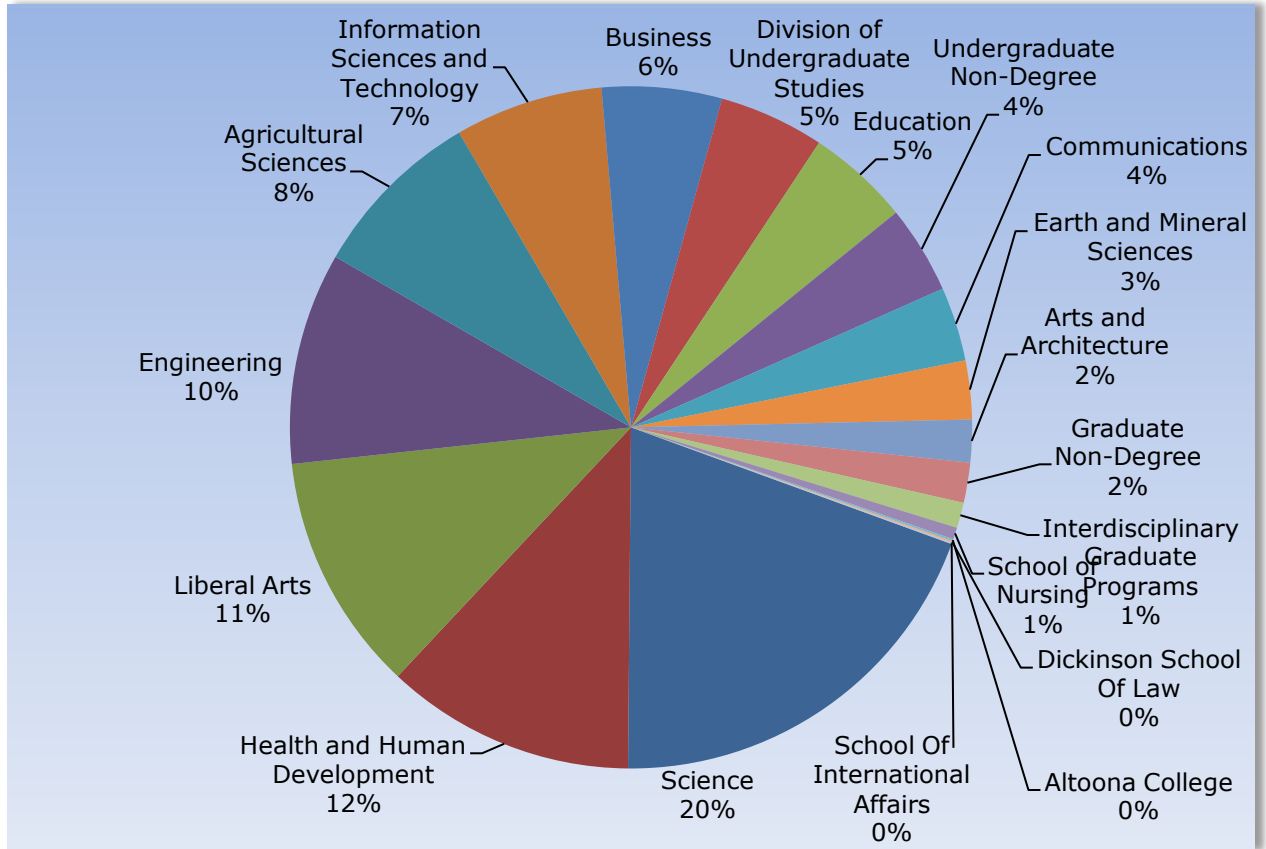


Figure 1. Distribution of students across major Colleges at University Park

Student Profiles

Admit type refers to how a student was admitted to Penn State University. The data in the table below represents both undergraduate and graduate admits at University Park. The undergraduate population of University Park during Fall 2009 was nearly 44,000 students. Approximately 10% of UP undergraduates have active wikispaces accounts. The Fall 2009 graduate student population at UP was 6,202, approximately 18% of these graduate students have active wikispaces accounts.

Table 6. Classification of admit type for UP students

Admit type	<i>n</i>	%
Freshman	4439	75.3
Graduate	1113	18.9
Advanced Standing	189	3.2
Other	74	1.3
Provisional	73	1.2
Total	5893	99.9

Note: 1: 38 students with undergraduate admission were also counted as instructors
 2: 624 students with graduate admission were also counted as instructors
 3: A student with law school admission was also counted as an instructor

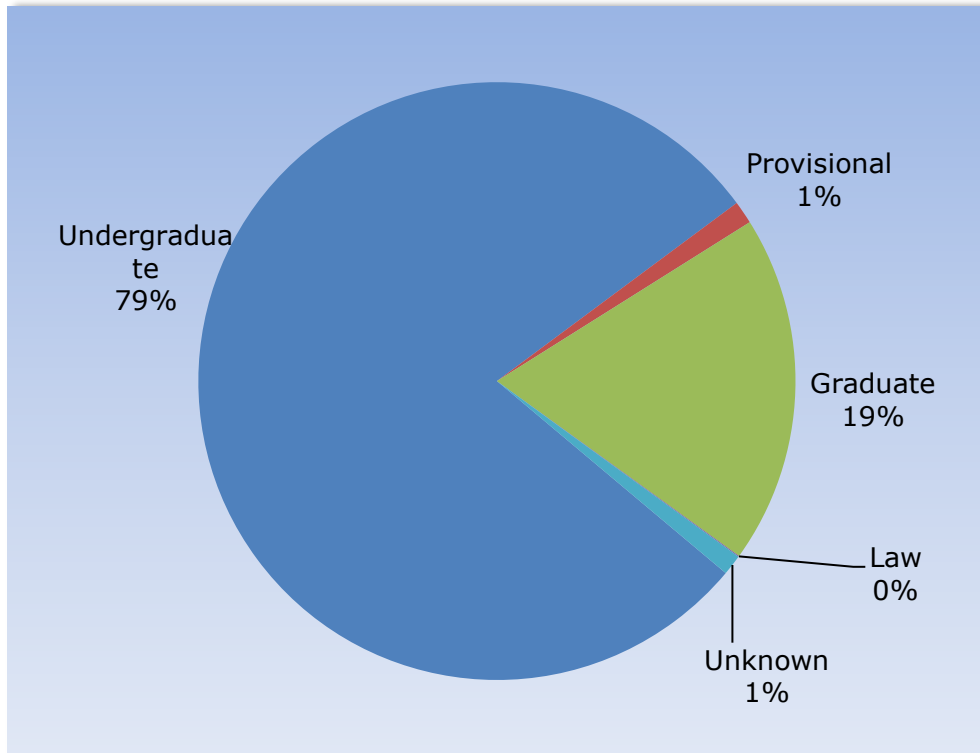


Figure 2. Classification of admit type for University Park students
 The majority of students using wikispaces at UP are full-time non-adult learners. Also note that 11.8% of student wikispaces users are less than half-time. In some instances, these cases may represent a user that is a full time Penn State employee using wikispaces as part of his or her job (not necessarily representing student/educational use).

Table 7. Adult learners

	<i>n</i>	%
Yes	1379	23.4
No	4514	76.6
Total	5893	100.0

Table 8. Full time, half-time and less than half-time students

	<i>n</i>	%
Full time	4932	83.7
Half-time	267	4.5
Less than half-time	694	11.8
Total	5893	100.0

Edit Counts

This section of the report deals primarily with edit counts of wikispace pages. An edit count represents any occurrence where a user makes a change to a wiki page within wikispaces. The majority of users (~85%) did not make any edits to pages. The scale used for edit counts is based on the data; most users made no edits, while others made only one edit, then another subset that made a small number of edits (2-10). Then the data begins to spread out a great deal beyond ten edits.

Edit counts and performance

In general, few differences were noted in terms of the cumulative GPA of wikispaces users when compared to the number of edits they made. Graduate students saw the biggest difference in GPA compared to edit counts, where those wikispace users that made over 10 edits averaged a 3.71 GPA, compared to 3.62 for 2-10 edits, 3.55 for 1 edit, and 3.64 for 0 edits. The maximum number of edits for a student is 2,324, with three students having over 1,000 edits and 74 students having over 100 edits.

