TODAY'S DISCUSSION BOARDS: THE GOOD, THE BAD, AND THE UGLY

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ABSTRACT
The aim of this paper was to investigate the Piazza usage trends amongst the Computer Science Engineering (CSE) department at a research-intensive university located in the southwestern part of the United States (US). Results showed that student and instructor interaction with Piazza varied from course to course with contribution data spikes correlating to important assignments or exams. Undergraduate and Graduate interaction with Piazza differed significantly with some slight overlap. Piazza use was much more prevalent amongst undergraduate CSE students. Undergraduate courses had higher average contributions per student and quicker response times. Logon patterns indicated that many students visit the page without contributing and the profile of the patterns were recognizable and consistent across graduate and undergraduate courses. It is good that Piazza provides a great outlet for interaction and problem-solving for students, but there are bad asynchronous forum factors, and unsettlingly ugly issues of student data and privacy. This investigation points to some interesting data trends and warrants further investigation into *why* students behave the way they do with Piazza and what impact this interaction has on their learning and well-being.

INTRODUCTION

Fostering fruitful discussion can contribute significant improvement to learning. Online tools and software for learning outside the classroom have become more prevalent and accessible for use. A primary example of these tools are online discussion boards like Piazza. There are practical applications of analyzing the current usage of online discussion boards: more online classes are being offered and instructors are increasingly incorporating discussion boards, flipping the classroom, and implementing education technology to augment their teaching. For this purpose, student usage data of Piazza was tallied and analyzed to learn more about student behavior and interaction with the online forum. The insight gathered can elucidate ways to enhance student learning, improve piazza and other forums, and introduce more effective ways to teach. All in all, these online communities and outlets for learning will be increasingly present and must be adequately understood.

Discussion boards are by nature, asynchronous; contributions occur at different times. While multiple users may be logged on and observing, posts pour in at different times and in some instances, can mimic real-time conversations (Andresen, 2009). Discussion boards provide an avenue for uninterrupted communication; participants can express their contributions to a discussion or problem-solving stream without worry of being overlooked or unheard due to timidity or reluctance to speak out. This can encourage an inclusive environment

with more contributions to the discussion (Andresen, 2009). Online learning environment is a large factor in the success of asynchronous discussion boards; the classroom culture fostered as well as the actual participants contributing to the content play a large role. Personality, ways of learning, and communication skill shape the learner-to learner interaction and foster the cohesive end-result of discussion (Guldberg & Pilkington, 2006). In this study, we take a look at multiple Piazza courses and seek to ascertain the degree of student interaction with the online forum-- the factors mentioned all contribute to the amount of student usage and contributions.

Effective instructors attempt to create a healthy learning community and a rich environment for collaboration. In mediating discussion, instructor's over-involvement can result in decreased interaction of learners and serve to quell the individual problem solving of the learners as they defer to the instructor for solution and wait for their answer instead of problem-solving themselves (Guldberg & Pilkington, 2007; Paloff & Pratt, 2001). Ideally, instructors should instead seek to mediate and facilitate the problem-solving and discussion present; confirming and clarifying concepts as a result of student-lead discussion. Piazza tracks the contributions of instructors in their course: their usage can provide a snapshot of how an instructor manages their online discussions and what effect it may have on the overall involvement and engagement of the students.

Asynchronous forums are ultimately used to foster a degree of deeper student learning. Research to assess the level of success of asynchronous forums has elucidated some interesting outcomes of employing discussion boards. A correlation of positive grade increase is seen with increased activity in discussion board use as evidenced by number of times a student posted and how many times they accessed the discussion board (Webb et al., 2004). Of course, it must be considered that varying levels of cognitive complexity and engagement are seen amongst different courses. In assessing the level of success in creating higher student learning, Schellens and Valcke (2005; 2006) found asynchronous forums to be more successful in creating pointed discussion for completion of assignments or tasks. The more discussion, the higher knowledge generation, and the higher level of productive, pointed discussion, the higher the phase of knowledge generation. This prior research and thoughts of improved learning through the use of discussion boards points to the importance of beginning to understand how Piazza is being used. Zhu (2006) points to the earlier discussed notion that instructor role plays an important part in the level of student learning achieved as a result of asynchronous discussion board usage. They found that instructor design of discussion board usage led to higher levels of student learning and is more significant than the actual technology employed. There is no blanket, re-usable technique for assessing the degree and quality of student participation in asynchronous discussion forums. There is often a large amount of data to be assessed and they are all separated temporally, making it sometimes difficult to assess, especially on the individual student level (Bali & Ramadan, 2007; Dringus & Ellis, 2005). This paper takes the first steps toward cohesive assessment and elucidation of information available in Piazza.

