

Always on Stress: The Emotive Impact of Anytime, Anywhere Discussion Boards

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Abstract:

This study assesses whether university students experience stress while using Piazza, an online discussion forum. Along with other forms of educational technology, the online discussion forum Piazza offers students and instructors potential benefits as well as drawbacks. Online discussion can generate several Piazza posts per day per student, along with additional emails and notifications. This near-constant stream of information could pressure students to keep up with new content, which could potentially lead to stress and confusion when posts may be incorrect and/or provide misconceptions. The aim is to clarify the impact on university students of the “always on” aspects of Piazza and other discussion forums. Data was gathered about how students use Piazza; their specific experiences; and whether using Piazza leads to stress or confusion. We found that although the content of discussion posts itself does not indicate stress or other emotions, students report pressure associated with checking websites and notifications. Students also report a mix of positive and negative emotions, including stress and anxiety, associated with Piazza use.

Key Words:

Educational Technology, Discussion Boards, Stress, Confusion, Frustration.

Introduction

Over the past five to ten years, the number and volume of supplemental educational technology resources for classes in higher education has grown rapidly. In addition to lecture, discussion sections, and the textbook, there are now video podcasts, GitHub email notifications, Gradescope notifications, Gradesource updates, emails from Learning Management Systems (LMS), and perhaps LinkedIn notices, Tweets, student response questions, and more. Some colleges use an online discussion forum called Piazza, which can have hundreds of discussion threads, totaling over 1,000 messages and thousands of contributions per term for some courses. New questions and answers on Piazza arrive at any hour of the day and night, necessitating almost round-the-clock monitoring for students to ensure they don't potentially miss something important. It takes time and effort to filter through the posts to determine which ones are relevant to students and, at times, to their success in the course. Keeping up with this firehose of notifications and content takes a considerable amount of time and can lead to chronic stress through over-attention, distraction, and ultimately exhaustion.

These new resources may enable new options for accessing information via search instead of through more methodical activities like reading a textbook, taking notes while reading or during lecture, or simply working through a problem or a project with only a certain set of resources available. When students encounter a roadblock, they can search for an answer instantaneously. They can scan through a class's podcast for relevant portions of a lecture, text a classmate or chat with classmates on social media, contact the teaching staff through email or other digital channels, or search for answers on a discussion board. Any of these behaviors has the potential to short-circuit reflective processes that can be valuable for learning.

Stress Appraisal Theory

According to stress and coping theory (Lazarus & Folkman, 1984), a source of stress in the environment (a stressor) may lead to individual stress if the stressor is appraised as relevant and if the individual is unable to cope with the stressor. In this context, stressors in a student's academic environment may create stress if a student does not feel able to cope with or manage the source of stress. Additionally, *Fear of Missing Out* (FOMO), has become synonymous with social media and online based platforms such as Piazza. A recent study showed FOMO to be associated with greater depression, anxiety, and physical symptoms (Baker, Krieger, & LeRoy, 2016).

Piazza, a wiki-style discussion forum, allows students to pose questions to their professors and teaching assistants while collaborating in a shared space with their peers. We hypothesize that a resource like Piazza may create stress for university students if:

1. Students appraise Piazza as relevant to their environment and view it as a potential source of academic stress; and
2. Students do not feel able to cope with the challenges of Piazza.

Here we describe some of the potential challenges that Piazza may present to students. These challenges are not necessarily limited to Piazza; they could arise from similar discussion forums or from online communities.

Potential Challenges with Piazza

As mentioned, Piazza is a wiki-style question and answer (Q&A) forum that highlights individual questions rather than using more traditional discussion threads. A wiki is a website that allows collaborative editing of its content and structure by its users (from the Hawaiian word, meaning “quick”) (Wiki, 2018). Piazza can be used within or outside of an institutional learning management system (LMS). The word Piazza comes from the Italian word for plaza—a common city square where people can come together to share ideas and knowledge.