Table 9. Edit counts for University Park students

	<i>n</i>	<i>%</i>	<i>Mean</i>	<i>Median</i>	<i>GPA</i>
0	5053	85.7	0.0	0.0	3.22
1	315	5.3	1.0	1.0	3.30
2-10	287	4.9	4.2	4.2	3.31
10+	238	4.0	98.8	34.0	3.30
<i>Total</i>	5893	100.0			

Table 10. Undergraduate edit counts for University Park students

	<i>n</i>	<i>%</i>	<i>Mean</i>	<i>GPA</i>
0	4275	88.7	0.0	3.1
1	223	4.6	1.0	3.2
2-10	173	3.6	4.14	3.1
10+	147	3.1	112.61	3.0
<i>Total</i>	4818	100.0		

Table 11. Graduate student edit counts at University Park

	<i>n</i>	<i>%</i>	<i>Mean</i>	<i>GPA</i>
0	775	72.2	0.0	3.64
1	92	8.6	1.0	3.55
2-10	114	10.6	4.18	3.62
10+	91	8.5	76.54	3.71
<i>Total</i>	1072*	99.9		

*Filtered by student level and valid cases, Graduate (GR), Law (LW) and Medical (MD) included

Table 12. Edit counts by adult learners

	<i>n</i>	<i>%</i>	<i>Mean</i>
0	1004	72.8	0.0
1	111	8.0	1.0
2-10	135	9.8	4.3
10+	129	9.4	98.8
Total	1379	100.0	

When examining edit counts by full time, half time and less than half time classifications, a trend emerges. Less than half time students tend to make more edits than half time students and half time students tend to make more edits than full-time students. A possible explanation for this is students that also work full time, and utilize wikispaces on the job.

Table 13. Edit counts by full time, half-time, and less than half-time students at University Park

	<i>Full Time</i>	<i>%</i>	<i>Mean</i>	<i>½ time</i>	<i>%</i>	<i>Mean</i>	<i>Less than ½ time</i>	<i>%</i>	<i>Mean</i>
0	4337	87.9	0.0	207	77.5	0.0	509	73.3	0.0
1	245	5.0	1.0	17	6.4	1.0	53	7.6	1.0
2-10	200	4.0	4.2	25	9.4	4.2	62	8.9	4.1
10+	150	3.0	71.2	18	6.7	103.67	70	10.1	156.7
Total	4932			267			694		

Edit counts by College

Breaking the data down by College edit counts and percents provides clues to how some Colleges are utilizing wikispaces. For instance, the College of Science represents the largest adoption numbers at nearly 37% of the College students have active accounts. When examining Science students' edit counts, nearly 96% students did not make an edit. The College of Science utilizes wikispaces as a platform for content delivery in an introductory Biology class. On the other hand, the College of IST has an adoption rate over 40%, and nearly ½ of the IST students have made at least one edit to wikispaces and 20% of IST students making over 10 edits. Upon further exploration, some IST faculty are using wikispaces more for collaborative purposes and teaming, compared to Science's approach in Biology 110 where wikispaces is more of a content delivery platform.

Table 14. Edit counts by College

	0		1		2-10		10+		Total	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Science	1106	95.8	40	3.5	6	0.5	2	0.2	1154	100.0
Health And Human Development	655	93.8	25	3.6	15	2.1	3	0.4	698	100.0
Liberal Arts	538	80.8	47	7.1	52	7.8	29	4.4	666	100.0
Engineering	501	84.6	34	5.7	29	4.9	28	4.7	592	100.0
Agricultural Sciences	440	90.3	32	6.6	11	2.3	4	0.8	487	100.0
Information Sciences and Technology	218	52.7	34	8.2	79	19.1	83	20.0	414	100.0
Business	298	89.0	21	6.3	11	3.3	5	1.5	335	100.0
Division Of Undergraduate Studies	281	95.6	10	3.4	3	1.0	0	0.0	294	100.0
Education	213	74.2	24	8.4	25	8.7	25	8.7	287	100.0
Undergraduate Non-Degree	200	81.3	7	2.8	12	4.9	27	11.0	246	100.0
Communications	177	85.5	10	4.8	12	5.8	8	3.9	207	100.0
Earth and Mineral Sciences	150	91.5	8	4.9	6	3.7	0	0.0	164	100.0
Arts and Architecture	106	89.1	8	6.7	2	1.7	3	2.5	119	100.0
Graduate Non-Degree	68	60.7	10	8.9	19	17.0	15	13.4	112	100.0
Interdisciplinary Graduate Programs	60	84.5	3	4.2	3	4.2	5	7.0	71	100.0
School of Nursing	33	100.0	0	0.0	0	0.0	0	0.0	33	100.0
Altoona College	3	50.0	0	0.0	2	33.3	1	16.7	6	100.0
Law	3	75.0	1	25.0	0	0.0	0	0.0	4	100.0
School of International Affairs	3	75.0	1	25.0	0	0.0	0	0.0	4	100.0

Instructor Wikispaces Data

A total of 1,823 instructors were identified as having an active wikispaces account. Professors were the largest group of wikispace users, representing nearly 20% of instructors using wikispaces. Associate professor was second at 15%, followed by assistant professor at 14.2%. The data are encouraging. It shows a fairly close distribution across instructor ranks illustrating wikispaces is not favored by only one or two instructor types.