Traditional asynchronous discussion forums have been seen to have some limitations and ineffectiveness in certain areas. Particularly, asynchronous forums have shown little feasibility for problem-solving based questions in physics and statistics courses (Kortemeyer, 2006; Hong et al., 2003). Conceptual questions are more general and can deviate from a central point and still address the issue, while problem-solving questions are hyper-specific: Am I using the correct formula here? As a result, these questions have a deal of latency in response and involve a degree of indefinite waiting for response. Overall, research points to the extreme importance of the instructor in shaping and dictating the online environment for their asynchronous discussion board; they must serve as a liaison for preparing content to engage students and shy from being overly-active within them.

Several of the aforementioned examples explore the usage of discussion boards generally, this paper will delve into Piazza usage specifically. Piazza (www.Piazza.com) is a popular free online discussion board that was founded in 2009 and used in thousands of courses internationally. The Piazza interface is an open and interactive discussion that resembles a wiki and forum where students can pose questions, engage in peer to peer collaboration, and is noted for its short response time (Blooma 2013; Parker & Canfield, 2013; Qasem, 2012). In this interface, students can create their own interface and faculty are able to access reports on student participation by aggregating the number of contributions, questions asked, and questions answered (Blooma, 2013). In Piazza, students and faculty alike can contribute to virtual classroom interactions, pose questions, and endorse or correct student responses (Minichiello et. al, 2013). While Piazza has been integrated in several different types of coursework, in our setting it is particularly prevalent in large undergraduate computer science and engineering (CSE) courses.

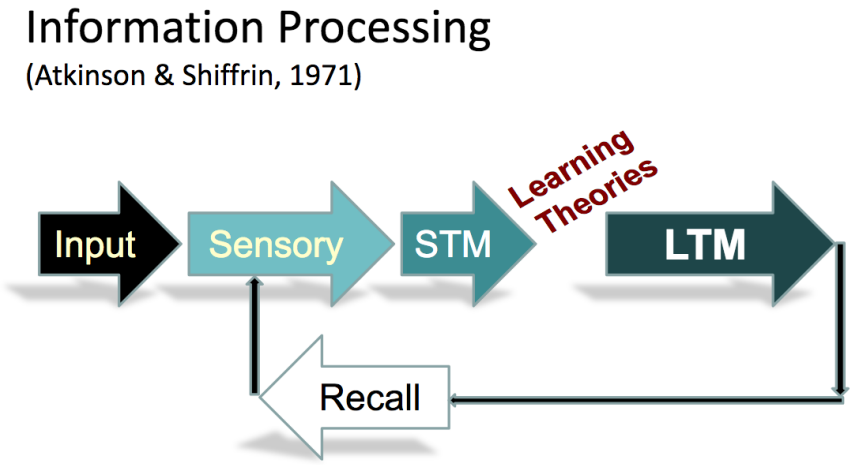
In this study, we discuss the Piazza participation and engagement data amongst CSE students in six classes at a research intensive university located in the southwestern part of the United States (US). Student number of contributions, questions asked, questions answered, questions viewed, and days online are analyzed. In addition,

posts per day and usage trends are analyzed and reported.

LITERATURE REVIEW

Information processing

Information processing (IP) will serve as the theoretical framework to critically evaluate extant literature germane to this study. The IP theory is used to understand how people encode information and create a schema that allows them to shift information from their short term into the long-term memory store.



Short term memory, also known as the 'working memory', can be viewed as the first receptor of input. Degradation of information in the short-term memory store occurs after a very short time period and conversely, the long term memory store is where the information resides in a near permanent state.

The structural composition of the IP Theory can be broken down into three distinct categories: The Sensory Register, The Short-Term Store and The Long-Term Store (Atkinson & Shiffrin, 1971). Seminal contributions have been made by Albert Bandura (1977), who suggests that there are four distinct stages that define the memory modeling process: Attention, Retention, Reproduction, and Motivation.