Although learning communities can be a viable pedagogy, communities are typically moderated and have norms developed by the members and/or by the physical space and time. With community members engaging in the online platform asynchronously, at any time of day or night, members may tend to participate more than necessary. This “always on” phenomenon, a central point of investigation of this study, can lead to several potential challenges that may reduce student morale. Piazza functions differently from typical asynchronous discussion forums in ways that can lead to challenges due to its “always on” nature. Students can receive notifications of new content every time a post or a response to a post is created. Because these posts may contain information relevant to a specific assignment, students may feel pressure to check the discussion forum frequently to ensure they do not miss important information. We will investigate these particular challenges in the context of a computer science course with active online discussion.

Notifications. Piazza can optionally notify users every time a new post is created or every time a post is updated/answered. Similar to social media, Piazza can generate frequent notifications through emails and website indicators. Users can also see “Average Minutes to Answer Questions,” which provides implicit expectations about how long a student needs to wait to receive a response.

These notifications can negatively impact work/life balance. Because most instructors truly care about communicating, this data inevitably incentivizes the instructional staff to answer questions quickly. As a result, Teaching Assistants (TAs) and instructors commonly answer questions throughout the day and night. This can erode the concept of “work time” and “personal time,” potentially disrupting a life balance, seen to create both higher quality work and a healthy learning community.

Rapid progression of discussions. In an active class with many student contributors (likely also including contributions from the instructor and TAs as well), discussions can move very quickly. Students answer each other’s questions, often before instructional staff respond.

Student answers can help the instructional staff manage the question load. However, occasionally students inadvertently answer with incorrect information. If those incorrect responses are not removed almost immediately, they can tacitly become “official policy.” These events place a significant burden on the teaching staff to continuously monitor Piazza for false or misleading information. As an example, consider a programming assignment. One student might ask whether they need to add code to their project to handle a rare and obscure failure condition. A second student replies that they do, and so the first student spends hours implementing that feature.

Around that same time, a member of the instructional staff replies that they do not, in fact, have to support that case. This leads to resentment and frustration on behalf of the student for "wasting" their time, and that can be directed at the teaching staff for not handling that false information in a timely fashion.

The rapid progression of discussions can also lead to inconsistent responses from the instructional staff. Some of the largest classes on campus can have 10 TAs and 20 tutors. To manage the Piazza load, different members of the instructional team will respond to student questions at different times. Although this approach can be efficient, it can lead to inconsistent responses between those providing responses. This can lead to confusion and lowered morale. In some cases, the inconsistency will be pointed to as a reason for why that part of the assignment needs to be invalidated entirely. Although this issue may not arise for all large classes, it was observed at the institute under study.

Abundance and urgency of information. Information about assignments or projects may be disseminated through Piazza much more rapidly than through other channels, such as during lecture. This means that clarifications or modifications may appear that students feel obliged to know or to check on.

This constant flow of information can create a distraction for students. For active classes, Piazza can have hundreds of threads, totaling thousands of messages. Because many of those questions are about assignments and projects, students may check the forum very frequently to make sure they do not "miss something important," such as a clarification of the assignment specification. From the faculty author's experience, some students who finish their assignment hold it until the last minute, just in case a post is provided that may give pertinent information that causes them to change their deliverable. The result is that Piazza becomes another social networking source of intermittent notifications.

The abundance of information can encourage short-cutting the development of problem solving skills. In many courses, questions are answered in minutes, not hours, by teaching staff. This can lead to a dynamic in which students post questions to Piazza when they encounter an aspect of the project that they do not know how to solve. Rather than visiting office hours or meeting with a TA in a discussion section, which would encourage active participation, the student can post and then has the option of passively waiting until the answer is delivered (often in just a few minutes). To be clear, we try to avoid students engaging in non-productive struggle. However, providing near-instant responses to questions not only removes the incentive to re-read the assignment and revisit the materials provided, it also attends to less effective pedagogical methods. There are several research-driven approaches which support the notion of allowing students to struggle. Piaget (1974) discovered that when students are allowed to struggle, they enter into a disequilibrium phase of learning. If they persist and are provided supportive resources, they will either accommodate or assimilate their schema and ultimately scaffold their understanding, so that when presented with a similar context, they are able to make the conceptual connections (Piaget, 1974). Providing an environment in which students can reflect upon not only what they learned but how they learned has been shown to improve students' abilities to learn in new contexts. This metacognitive approach allows students to become aware of their current level of

understanding and what is required to extend their learning (Washington, Bardolph, Hadjipieris, Ghanbari, & Hargis, 2019).