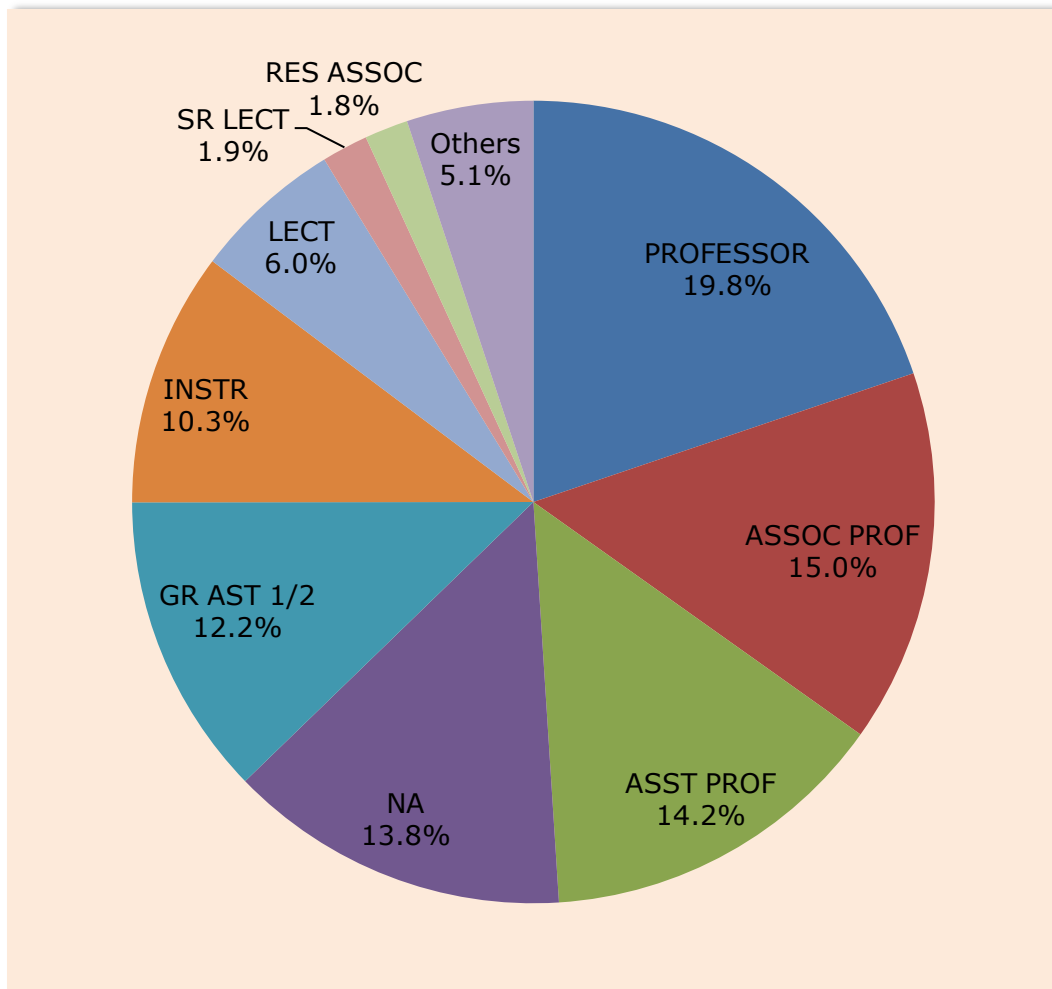


Figure 3. Rank of instructors that use wikispaces

Table 15. Rank of instructors who use wikispaces

Rank Title	n	%
PROFESSOR	361	19.8
ASSOC PROF	274	15.0

ASST PROF	258	14.2
NA	251	13.8
GR AST 1/2	223	12.2
INSTR	187	10.3
LECT	110	6.0
SR LECT	34	1.9
RES ASSOC	32	1.8
SR RES ASC	16	0.9
ASSOC LIBR	14	0.8
SR INSTR	13	0.7
GR AST 1/4	10	0.5
SCH-PSTDOC	6	0.3
ASST LIBR	5	0.3
GR AST 3/4	5	0.3
LIBR	4	0.2
PROF PRACT	4	0.2
SR SCNTST	4	0.2
FEL-PREDOC	3	0.2
RES ASST	2	0.1
AFF AST PR	1	0.1
ASST	1	0.1
FEL-TRNE	1	0.1
GRAD LECT	1	0.1
SR RES AST	1	0.1
Unknown	2	0.1
Total	1823	100.0

Instructor Edit Counts

Overall, instructors show slightly higher edit counts than students, especially undergraduates, at University Park. Potential reasons include instructors creating content using wikispaces for online/hybrid courses, leveraging wikispaces for student projects where the instructor needs to interact with students in the wikispaces itself and potential use of wikispaces to support research.

Table 16. Instructor edit counts

	<i>n</i>	<i>%</i>	<i>Mean</i>
0	1348	73.9	0
1	137	7.5	1
2-10	198	10.9	4.2
10+	140	7.7	113.3
Total	1823	100.0	

Instructor use by Department and College

When examining instructor use by department, Director of Academic Affairs returns as the top result, with 122 instructors. It is important to note that many instructors in the dataset are from non-traditional departments, such as administrative areas that are not related to teaching. This is due to individuals from these departments teaching courses across the University system in addition to performing their job duties. The Director of Academic Affairs classification in the department field

represents Academic Affairs at Penn State Greater Allegheny. Also worth noting is that some Colleges also appeared in the Department field, such as Liberal Arts.

Psychology and Biology departments represent the second and third largest departments leveraging wikispaces. In terms of edits, these two departments represent a large amount of activity.

Table 17. Top ten departments based on instructor use of wikispaces

Department	n	%	with edits	Edit mean
Director of Academic Affairs	122	6.7	36	14.0
Psychology	84	4.6	38	110.9
Biology	75	4.1	11	170.5
Liberal Arts	33	1.8	9	16.4
Computer Science and Engineering	30	1.6	9	38.0
English	29	1.6	7	2.7
Human Development and Family Studies	29	1.6	3	2.3
Biochemistry and Molecular Biology	28	1.5	5	1.4
Chemistry	27	1.5	1	4
Business Administration	26	1.4	2	9.5

Table 18. Top ten colleges based on instructor use of wikispaces

College	n	%	with edits	Edit mean
Liberal Arts	310	17.0	92	55.8
Science	214	11.7	40	60.9
Engineering	147	8.1	32	15.8
Penn State Greater Allegheny	130	7.1	41	15.0
Health and Human Development	124	6.8	13	16.8
Penn State Harrisburg	100	5.5	24	24.3
Agricultural Sciences	91	5.0	17	7.8
Arts and Architecture	66	3.6	13	6.7
Education	49	2.7	15	19.8
Earth and Mineral Sciences	48	2.6	12	34.3

Table 19. Active instructor wikispaces accounts across colleges compared to instructor populations within the College at UP.

College	Instructors total	Wikispaces account	% population
Information Sciences and Technology	47	34	72.3
Liberal Arts	576	310	53.8
Science	402	214	53.2
Communications	61	31	50.8
Engineering	356	147	41.3
Health and Human Development	304	124	40.8
Arts and Architecture	182	66	36.3
Ag Sciences	309	91	29.4
Business	135	36	26.7
Education	188	49	26.1
Earth and Mineral Sciences	243	66	19.8

NOTE: the N value for instructors was retrieved from the Penn State Fact Book, and includes all personnel under "Academic" classification for each College for Fall 2009.

Conclusion

The wikispaces dataset reveals some interesting data. When compared to the blog dataset, especially wikispaces adoption by instructor rank, the data hints that instructors, specifically tenured and tenure-track instructors, might be using wikispaces for a variety of purposes. The breakdown of users by faculty, student and other (likely staff and administrators) is also very different than the blog distributions. The wikispaces distributions give an impression that wikispaces is a very powerful organizational platform in addition to an important educational platform. Finally, the three pedagogies that emerge from the data should be explored further, possibly in a more qualitative approach. The creation of a 'wikispaces examples' database or repository is something instructors may find very useful as they explore how to leverage wikispaces in educational contexts.

Next steps

The wikispaces dataset only consisted of access IDs and associated edit counts. A richer dataset, including date information as well as specific wikispaces created by users may yield more interesting findings. For instance, examining the activity within a single wikispace might provide information on how to best implement a successful, interactive wiki. The research team will continue to work with Emerging Technologies to obtain a richer dataset that will allow us to explore research questions outside the simple scope of how active individual users are within the platform.

Blogs @ PSU Executive Summary

The Penn State Blog Platform (<http://blogs.psu.edu>) originates from Education Technology Services (ETS), a group situated within Information Technology Services (ITS). The blog data analyzed in this report begins January 11, 2008, when ETS migrated from an older version of Movable Type to Movable Type 4. The data was exported from the system on 4/30/2010, and was then combined with data from the data warehouse from mid-May to early June 2010. Semester data from Spring 2008 through Spring 2010 is included in this section.

The College of Business ranks as the largest College when examining student accounts in the blog system (n=1,805). Business also ranks as the largest College of inactive student users; over 60% of the students with accounts from the College of Business do not register any activity in the system aside from logging in at least once. This reflects an odd trend as over 40% of all students who logged in to the system at least once and have an author creation date do not register any activity in the blog system (no blogs created, entries created or comments created). Two potential reasons were identified for this trend:

1. Lack of follow through: instructors might be asking students to write in personal blogs, but not following through with any sort of rubric or graded assignment to make sure students are writing in the blog platform.
2. Blog platform user interface (UI): When introducing both students and instructors to the blog platform, a conceptual hurdle exists between what one may consider a 'traditional' blog dashboard compared to Movable Type's dashboard at PSU. In a traditional blog, a blogger will login with proper credentials, then be presented with a **single blog dashboard** where the user can begin writing. Upon logging in to Blogs @ PSU, the user is presented with a **multiple blog dashboard**, allowing the user to create multiple blogs within his or her webspace. This seemingly insignificant difference, compounded by what some would call a confusing UI, might be a contributing factor to the number of blog users that register no activity in the blog platform.

The College of Education has the lowest percentage of students that register no activity (~19%) and the highest percent of students that register both entries and comments in the blog platform (~39%).

The growth rate of the blog platform appears to still be on the rise from semester to semester. From the spring semester of 2009 to spring 2010 is the first instance of a drop in new accounts created. When examining semester-to-semester growth, all other semester in the dataset saw an increase, with the number of accounts created in Spring 2008 to Spring 2009 nearly tripling.

When attempting to classify the types of users within the blog system a k-means cluster analysis was performed. This cluster analysis led to three classifications of bloggers (the inactive users were not included in the cluster analysis):

1. Entry-dominant users: these users created the most entries and stayed in the blog system for the longest duration of time.
2. Comment-dominant users: these users created few entries, but created many comments across different blogs. These users were active in the blog platform for a short duration.
3. Infrequent users: these users showed very little activity in the system with very few entries and comments. Also, these users were active in the system for a very short duration of time.

There seems to be positive relationship between blogging activity and to GPA growth. Infrequent users show a .01 increase in cumulative GPA from the account creation date to spring 2010, and comment-dominant users had a .02 increase. Entry-dominant users, however, see a .06 increase in GPA.