Classroom Culture

It was reported in the literature that for an instructor to create a positive classroom climate, propagating feedback loops allow energy and direction to infuse the learning environment (Bright, Turesky, Putzel, & Stang, 2012). This is supported by a meta-analysis of what students value in the classroom. The findings suggest that 'genuine dialogue' and building 'strong ties' are deeply valued by students, which in turn leads to increased attention, and cultivation of a sense of community within the college classroom (Elliot, 2016). However, negative feedback loops, also known as 'damping feedback', have been shown to impinge upon the students' ability to take risks and engage fully in class (Axley & McMahon, 2006)

Online Communities

By definition, an online community is a group of people with a purpose, working in a virtual environment, who are supported by technology (Preece, 2000). There are several ways to communicate through online mediums and this in turn creates a range of technologies to support online communication. The literature on Piazza reflects some distinct attributes of this platform as an online community in that it is student-focused and driven by student questions (Blooma, 2013; Hwan et. al, 2016). Despite the multitude of technologies aiming to facilitate communication online, there have been relatively few attempts to measure the effectiveness of the structures in place to facilitate discussion (Preece, Maloney-Krichmar, & Abras, 2003).

Discussion Boards

One mechanism to facilitate online learning can be an active discussion board. Discussion boards have been used as communication platform for a group or online community and additionally have the capacity to serve as a means of archiving and searching communication (Slaton, 2001; Harman & Koohang, 2005). Discussion boards can be an integral part of e-learning and have the potential to function as a learning object; they can also function as a supplement to course materials, providing a dynamic syndicated content (Harman & Koohang, 2005). The literature also points to the potential for discussion boards to improve students' learning in higher

education. Integrating discussion board usage is one means of reducing social barriers and has been shown to present improvements in academic performance and building community (Alghamadi, 2013; Covelli, 2017; Vellukunnel, 2017).

In contrast to the literature supporting the integration of discussion boards in classroom instruction, there is also research that points at the insufficiencies of online discussion boards and highlights the potentially negative consequences of relying upon these platforms. More specifically, discussion boards encourage a depersonalized and highly mediated learning environment (Ruberg, Moore, & Taylor, 1996; Thomas, 2002).

Piazza

One discussion board with relatively high functionality for a free discussion board is Piazza (www.Piazza.com). This platform combines a traditional discussion board with wiki functionalities and was developed with the aim of increasing classroom engagement (Koprinska, Stretton, & Yacef, 2015; Piazza, 2015). Additionally, Piazza has been integrated into flipped classrooms (Clark, Kaw, Lou, Scott, & Besterfield-Sacre, 2018).

There is limited research examining the integration of Piazza, but this discussion board is observed to be commonly utilized in Computer Science (CS) programs. In a recent study on Piazza usage in CS courses, the effectiveness for students was examined and a positive relationship was established between active Piazza users and overall course performance (Vellukunnel, 2017; Minnes, Mayberry, Soto, & Hargis, 2017). Piazza has also been found to create an environment that encourages engagements by sometimes marginalized groups, and particularly women in science, technology, engineering and mathematics (STEM) fields (Sankar, Gilmartin & Sobel, 2015). This study strives to build upon the existing literature on discussion boards, fill some of the gaps in the literature on Piazza usage, and present an overview of the trends of Piazza student engagement.

METHODS

The initial criteria for institutions to be included in this study of Piazza usage focused on large, public, research intensive institutions that offer CS coursework, and are on the quarter (not semester) system. These criteria narrowed our study to 11 potential US institutions. We then analyzed the selected 11 institutions and classified them by student enrollments, admissions percentages, and Piazza usage. After this initial analysis, we elected to search for Piazza discussion boards which occured in the winter 2018, fall 2017, and spring 2017 quarter to provide the most recent data set of completed courses. To identify courses, Piazza allows users to view a dropdown list of courses within the given institution and major. This provided us with additional data regarding Piazza presence within a CS department and allowed us to further narrow the list to eight institutions that demonstrated high levels of Piazza usage in CS coursework. At this point in our analysis, issues of access became apparent across the eight selected institutions. When we selected to join a course, it required a university-specific email domain, and as a result were unable to access the course page. This requirement led us to focus the study within our home institution where we had email domain access and therefore access to all Piazza course pages.

Our institution offers computer science engineering (CSE) courses at both the undergraduate and graduate level. This was our context for gathering and illustrating Piazza usage trends. Using the same methods as described above, we identified courses available at our institution: seven CSE courses were available for sign-up in the fall quarter, three in the spring quarter, and 20 in the winter quarter. Piazza courses were identified in the university's dropdown list and added to the account for access via signing up as a student. We initially selected 14 Piazza pages (Appendix A): six undergraduate courses (CSE 1X or CSE 1XX) and eight graduate courses (CSE 2XX) that provide representative Piazza course experience across fall, winter, and spring quarter of the 2017-8. An average of two contributions per student and 50% of students making a contribution were set as minimum student contribution requirements for adding courses for assessment.