The present study aims to clarify the impact of these “always on” aspects of Piazza on students. At the large research institution in this study, Piazza has been commonly used in computer engineering courses. Many of these instructors have used Piazza and have anecdotal observations about its effects on students that we wanted to investigate more formally. We gathered data about how students are using Piazza, what types of experiences they have had, and whether using Piazza leads to stress or other emotions.

Research Questions

1. What is the emotional impact of Piazza on students?
2. Do tools such as Piazza increase stress and therefore decrease learning?

The present study uses data collected from Piazza posts, a student inventory of potential sources of stress, and a small group perception study to address the above questions. We first investigated whether or not Piazza is a potential source of stress and then, once the findings demonstrated Piazza is a potential source of stress, we looked for evidence that students are experiencing stress related to Piazza use.

Literature Review

Discussion Boards

There has recently been an effort to understand the nature of asynchronous discussion forums in the context of online education, including studies of how students are participating and how instructors choose to interact in these forums (see Andresen, 2009). Overall, online discussion forums can provide a unique platform for students to communicate with peers and instructors, even when those same students are reluctant to speak up during class (Sankar, Gilmartin, & Sobel, 2015). Online discussion forums can reduce the effects of student perceived status and allow for controversial conversations to take place (Chen & Chiu, 2008).

Research has shown students value instructor contribution to discussion, although this contribution should remain limited to prevent stifling of student conversation (Mazzolini & Maddison, 2003). Students prefer an active, easy-to-use forum and may create their own space for discussion if the platform provided does not suit their needs (Deng & Tavares, 2013).

Piazza

According to the product website, www.piazza.com, Piazza has been used by over 50,000 professors and 1.3 million students in 1,500 schools and 90 countries (“Ask. Answer. Explore. Whenever,” 2018). Piazza was created to facilitate discussion among students who may feel reluctant to communicate with their peers in a classroom setting, particularly female and minority STEM students (Sankar, Gilmartin, & Sobel, 2015). Students using Piazza are given the option to communicate anonymously, allowing reluctant students to voice questions and participate without fear of judgment.

Voluntary participation in Piazza may be relatively high for computer science students, especially if the teaching staff encourages its use (Vellukunnel et al., 2017; Minnes, Mayberry, Soto, & Hargis, 2017). Vellukunnel and colleagues (2017) studied students' Piazza participation in a computer science course taught at two universities in North Carolina (560 students and 26 TAs total). They found that 81% of students posted at least once and over 99% of students viewed Piazza posts. Students primarily asked questions related to solving homework/project problems and to course logistics. Only a few questions were classified as interactive, reflecting a high level of reasoning (for example, questioning the efficiency of a process demonstrated in the class lecture). Piazza was mainly used for constructive problem solving, which showed a correlation with course grades. At one of the two universities, students who asked at least one constructive question received a higher grade on average than students who did not.

Stress, Confusion, Disequilibrium, Metacognition

While online discussion forums such as Piazza clearly provide a valuable channel for student communication, instructors and TAs have questioned the emotional impact this tool may have on students and teaching staff. Instructors at the university in the present study have reported pressure to appear available to students, to remain aware of the nature of student questions, and to monitor answers to ensure misinformation is not being spread. New instructors and TAs may be more susceptible to these pressures because of their desire to be perceived as knowledgeable and relatable to students, especially when it comes to end-of-semester evaluations. Boice (1991) found that new instructors' lack of confidence led to over-preparing lecture materials in an effort to deliver better content, while neglecting more engaging teaching methods. This focus on teaching preparation in the presence of negative reviews and evaluations led to disillusionment and failure to dedicate time to other responsibilities like scholarly writing.

Although we did not have student reports about the emotional impact of Piazza and other discussion forums prior to this study, there is little doubt college students are generally experiencing stress: recent studies indicate over 35% of students report stress as the leading factor affecting their academic performance (American College Health Association, 2018). Online activity may contribute to some of this stress; over 15% of students report internet use/computer games affecting performance.