Although gender does not play a role in the distribution of users, it does show significant differences when examining activity. Male students are more likely to show no activity in the system, while female students are more likely to create both entries and comments and stay active in the system longer.

Methodology

The dataset analyzed from Blogs @ PSU contained several different data points. Four primary tables were exported from the Blogs platform:

1. Blogs: this table contains a unique blog ID, blog name, blog URL, author ID and blog creation date.
2. Authors: this table contains a unique author ID, access ID, name and author creation date.
3. Comments: this table contains a unique comment ID, access ID, comment date, blog ID and entry ID.
4. Entries: this table contains a blog ID, access ID, entry date, tags and unique entry ID.

These four tables create a small relational database that was then combined with database tables from the Penn State data warehouse.

In an attempt to provide context, the numbers found in the Blog dataset are compared to more general PSU data, such as College or campus populations. These comparisons are not 100% accurate because our sample spans several semesters while the PSU population numbers typically represent a single semester. This population data was extracted from the Penn State Fact Book and simply used to provide the reader a better context for the data.

Special thanks to Cole Campese and Brad Kozlek from Education Technology Services for providing the data. We then linked this information to the datawarehouse, specifically the `dbo_uf_student_sem`, `dbo_uf_student_bio_all` and the `uf_instructor_bio` tables in the student database.

The data exported from blogs was received on 4/30/2010. Users are identified as students if they have a student record in the data warehouse in the semester when they first logged into the blog system. Users were identified as instructors if they taught courses in spring 2008 or beyond. The leftover users were labeled as "other" category. The researchers do not have access to a general human resource table in the data warehouse to verify the classification of the cases that represent the 'other' classification. The assumption is that the majority of these users are staff or administrators based on no matches found in the instructor or student warehouse database tables.

This report refers to "active blog users". This refers to any PSU user that logged into the blog system at least once from 1/11/08 to 4/30/10. The action of logging in creates an 'author creation date' for the user.

Dataset

The total blog dataset, from 1/11/2008 to 4/30/2010, represents 19,718 unique users. The majority of these users are students (n=17,305), followed by staff (n=1,151) and instructors (n=776). A remaining 486 users show up in the data warehouse as both students and instructors, most likely representing graduate students.

NOTE: the 'Other' count is not verifiable based on permissions to the data warehouse; this number represents the 'leftover' data that could not be matched to student or instructor records in the data warehouse. The assumption is that this number represents predominantly staff and administrators at Penn State, but is likely to also contain a small percent of other classifications.

Table 20. Blog users by classification

Identity	n	%
Student	17305	87.8
Instructor	776	3.9
Student and Instructor	486	2.5
Other (staff)	1151	5.8
Total	19718	100.0

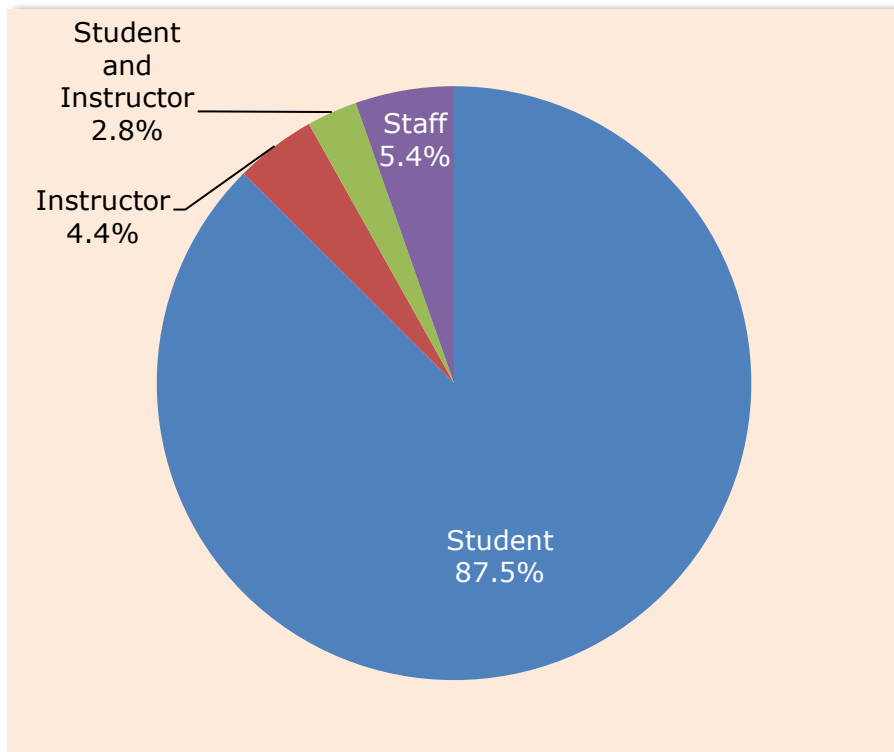


Figure 4. Blog users by classification

Adoption and Growth rate

From spring 2008 through spring 2010, 19,718 unique users created blog accounts. When analyzing the date of account creation, 24.5% of this population created accounts in Fall of 2009 (n=4827) followed by spring 2009 (n=4529) and spring 2010 (n=3955).

Table 21. Blog account creation by semester

Academic Year	Semester	n	%
2007-08	200708SP	1218	6.2
	200708SU	643	3.3
2008-09	200809FA	3540	18.0
	200809SP	4529	23.0
	200809SU	1006	5.1
2009-10	200910FA	4827	24.5
	200910SP	3955	20.1
	Total	19718	100.0

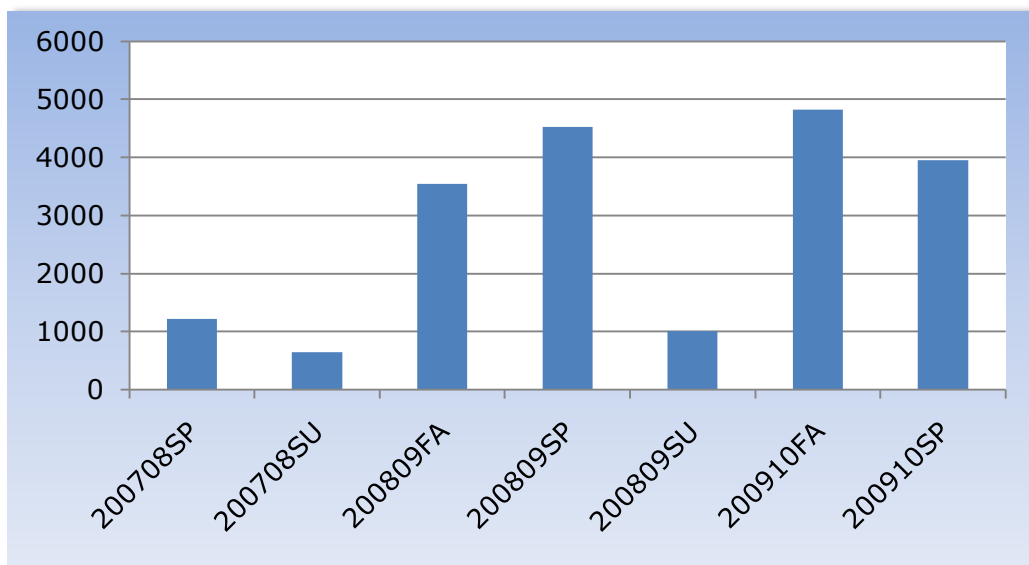


Figure 5. Blog account creation by semester

The blogs @ PSU platform, overall, experienced considerable growth over the seven semesters of data represented in this report. To explain growth rate, same semesters were compared to one another (spring semesters, summer semesters, fall semesters). The largest growth period was experienced between spring 2008 (n=1,218) and spring 2009 (n=3,540) a 27.1% growth rate. The only negative growth rate was experienced between spring 2009 (n=4529) and spring 2010 (3955), a rate of -12.7%. All other semester comparisons were positive.

Table 22. Blog growth rate by semester

Semester	n	% growth
Spring 2008	1218	-
Spring 2009	3540	27.1
Spring 2010	3955	-12.7
Summer 2008	643	-

Summer 2009	1006	56.5
Fall 2008	3540	-
Fall 2009	4827	36.4

Student Campus Distribution

Over 70% (n=12786) of student blogs originate from the University Park campus. This is followed by World Campus (n=1197), Altoona (n=595), Erie (n=566) and Harrisburg (n=453).