Discussed and represented herein (Table 1) are six selected courses reflecting sufficient enrollment numbers, a coverage of all three recent quarter terms, adequate student contribution, and overall Piazza activity. Specifically, the characteristic participation engagement points of average contributions per student and average questions per student were used as a mechanism for choosing one course over another, as more involved courses allowed for more observation of CSE student usage trends. A student enrollment minimum of 100 and a minimum contributions per student of six were deemed as sufficient. Courses were also investigated to see if podcast versions of the lectures were provided. This information was often on the piazza page itself, but podcast availability was confirmed by accessing course syllabi and departmental site and resource pages. Podcasts are serial audio files describing a story. In our case, the story is a set of class lectures. The podcasts (technically Vodcasts, since they include video) are captured and provided to students following each class session through a university secured electronic portal. The presence of this feature in the course was posited to be a potential

contributing factor to the usage of Piazza. In addition to whether or not a course was podcasted, the inclusion of specific requirements of Piazza participation being considered in the grading structure was identified as an important potential contributing factor in the rate of Piazza participation. This incentivization essentially guarantees full usage of the course page and some atypical trends and variables arise. For this reason, only courses without Piazza participation in the grading structure were analyzed (Table 1). Usage patterns amongst classes with grading incentivization are available in Appendix A.

Quantitative usage of Piazza by CSE students at this institution was evaluated. This included Piazza

- course enrollment;
- percent of enrolled students that made a contribution;
- total number of posts;
- total contributions;
- number of instructor/student responses;
- percent of questions receiving instructor/student responses;
- percent of student responses endorsed by the instructor;
- number of student questions; and
- average response time.

Table 1. Piazza participation.

Course Name	Enrollment	Total Posts	Average Contributions per Student	Average Response Time
CSE 255	219	658	13	32 mins
CSE 123	110	394	12	19 mins
CSE 252A	178	407	8	72 mins
CSE 12	316	1645	18	31 mins
CSE 131	162	528	16	17 mins
CSE 250B	319	513	6	104 mins

Once logged into a CSE course, the user is able to access all question and answer posts, class resources and documents, and a summary of usage statistics. Data related to usage trends was collected by navigating to the Statistics tab for each course on Piazza. Summarized usage trends were collected by selecting “View Piazza Report” from the Statistics page. Usage trends were collected for unique users per day and unique posts per day by creating a screen capture of the graphs displayed on the Statistics page. Hovering over the graph shows the value of individual data points. Data points for peak values were collected and analyzed. Data from the posted syllabi for each course was collected either from the course’s Piazza website or from the public online directory of CSE courses. Dates corresponding with exams and/or deadlines were collected from these syllabi. After collection of student usage graphs from the Piazza course statistics page, the progression of student engagement with the course over time was analyzed. Specifically, for each course, a peak of student questions asked was identified. Upon recognition of this peak and its corresponding date, a quick investigation of the posts’ content during this date was done to ascertain what major assignment(s) or test may be the cause of a spike in the page usage. This date was then confirmed by reading the course syllabus.

RESULTS

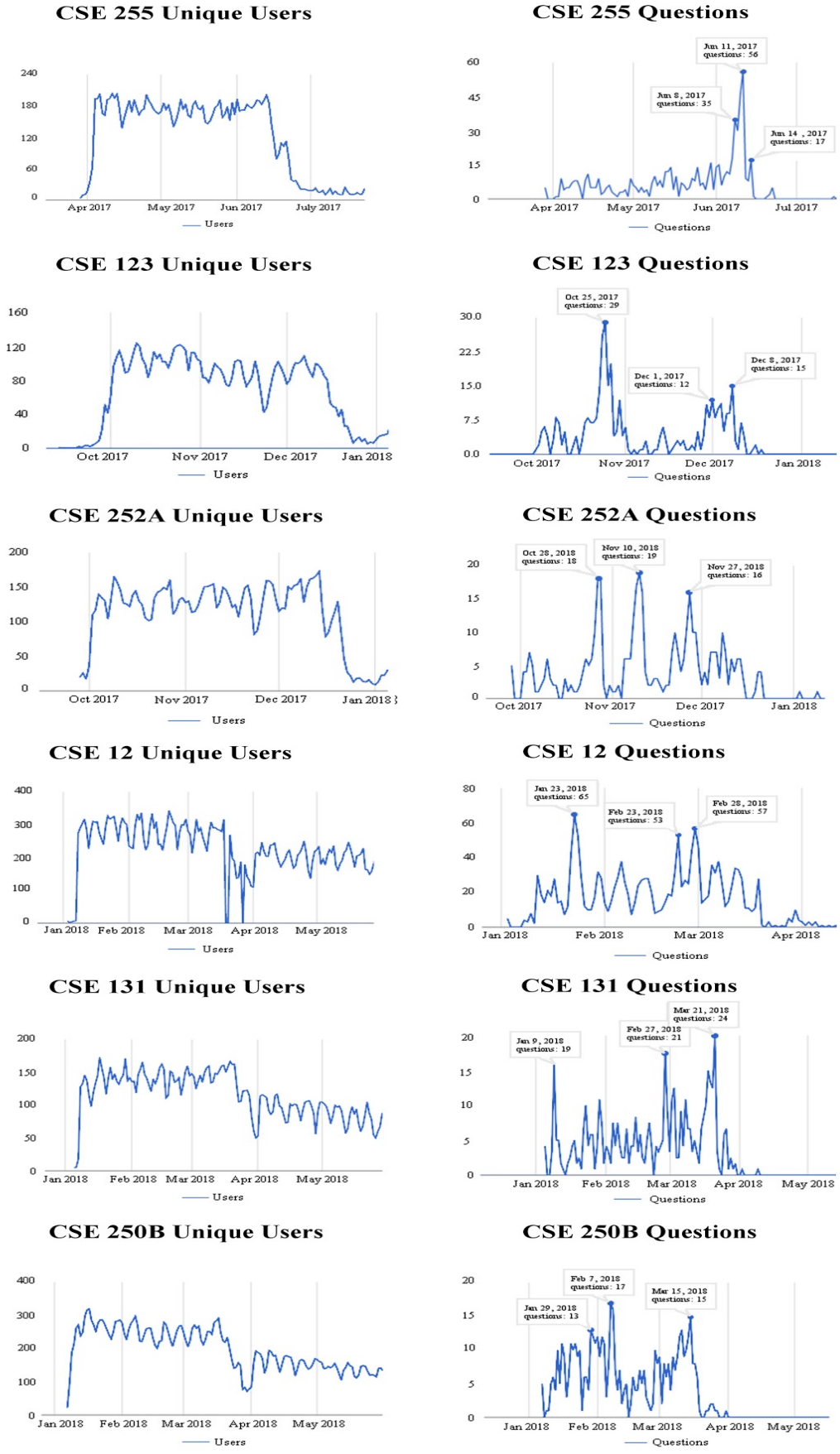


Figure 1. Piazza Usage Plots. Unique users are logs of when an individual student logs on at least once during a

given day. Questions asked for the corresponding courses are shown in the right panel with 3 highest usage dates marked by their date.

DISCUSSION

Use of Piazza amongst students in CSE at a large public research-intensive university in the US operating on the quarter system was investigated (Appendix A). Courses in the spring 2017, fall 2017, and winter 2018, were specifically observed. CSE courses at the institution often involve a series of programming homework assignments, exams, and/or a programming project. By nature, this requires students to answer many programming questions and code their own answers. Critical thinking anchored by knowledge of concepts taught in class and text are necessary to complete the tasks at hand.

Piazza is used in these courses as an avenue for students to ask questions outside the classroom or office-hour periods. Students can directly ask clarifying questions on assignment instructions, due dates, exams, etc. It allows for the students to work together collectively to critically think and problem-solve to tackle a common goal: completing a question or understanding a concept. Because of the nature of these CSE classes where original programming code is required, there are often stipulations or general understanding that source code or other information that would otherwise state the answer is not allowed for posting. Student contributions were observed to generally entail logistical clarifications (tests, HWs, grading, etc.) or content specific problem solving (HW questions, Review questions, etc.). The actual content of these contributions, however, was not the focus of this work, but instead on how Piazza was being used.

Overall, the Piazza courses shown in Appendix A convey a robust use of Piazza in the CSE department at this university. Total course contributions ranged from 1,347 to 5,619 contributions and total posts ranged from 394 to 1,645 posts. Posts include all notes and subsequent comments posted by the students. Piazza contributions entail "posts, responses, edits, follow-ups, and comments to follow-ups" (“Class Statistics”). Question response rate amongst all CSE courses investigated in Table 1 was very high, with an average response rate of 93%. Overall response rate totaled about 93% (Appendix A). Classes vary widely in their method of participation: some courses are driven by instructor responses while others have a majority or responses coming from fellow students. Literature addresses the question of the “role of the instructor” in discussion forums and suggests that they should take a hands-off approach (Andresen, 2009) . The data within this CSE department shows that there are multiple instructing approaches in using Piazza. The online learning environment fostered by the instructor and students is a large factor in the success of asynchronous discussion boards and naturally; personality, classroom culture, ways of learning, and communication skill vary from classroom to classroom and student to student (Guldberg & Pilkington, 2006). For this reason, we can expect quite a degree of heterogeneity amongst usage data, but given the subject-matter and institution, some commonalities are seen as well amongst certain courses.