Table 23. Student blog distribution by campus

	n	%
University Park	12786	71.9
World Campus	1197	6.7
Altoona	595	3.3
Erie	566	3.2
Harrisburg	453	2.5
Berks	323	1.8
New Kensington	231	1.3
Brandywine	206	1.2
Worthington Scranton	204	1.1
Mont Alto	185	1.0
Du Bois	181	1.0
Hazleton	137	0.8
York	123	0.7
Greater Allegheny	99	0.6
Abington	97	0.5
Lehigh Valley	87	0.5
Beaver	67	0.4
Fayette	66	0.4
Schuylkill	44	0.2
Shenango	43	0.2
Wilkes-Barre	35	0.2
Foreign Studies	27	0.2
Great Valley	23	0.1
Hershey Med Ctr	15	0.1
Carlisle	1	0.0
Total	17791	100.0

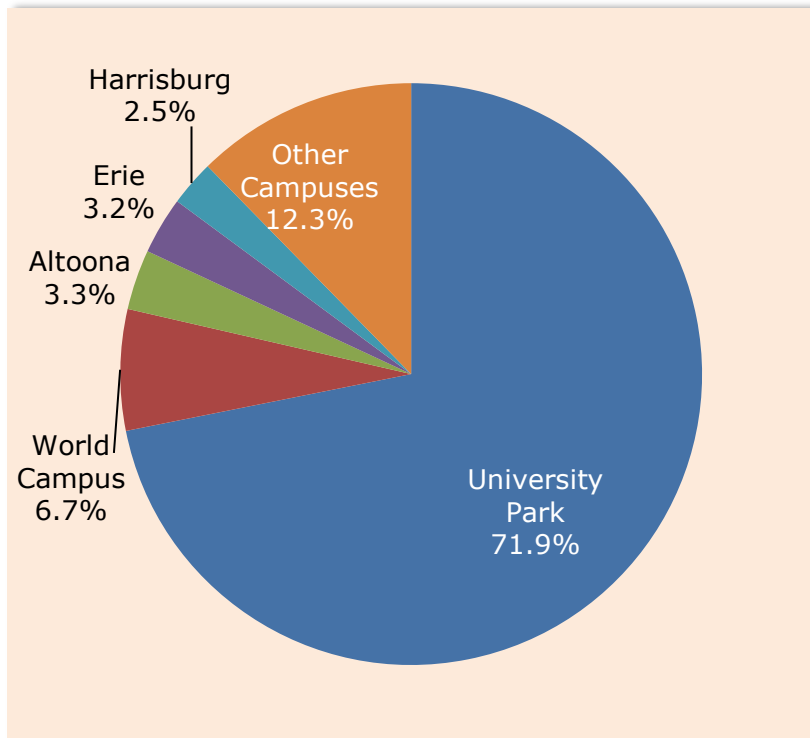


Figure 6. Student blog account distribution by campus

Student adoption

The blog data are dominated by student data (n=17791). First-time student use is very similar, then, to the overall use when examining student adoption trends compared to overall adoption across faculty, students and other categories of users.

Table 24. Student blog account creation by semester

Academic Year	Semester	n	%
2007-08	200708SP	823	4.6
	200708SU	489	2.7
2008-09	200809FA	3243	18.2
	200809SP	4211	23.7
	200809SU	815	4.6
2009-10	200910FA	4522	25.4
	200910SP	3688	20.7
Total		17791	100.0

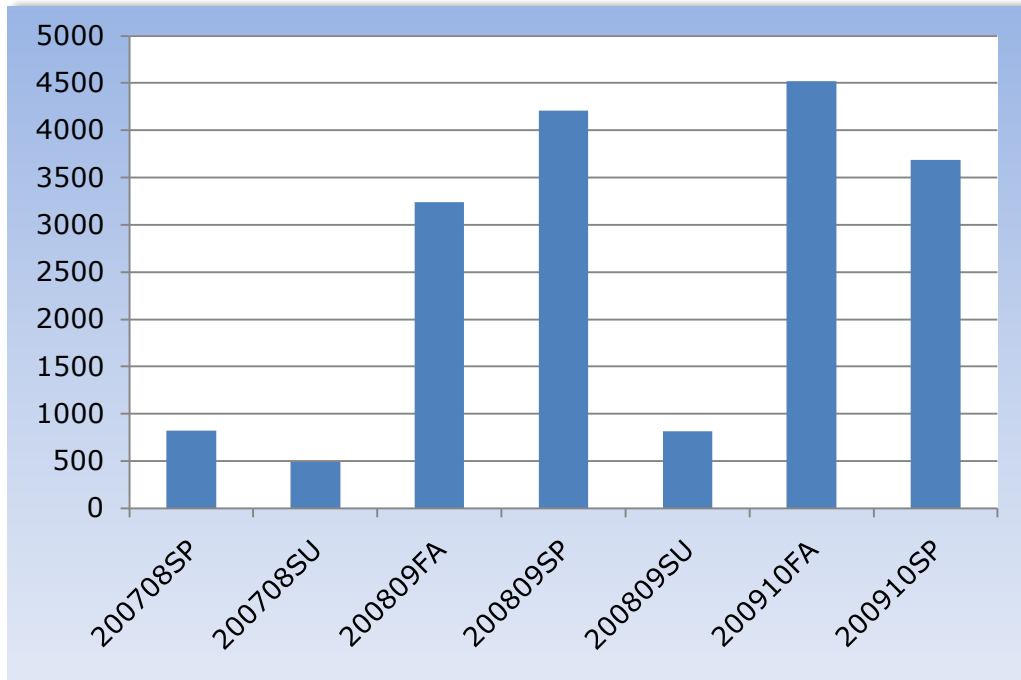


Figure 7. Student blog account creation by semester

University Park Statistics

A total of 12786 University Park students logged into the blogs @ PSU platform between 1/11/2008 and 4/30/2010. The number of users increased substantially from spring and summer 2008, and now appear to be stabilizing throughout 2009 and 2010. Note that 519 students were also classified as UP instructors, most likely this number represents graduate students or full time employees that also register for courses.

Table 25. University Park student blog accounts created by semester

Academic Year	Semester	n	%
2007-08	200708SP	551	4.3
	200708SU	330	2.6
2008-09	200809FA	2264	17.7
	200809SP	3315	25.9
	200809SU	523	4.1
2009-10	200910FA	3126	24.4
	200910SP	2677	20.9
	Total	12786	100.0

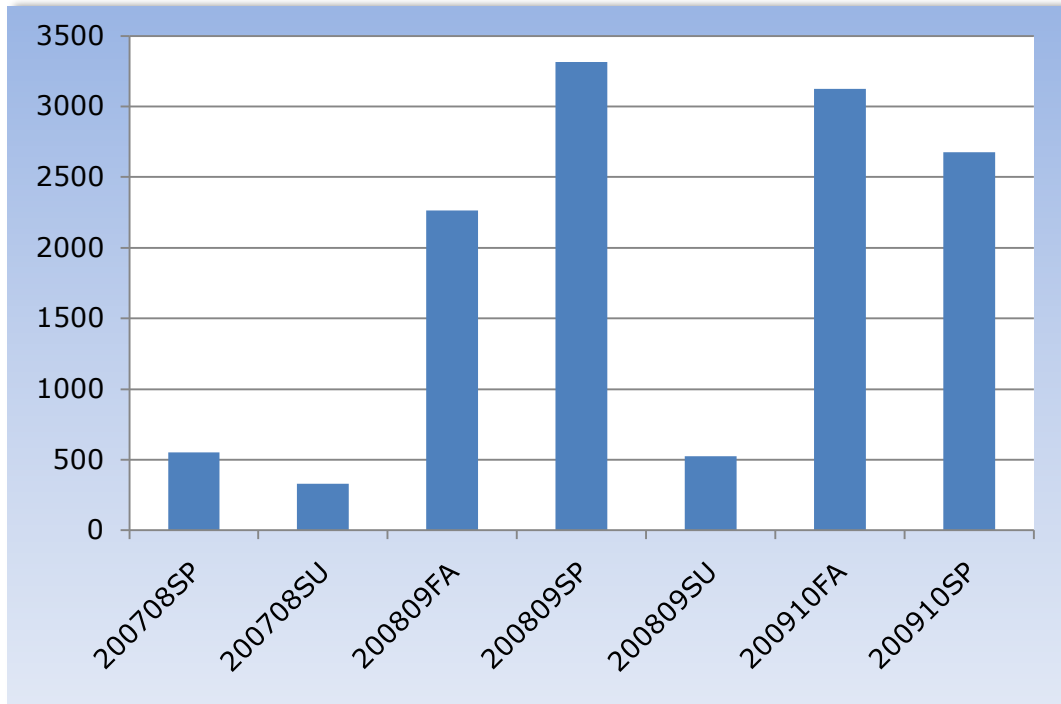


Figure 8. University Park student blog accounts created by semester

Student Profiles

The gender breakdown is fairly even for blog accounts, with males holding a slight edge over females with 51% of the University Park users. The majority of University Park students with active blog accounts represented traditional students, enrolled full time with the university.