The courses assessed included both undergraduate and graduate courses. Piazza use was much more prevalent amongst undergraduate CSE students. Average contributions per student in the undergraduate courses was about 15 contributions. In the graduate courses there were only an average of nine contributions per student. In addition, graduate student courses only averaged 2.6 questions per student, while undergraduate courses averaged four questions per student. Average response time in undergraduate courses was also less than a third of the response time seen in graduate courses (Appendix A and Table 1).

These trends point to key observations. Undergraduates, on average seem to have a more involved relationship with Piazza, contributing much more often than graduate students. Are graduate students interacting with it less often because of less need or pressure? Or does the structure of assignments differ at a higher level of education?

The questions addressed to this point warrant a deeper investigation of patterns and trends within these contributions observed (Appendix A and Table 1). Specifically, in the undergraduate course, CSE 12, there were three spikes in usage as signified by questions asked (Figure 1). These dates were assessed closely by reading the course Piazza posts during that day and verifying assignment due dates as outlined in the specified course syllabus. Syllabi and course information was accessible without actually being a student enrolled in the in-person course; the Piazza page or the university computer science department website harbored these course details. In the CSE 12 course, Jan 23rd consisted of the most questions with 65. This was a day before their second programming assignment was due; so accordingly, students utilized the piazza page significantly more to complete the assignment and collaborate with others, while also asking the instructor for clarification and guidance on the problems. Similarly, on February 28th, 57 questions were asked the day their sixth programming assignment was due. February 23rd also corresponds with a programming assignment.

In a graduate course, CSE 250B (of similar enrollment to CSE 12, Table 1), The highest usage date fell on February 7th, 2018. 17 questions were asked the day before the course's first midterm, signifying the first test of the entire quarter. The second-most usage of 15 questions asked occurred March 15, 2018; which was attributed to a final exam 2 days afterwards. Finally, January 29th had 13 questions asked two days before their third homework assignment was due.

Students regularly logged on for the undergraduate, CSE 12 course. From January 2018 to March 2018, CSE 12 garnered approximately 210-310 students visiting the site; Piazza dubs each student that logs into the class page at least once that day as a "Unique User." This average shifts in the latter portion of the course from April to May 2018, where the course only garners 130-250 unique users. Another undergraduate course, CSE 131, bears a strikingly similar pattern to this, where students login at a somewhat constant range that dips slightly in the last two months of the quarter but also remains constant. CSE 250B also mimics the pattern of CSE 12 and CSE 131, despite being a graduate course. While this login pattern is the same, actual contributions to the piazza page do not occur similarly amongst undergraduate and graduate courses. CSE 250B has significantly lower questions asked, and the focus of the questions are different. Many questions in higher usage dates were exam focused instead of homework or assignment focused. The highest peaks observed in Figure 1 for the undergraduate courses were almost solely due to homework or project based assignments, while a larger percentage of higher usage dates in graduate courses were attributed to an exam of some sort. Interestingly, CSE 255, CSE 252A and CSE 123 all exhibit a unique users profile that increases sharply at the beginning of the quarter, plateaus throughout the duration, and abruptly decreases to no usage at the end of the course. The consistency of these logon patterns in CSE courses reach across undergraduate and graduate courses.

In relation to this apparent consistency, a compelling observation amongst all courses is the phenomena that peaks in questions asked do not correlate strongly with number or unique users. Students are regularly logging on; but, despite say, 300 students logging on, only 10-60 may ask a question. This suggests that students regularly check the site to see what they've missed or peruse the posts for specified information without contributing to the discussion or problem-solving. Do students check for a purpose? It begs to question, do they logon to complete their assignment or another task, or is it simply a mental necessity to put their mind at ease? This type of log-on-daily attitude is one that brings up an interesting question of what these type of learning communities contribute. What is Piazza's impact on student learning and their emotional experience with it? Do notifications and the simple presence of a page being updated daily cause a sense of uneasiness amongst the students that would otherwise not have used the site to ask a question or contribute to a response? We will attempt to categorize the findings in areas of “Good, Bad and Ugly” below.