Table 26. Gender split for University park students with blog accounts

	n	%
Female	6271	49.0
Male	6515	51.0
Total	12786	100.0

Table 27. Adult learner split for University Park students with blog accounts

	n	%
No	11058	86.5
Yes	1728	13.5
Total	12786	100.0

Table 28. Full time, half-time and less than half-time classifications for University Park students with blog accounts

	n	%
Full time	11470	89.7
Half time	835	6.5
Less than half time	481	3.8
Total	12786	100.0

Approximately 85% of active blog accounts were created by undergraduates, admitted to the university as Freshman. Just over 10% of the University Park accounts were created by students admitted to graduate school.

Table 29. Admit type for University Park students with blog accounts

Admit Type	n	%
Freshman admit	10958	85.7
Graduate Student admit	1281	10.0
Other admits	547	4.3
Total	12786	100.0

College distribution

Five colleges represented over 50% of all blog users at University Park. The College of Business represented the largest population, accounting for 14.1% of all UP student blog accounts (n=1805). Communications was second with 13.1%, followed by Engineering (11.8%), Education (11.5%) and Liberal Arts (10.6%).

Table 30. College distributions for University Park students with blog accounts

College	n	%
Business	1805	14.1
Communications	1679	13.1
Engineering	1505	11.8
Education	1465	11.5
The Liberal Arts	1360	10.6
Division Of Undergraduate Studies	1214	9.5
Health And Human Development	765	6.0
Information Sciences And Technology	685	5.4
Arts And Architecture	541	4.2
Science	510	4.0
Agricultural Sciences	482	3.8
Earth And Mineral Sciences	406	3.2
Undergraduate Non-Degree	172	1.3
Graduate Non-Degree	80	0.6
School Of Nursing	59	0.5
Interdisciplinary Graduate Programs	39	0.3
Altoona College	5	0.0
School Of International Affairs	5	0.0
Intercollege Undergraduate Programs	4	0.0
Capital College	2	0.0
Dickinson School Of Law	2	0.0
Abington College	1	0.0
Total	12786	100.0

Blogging Activity

Within the blog platform, several different types of activities are tracked. The primary variables tracked are entries created on a blog and comments in response to entries. Approximately 44% of students that have an active account in the system did not make any blog entries or comments.

Table 31. University Park student blogging activity

Activity	<i>n</i>	%
No entries or comments	5581	43.6
Entries only	4328	33.8
Comments only	624	4.9
Both comments and entries	2253	17.6
Total	12786	100.0

Students with no blogs

Of the 12,786 student blog accounts at University Park, 3598 did not create a blog. 2920 of these students did not register any blog activity upon logging into the blog platform; they have a registered author creation date meaning they logged in at least once, but did not participate in any type of activity.

Table 32. Activity of University Park students with no blogs created compared to users with at least one blog

		Student			
		No blog created		At least one blog created	
		<i>n</i>	%	<i>n</i>	%
Blogging activity	No entries or comments	2920	81.2	2661	29.0
	Entries only	121	3.4	4207	45.8
	Comments only	448	12.5	176	1.9
	Both comments and entries	109	3.0	2144	23.3
Total		3598	100.1	9188	100.0

Blogging activity by gender

Although the breakdown of gender among UP student blog accounts is fairly equal, females appear more likely to blog when compared to males.

Table 33. University Park student blogging activity by gender

Activity	Gender			
	Female		Male	
	<i>n</i>	%	<i>n</i>	%
No entries or comments	2307	36.4	3274	50.3
Entries only	2285	36.4	2043	31.4
Comments only	342	5.5	282	4.3
Both entries and comments	1337	21.3	916	14.1
Total	6271	100.0	6515	100.0

Blogging activity and student performance

When examining the difference between undergraduate students with no activity and students with a high level of activity, almost two tenths of a GPA difference exists. A direct relationship between blogging and what effect, if any, it has on GPA cannot be determined by this data set. But the numbers do indicate that students with higher GPAs typically show more activity within the blog

platform. When examining graduate students, a positive difference also exists, but it is less than one tenth of a difference in GPA. The following table does not indicate that blogging contributes to better performance. It indicates that people with better performance tend to blog more (i.e., make both entries and comments)

Table 34. University Park undergraduate blogging activity by cumulative GPA (the semester when students first logged into the blog system)

		GPA
Activity type	no entries or comments	3.20
	entries only	3.25
	comments only	3.19
	both entries and comments	3.37

Blogging activity across Colleges

When examining activity across Colleges at the University Park campus, the data helps inform an earlier table (table 30) regarding adoption of the blog platform across Colleges. Although Business represents the largest userbase of active accounts, it also represents the largest number of inactive students (63%). Communications represents the largest amount of students making entries (54.3%). From a pedagogical standpoint, blogs might be leveraged for students to practice online writing, creating mock stories that would appear in such online spaces as newspapers, magazines or eBooks. Education represents the highest percent userbase in terms of high activity, where nearly 40% of users actively create entries and comments within the blog platform. Arts and Architecture has the largest percent of students showing comment activity (15.5%). Critique is a big part of many art courses, and perhaps the blog platform is being leveraged in a way that students can comment on instructor posts showcasing various artistic works.

Table 35. University Park blogging activity by College

	Activity type									
	no entries or comments		entries only		comments only		both entries and comments		Total	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Business	1137	63.0	487	27.0	71	3.9	110	6.1	1805	100.0
Communications	434	25.8	912	54.3	89	5.3	244	14.5	1679	100.0
Engineering	845	56.1	404	26.8	38	2.5	218	14.5	1505	100.0
Education	280	19.1	517	35.3	87	5.9	581	39.7	1465	100.0
The Liberal Arts	522	38.4	374	27.5	83	6.1	381	28.0	1360	100.0
Division Of Undergraduate Studies	663	54.6	424	34.9	30	2.5	97	8.0	1214	100.0
Health And Human Development	347	45.4	247	32.3	60	7.8	111	14.5	765	100.0
Information Sciences And Technology	238	34.7	296	43.2	23	3.4	128	18.7	685	100.0
Arts And Architecture	217	40.1	127	23.5	84	15.5	113	20.9	541	100.0
Science	234	45.9	138	27.1	27	5.3	111	21.8	510	100.0

Agricultural Sciences	278	57.7	139	28.8	9	1.9	56	11.6	482	100.0
Earth And Mineral Sciences	220	54.2	137	33.7	9	2.2	40	9.9	406	100.0

Cluster analysis of student blog characteristics

To this point, the classifications of blogging activity are drawn across categories determined by the database (no entries or comments, entries only, comments only and both entries and comments). A k-means cluster analysis was conducted using SPSS in an attempt to see if a natural grouping occurs when examining five distinct variables. The five variables used in the cluster analysis were:

1. Number of entries
2. Number of comments
3. Number of blogs commented on
4. Number of blogs with entries
5. Activity duration in days (number of days from author creation date to last recorded activity)

To minimize the noises in the data, only undergraduates admitted in fall 2006 at University Park were included in the analysis. Z-scores were calculated to standardize the variables before the clustering. Note that all students with NO activity (no entries or comments) were omitted from the cluster analysis. The cluster analysis led to three groups with separate blog characteristics (see Figure below).

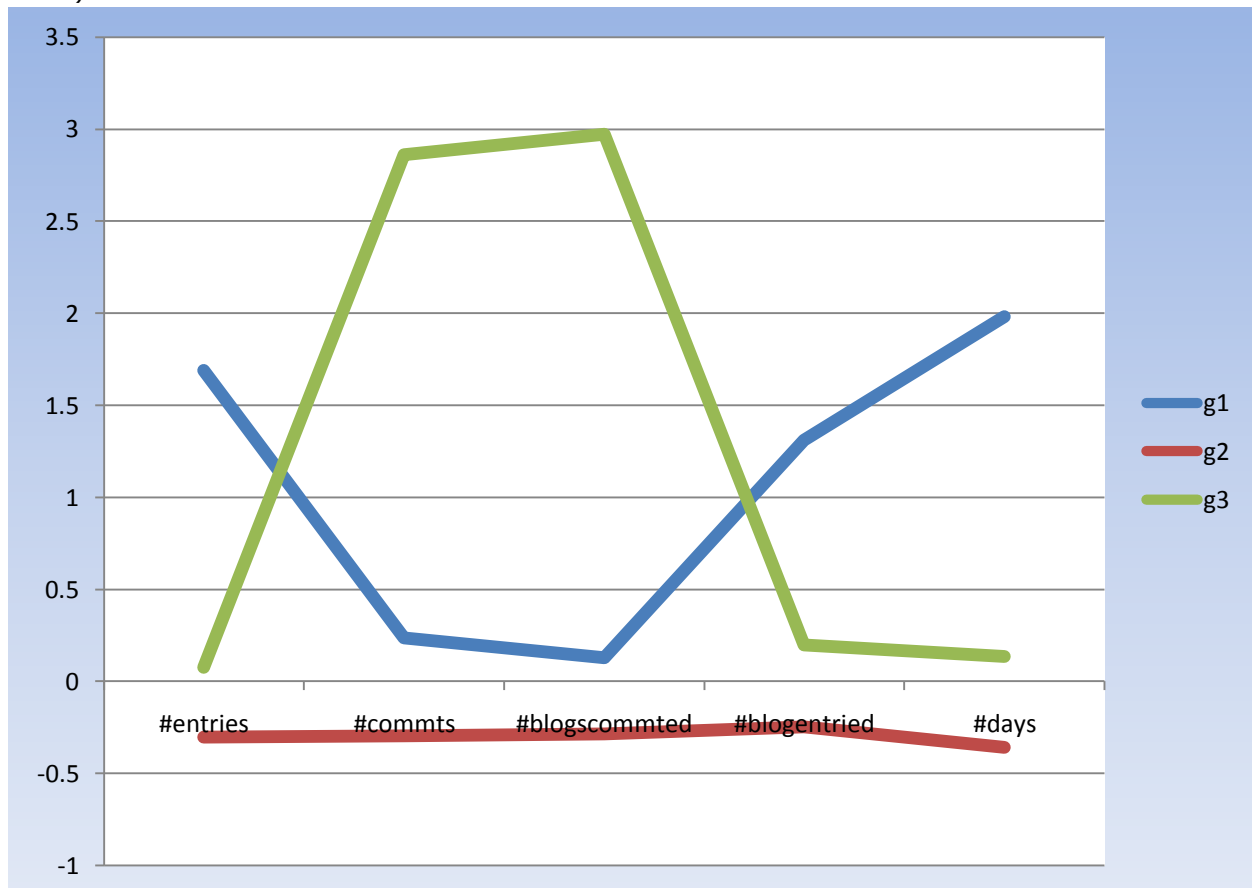


Figure 9. Cluster analysis results for student blog characteristics

The first group exhibits entry-dominant characteristics, creating several entries across several blogs and staying active in the system longer than the other two groups. The second group, infrequent users, exhibits very little activity across the system when examining all five variables. The final group, comment-dominant users, show high comments and commenting across several blogs. Another way to view the entry-dominant and comment-dominant users could be creators and responders.

Cluster analysis results and GPA

When analyzing these three distinct groups, a small difference seems to exist in GPA over time (Table 36). The cumulative GPA of each student was recorded on the semester he or she began blogging (called "Past GPA") then the most current cumulative GPA was also captured for each student. Repeated measure ANOVA was used to determine whether the change of GPA was significantly different across the three groups. First, a repeated measure ANOVA was performed for the three groups. Results indicate that there was significant difference among the three groups in terms of GPA change ($p < .01$). However, the results may have been somewhat biased by the drastically unbalanced sample size of infrequent users and the other two groups despite that the Type III square was used in SPSS for the adjustment. Therefore, a second repeated measure ANOVA was performed between comment-dominant and entry-dominant groups. The results indicated that entry-dominant groups have a significantly larger growth in GPA than comment-dominant groups ($p < .01$). This indicates that the students' GPA change may be affected by how they blog.

It should be noted that the analysis was based on the observational data where randomization was absent. Therefore, it is not certain whether the relationship is causal or correlational because other variables were not controlled during the comparison. Future research should test the effect of blogging on GPA change using experimental designs.

Table 36. Cluster analysis groups and GPA

Group	Past GPA	Current GPA	Difference
Infrequent users	3.20	3.21	0.01
Comment-dominant users	3.36	3.38	0.02
Entry-dominant users	3.50	3.56	0.06

Instructor Blog Data

A total of 1411 instructors have registered accounts in the blogs @ PSU platform. Note that 543 of these cases are also classified as students, likely representing the large population of graduate ½ time graduate students in the instructor data set.

Table 37. Instructor rank of blog users

Rank	<i>n</i>	%
Gr Ast 1/2	250	19.8
N/A	181	14.3
Asst Prof	161	12.8
Instructor	152	12.0
Assoc Prof	131	10.4
Lecturer	119	9.4
Professor	91	7.2
Gr Ast 1/4	33	2.6
Sr Lecturer	33	2.6
Grad Lecturer	27	2.1
Res Assoc	20	1.6
Sr Instructor	14	1.1
Gr Ast 3/4	10	.8
Fel-Predoc	9	.7
Assoc Libr	7	.6
Sch-Pstdoc	6	.5
Unknown	4	.3
Asst Libr	4	.3
Libr	2	.2
Prof Pract	2	.2
Aff Ast Pr	1	.1
Fel-Pstdoc	1	.1
Res Asst	1	.1
Sr Res Asc	1	.1
Sr Res Ast	1	.1
Sr Scntst	1	.1
Total	1262	100.0

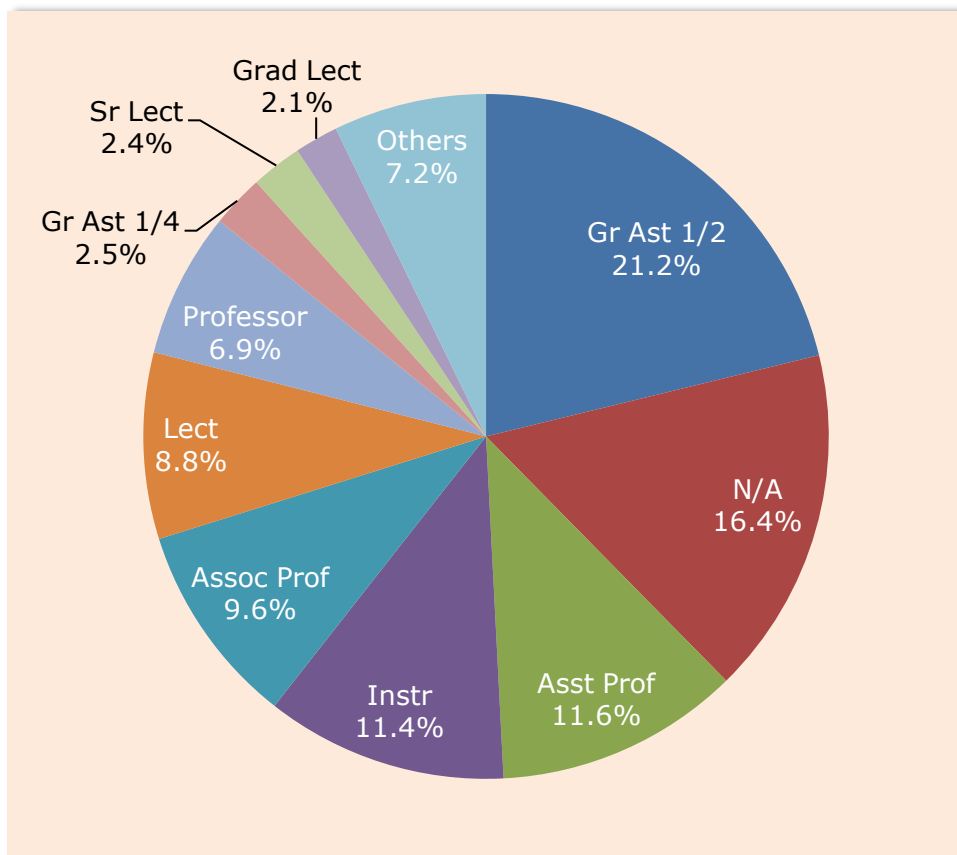


Figure 10. Rank of instructors with blog accounts

Instructors by College

Liberal Arts is by far the most active College in terms of instructors, with 281 instructors having Blog accounts.