Good

In lieu of meet-ups at a library or limited office hours, students have available to them a discussion board where they can ask questions at any time and recruit a group of classmates and instructor(s) to help them learn and problem-solve. Piazza facilitates a litany of outside-classroom interactions that may not happen otherwise. Access to this site provides an opportunity to enhance learning and retention via meaningful interactions within the question and answer based system. Discussion boards provide a unique opportunity of uninterrupted communication and an inclusive education environment. Normally timid or reluctant students can express their contributions without fear (Andresen, 2009).

As mentioned earlier, active Piazza use has been seen to lead to positive overall course performance (Vellukunnel, 2017; Minnes, Mayberry, Soto, & Hargis, 2017). Piazza also can create an inclusive environment that encourages engagement by underrepresented groups (Sankar, Gilmartin & Sobel, 2015). Piazza provides a largely asynchronous style of question and response. This type of discussion forum has been seen to produce a task-oriented environment that results in higher levels of new knowledge (Schellens and Valcke, 2006; Schellens and Valcke, 2005). Piazza also serves as a great tool for instructors to assess student participation. As seen in this paper, student usage patterns and contribution statistics can be analyzed. For instructors, access to a .csv file creates a facile way to see how the classroom is interacting with Piazza. In addition, easy to understand reports and quick-hit information like “top-student contributors” are also available.

Bad

In an asynchronous discussion forum like Piazza, students can ask questions that are instantly responded to or there can be a degree of latency to the response; in some instances, questions may go unanswered. Question response rates seen in Appendix A range from 81% to 100% and average response time varied widely from 17 minutes all the way to 104 minutes. This waiting or non-response can dampen a student’s ability or potential to solve a problem.

Also, this format of forum can lead to confusion amongst students-- multiple postings, comments, and contributions can lead to students responding to the wrong post or miss out on key information in problem-solving (Dringus and Ellis, 2005).

While Piazza does provide a litany of statistics and data regarding student usage of the page, there is no blanket way to assess participation with explicit clarity. When incentivized with participation credit, students can opt to post minimum response requirements to get credit and not actually contribute a meaningful post (Palmer et al, 2008). Literature has shown that only a small portion of students are largely responsible for the total number of posts or contributions within a discussion forum (Breslow et al, 2008). Piazza dubs these students as "Top contributors," and their habits can skew what may actually be occurring amongst the majority of the classroom.

Ugly

In the initial investigations of Piazza usage amongst the CSE department at this university, we stumbled upon some unforeseen discussions which caused a proverbial flag to be raised. As outlined in the methods, we were able to navigate to various Piazza courses. Although access was limited to university email domain, once present on the class page you could obtain fairly sensitive information without being enrolled in the actual class. For example, page posts often are tagged with a student's full name unless they choose to classify that post as anonymous. Many in our investigation opted not to post anonymously. Even for the few that did choose this route, the statistics page posts full names of top student contributors to the Piazza page. In every report summary seen in this investigation, full student names were seen. In our case, we poured through this information months after the conclusion of the courses.

On one hand, this points to the ease of which we were able to obtain this information without having to consult with the classes in any way; on the other, it inspires the question of what truly is open source and what does privacy mean?

This line of questioning led us to the subject of student privacy and student data. Piazza Careers has quietly integrated itself into the site, without many knowing what it actually means. Piazza has been a free resource for students, but in 2014 Piazza Careers began, selling student data to interested parties and recruiters. Do students realize what Piazza Careers is? Are they explicitly aware that their data is being sold? Well, Piazza's privacy policy addresses this and students must "opt-in" to the service. But in practice, opting-in involves recognizing an auspiciously pre-checked sign-up box upon the initial setup of your Piazza account. This issue is at least eye-raising and has been covered extensively and completely elsewhere (Hill, 2016a; Hill, 2016b).

LIMITATIONS

Statistical analysis proved difficult due to the requirement of signing up as a student. If you sign-up for a Piazza course as an instructor or TA, you are given access to a .csv file when you navigate to the statistics page of the course. This gives tabular entries of student contribution statistics, which facilitates facile processing for statistical analysis of both individual student and course averages. Piazza provides a smaller amount of statistical analysis accessible through student log-in; that data is represented herein. Future studies may be aided by access of the site with special TA or instructor as afforded by the course professor. There is much to be said about the sheer amount of data accessible without this step.

As mentioned in the methods section, we were limited to analyzing courses which were available to us in the sign-up process. 30 total Piazza courses were available at our institution, but the distribution of the courses was not balanced; notably, the spring 2017 quarter only had three total courses available to pull data from. Two of these spring 2017 courses had very low enrollment of 16 and 28 students. This comparative lack of representation for this quarter effectively limits the overall balance of the data across all three quarters (Appendix A).

CONCLUSION

This paper provides a characterization of Piazza usage amongst CSE students whilst also stumbling upon the Good, Bad, and Ugly of Piazza and asynchronous discussion boards as a whole amidst overarching themes of data access and privacy. The statistics freely accessed in this investigation point to robust piazza usage at this university and can serve as a reference point or indicator for instructors teaching within similar departments or fields on how their students may interact with their online discussion boards.

The issues and concerns raised about Piazza Career services warrants a consideration of the universities and institutions which use the site. What should we/they do about this? We suggest that students and instructors are

educated before use by the university. This could serve to coach students on how to opt-out of sharing their student data if desired and enhance the transparency on what seems to be an easily overlooked component.

The student Piazza usage results illustrated some intriguing trends within individual courses and revealed differences and similarities between undergraduates and graduate courses. Future studies warrant further investigation into *why* students behave the way they do with Piazza and what impact this interaction has on their learning and well-being. In addition, observation of CSE students within a semester system would prove useful for comparison and serve as an indicator for what dictates usage of Piazza.

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APPENDIX A.

Master Table of Piazza participation.

Course Name	Quarter	Podcasted?	Piazza Participation Credit?	Usage Class (Low, Med. High)	Enrollment	% to make contribution	Total Posts	Total Contributions	**Average Contributions per Student**	Instructor Responses	% of questions receiving Instructor response	Student Responses	% of questions receiving Student response	% of student responses endorsed by instructor	Student Questions	**Average Questions per Student**	Question Response Rate	**Average Response Time**
CSE 216	Interaction Design Research	Spring 2017	N	Y	Low	28	100%	104	234	**9**	41	63%	16	21%	8%	62	**3**	81%	**42 mins**
CSE 255	Big Data Analytics Using Spark	Spring 2017	N	N	High	219	76%	658	2773	**13**	187	30%	796	66%	34%	581	**3**	81%	**32 mins**
CSE 291	Embedded Image Processing	Spring 2017	Y	N	Low	16	56%	36	60	**4**	9	73%	1	9%	0%	11	**1**	82%	**N/A**
CSE 123	Computer Networks	Fall 2017	N	N	Med	110	82%	394	1314	**12**	390	93%	79	17%	33%	337	**4**	99%	**19 mins**
CSE 210	Principles of Software Engineering	Fall 2017	N	N	Low	37	76%	177	378	**11**	80	100%	6	8%	33%	79	**3**	100%	**78 mins**
CS	Com	Fa	Y	N	M	178	69	4	134	**8**	30	76	13	27	23	36	**3**	95	**72**

E 252A	puter Vision I	ll 2017			ed		%	07	7		4	%	1	%	%	2		%	**mins**
CSE 12	Basic Data Structures and Object-Oriented Design	Winter 2018	Y	N	High	316	87%	1645	5619	**18**	1385	78%	542	27%	11%	1491	**5**	97%	**31 mins**
CSE 110	Software Engineering	Winter 2018	Y	Y	High	197	99%	866	3441	**18**	597	90%	186	23%	26%	601	**4**	100%	**36 mins**
CSE 131	Compilers	Winter 2018	Y	N	High	162	87%	528	2431	**16**	312	50%	510	56%	21%	462	**3**	95%	**17 mins**
CSE 190A00/B00	Successful Entrepreneurship	Winter 2018	N	N	Med	112	56%	150	338	**4**	77	88%	6	7%	33%	84	**1**	94%	**60 mins**
CSE 190D00	Statistical NLP	Winter 2018	N	Y	Med	106	73%	249	1030	**10**	173	73%	162	64%	29%	211	**2**	100%	**54 mins**
CSE 202	Algorithm Design and Analysis	Winter 2018	N	N	Med	97	64%	189	498	**6**	146	78%	30	14%	29%	169	**2**	88%	**31 mins**
CSE 222A	Computer Communication Networks	Winter 2018	N	N	Low	27	67%	33	69	**3**	13	80%	2	13%	0%	15	**1**	93%	**49 mins**
CS	Mach	W	N	N	H	319	59	5	183	**6**	37	67	28	39	27	47	**2**	93	**10**

E 250B	ine Learning	inter 2018			igh		%	13	2		4	%	9	%	%	6		%	**4 mins**