Table 38. Instructors by College or Unit

	n	%
Liberal Arts	281	22.3
Unknown	107	8.5
Science - Eberly College	95	7.5
Education	83	6.6
Arts And Architecture	75	5.9
Ps Harrisburg	63	5.0
Ps Greater Allegheny	57	4.5

Engineering	56	4.4
Communications	53	4.2
Agricultural Sciences	44	3.5
Health & Human Dev	41	3.2
Ps Erie	40	3.2
Earth & Mineral Sciences	30	2.4
Business - Smeal College	26	2.1
Ps Worthington Scranton	26	2.1
Ps Altoona	23	1.8
Ps New Kensington	22	1.7
Info Sciences & Tech	20	1.6
Ps Abington	16	1.3
University Libraries	11	0.9
Information Tech Services	8	0.6
Research-Defense Rel	8	0.6
University Outreach	8	0.6
Nursing - School	7	0.6
Ps Berks	7	0.6
Student Affairs	7	0.6
Undergraduate Education	7	0.6
Ps Great Valley	5	0.4
Ps Schuylkill	5	0.4
Ps Fayette	4	0.3
Ps Wilkes-Barre	4	0.3
Ps Beaver	3	0.2
Ps Brandywine	3	0.2
Ps Mont Alto	3	0.2
Educational Equity	2	0.2
Penn State World Campus	2	0.2
Ps York	2	0.2
Research-Strat Initiative	2	0.2
Athl Rec Serv & Support	1	0.1
General & Acad Officers	1	0.1
Housing And Foods	1	0.1
Ps Dubois	1	0.1
Ps Hazleton	1	0.1
Ps Lehigh Valley	1	0.1
Total	1262	100.0

Instructor adoption across Colleges at University Park

The College of Communications far outpaces other Colleges in terms of instructor adoption with nearly 87% of instructors having a Blog account. Liberal Arts and Education follow, with 48.8% and 44.1% adoption. Note that Business boasts the highest student use of the blog platform, but only 19.3% of Business faculty have a blog account. One possible reason for this is the use of the blog platform in early, large lecture business courses by a small number of instructors.

Table 39. Instructor adoption across Colleges at University Park

College	*Instructors total	Blog accounts	% population
Communications	61	53	86.9
Liberal Arts	576	281	48.8
Education	188	83	44.1
Information Sciences and Technology	47	20	42.6
Arts and Architecture	182	75	41.2
Science	402	95	23.6
Business	135	26	19.3
Engineering	356	56	15.7
Ag Sciences	309	44	14.2
Health and Human Development	304	41	13.5
Earth and Mineral Sciences	243	30	12.3

NOTE: the N value for instructors was retrieved from the Penn State Fact Book, and includes all personnel under "Academic" classification for each College for Fall 2009.

Instructor Use across Colleges at University Park

Out of the 281 instructors from Liberal Arts that use blogs, over 50% register no activity. Health and Human Development represents the largest inactive group of instructors at ~59%. Education, on the other hand, contains the largest instructor population that contributes both entries and comments at 42%.

Table 40. Instructor activity across Colleges at University Park

	no entries or comments		entries only		comments only		both entries and comments		Total	
	N	%	N	%	N	%	N	%	N	%
Liberal Arts	150	53.4	59	21.0	14	5.0	58	20.6	281	100.0
Science - Eberly College	47	49.5	26	27.4	3	3.2	19	20.0	95	100.0
Education	18	21.7	21	25.3	9	10.8	35	42.2	83	100.0
Arts And Architecture	15	20.0	17	22.7	28	37.3	15	20.0	75	100.0
Engineering	40	71.4	9	16.1	1	1.8	6	10.7	56	100.0
Communications	18	34.0	18	34.0	6	11.3	11	20.8	53	100.0
Agricultural Sciences	25	56.8	14	31.8	1	2.3	4	9.1	44	100.0
Health & Human Dev	24	58.5	12	29.3	1	2.4	4	9.8	41	100.0
Earth & Mineral Sciences	13	43.3	8	26.7	2	6.7	7	23.3	30	100.0
Business - Smeal College	13	50.0	10	38.5	1	3.8	2	7.7	26	100.0
Info Sciences & Tech	6	30.0	6	30.0	3	15.0	5	25.0	20	100.0

Note: "Unknown" was the second highest classification for College, as some Instructors do not share a College association in the data warehouse.

Top 10 blog use across departments

English, a Department within Liberal Arts, shows the highest instructor utilization of blogs at 73 instructors. Of the 73 instructors, nearly half register no activity in the blog system. Curriculum and Instruction, within the College of Education, has 41 instructors with blog accounts and over 85% of these instructors register activity in the blog platform.

Table 41. Top Ten departmental activity

	no entries or comments		entries only		comments only		both entries and comments		Total	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
English	36	49.3	17	23.3	1	1.4	19	26.0	73	100.0
Dir Of Academic Affairs	25	46.3	18	33.3	2	3.7	9	16.7	54	100.0
School Of Music	7	16.3	6	14.0	27	62.8	3	7.0	43	100.0
Curriculum & Instr	6	14.6	8	19.5	5	12.2	22	53.7	41	100.0
Biology	17	44.7	11	28.9	3	7.9	7	18.4	38	100.0
Applied Linguistics	16	57.1	4	14.3	2	7.1	6	21.4	28	100.0
Liberal Arts	11	42.3	5	19.2	3	11.5	7	26.9	26	100.0
Behavioral Sciences	5	20.0	11	44.0	0	0.0	9	36.0	25	100.0
Communication Arts & Sciences	5	25.0	7	35.0	0	0.0	8	40.0	20	100.0
Philosophy	3	15.0	5	25.0	3	15.0	9	45.0	20	100.0

Conclusion

Blog adoption continues to rise across Penn State, but the data shows a leveling off of the large increases in growth experienced from 2008 to 2009. A wide variety of pedagogical approaches appear to exist with blog deployment. A few instructor uses that were uncovered:

- The blog as a one-way information sharing platform.
- The blog as a place for the instructor to post, then students respond.
- The blog as a place for all students to post and comment (instructor manually adds students to his or her blog, so the whole class can author posts)
- The blog as the centerpiece for a course, including additional web pages with syllabi, assignments, class policies, etc.
- The blog as a 'hub' to all other student blogs, where the instructor directs readers to various student posts each week.

Continued exploration into student blogging and its relation to GPA is necessary. Based on the data, entry-dominant bloggers tend to stay active in the system the longest and display the largest gains in GPA over time. Taking this into perspective, perhaps entry-driven pedagogies should be the focus of blog use in the flow of courses.

Activity data between both the blog platform and wikispaces show similar trends; a large number of users, both students and instructors, login but register no activity. Additional exploration is required to identify why this occurs. Once reasons are identified, iterations of the system (or how training takes place around the system) should take place.

Instructor rank and use patterns across both blogs and wikispaces require further exploration. Some have posited that instructors favor wikispaces, because it is more 'controlled' compared to the blog platform. Based on the dataset for the two platforms, it would appear that the blogs are being used more heavily for education while wikispaces appears to have users leveraging the platform for a wide variety of tasks. Some very interesting and meaningful content exists on instructor blogs, particularly those that have a 'running' blog from semester to semester, keeping a continuous dialog with students. As Penn State moves forward with online education and open online repositories, continued strategic planning needs to take place to identify ways to leverage this pre-existing content for a much larger audience than a single course. Many factors, including FERPA regulations and intellectual property concerns, need to be addressed.