Stress can be understood in terms of stressors, things and events that can create stress; responses to stressors, involving appraisal of the situation and an individual's coping responses (Folkman, 2013). To assess whether students are experiencing stress, researchers can look for the presence of both stressors and students' reactions to stressors, including physiological, emotional, behavioral, and cognitive reactions (Gadzella, 1994). When metacognitive learning strategies are applied to a classroom, students are provided with the opportunity to "Externalize mental events" and identify what is blocking deep learning in their setting. This process has been shown to enhance a students self-directed and self-efficacy learning skills and equip the learner with the ability to complete the task at hand (Bransford, Brown, & Cocking, 2000).

Confusion and disequilibrium can be a vital component of deep learning. When students enter a state of disequilibrium they are presented with two choices, the first being to assimilate the new information into the extant plan or methodology. The second

choice is to accommodate the new knowledge by replacing the old with the new. When one of these choices is made, cognitively, order is restored, and a balance is returned, allowing information to be processed into students' long-term memory (Piaget, 1974). When considering the impact both confusion and student frustration can have on knowledge acquisition, the literature suggests that taken on their own, states of confusion and frustration are negatively associated with learning. However, when students experience both confusion and frustration in the correct amounts for a short duration, this can lead to deeper learning and understanding (Liu, Pataranutaporn, Ocumpaugh, & Baker, 2013). Furthermore, the literature suggests that students who used a metacognitive approach towards their learning are able to identify the complexity of the material they studied and in turn pose challenging questions to their peers (Chick, Karis, & Kernahan, 2009). Metacognition is the ability to think deeply about how one learns and processes new information. This higher-level ability to reflect and monitor one's own learning has been shown to enhance the self-regulated learning skills (Chick, Karis, & Kernahan, 2009).

Social Media and Online Activity

Using social media platforms can cause some disruption to educational environments. Findings from a study using surveys and a focus group initially point to the fact that students see social media as a tool to engage in social connections with peers (Gettman & Cortijo, 2015). A trend from this study indicated students are interested in receiving course information on a social media platform is accessed on a regular basis by many users. Conversely, the same study found that many students wanted to keep their private and scholarly activities separate. Analyses of both the qualitative and quantitative data confirmed students have relatively negative attitudes towards instructors initiating the use of social networks for academic purposes (Gettman & Cortijo, 2015). Finally, recent research indicates the more an instructor is involved in the organization of activities using social networks, the less comfortable students are in accessing the information (Gettman & Cortijo, 2015, but see Mazzolini & Maddison, 2003 and Bork & Rucks-Ahidiana, 2013 for other perspectives).

The American Psychological Association's Stress in America™ survey (2017) describes the profile of a "constant checker," someone who constantly checks emails, texts, or social media accounts. This profile describes 43% of Americans, with younger adults checking technology more than older adults. This group of individuals reports more stress than those who do not frequently check their accounts/devices, reporting an average of 5.3 on a scale from 1 (little to no stress) to 10 (a great deal of stress). Additionally, 63% of Millennials report feeling constantly attached to their phone or tablet. Fear of missing out (FoMO) can be described as a concern of being disconnected from experiences or events from the individual's concentric circle. Recent studies have shown a correlation between FOMO and depression, insomnia, stress, and emotional tension (Riordan, Flett, Hunter, Scarf, & Conner, 2015). The research points towards heavy users of social media experiencing anxiety and social media fatigue through intense use (Dhir, Yossatorn, Kaur, & Chen, 2018). Boksem, Meijman, & Lorient (2005) have shown students who experience social media fatigue from the constant engagement in social media discussion boards are also likely to experience detrimental outcomes to their cognitive abilities.

Methods

Setting

The study was conducted in a computer science engineering (CSE) course at a large, research-intensive public university located in the western region of the United States. Procedures were approved by the Institutional Review Board (IRB) at the university and all subjects consented to have their de-identified data used in this study.

Participants

The participants for this study were 167 second semester junior and senior CSE students (23 female, which represents the current gender ratio for this discipline). This student number represents a single class in the CSE department. All participation in this study was voluntary. Out of the 167 students in the class all participated in the Small Group Perception Survey. All information was numerically coded, and confidentiality was maintained to the extent stated and required. The instructor provided clear instructions through the syllabus for first time users of Piazza. The first day of class was designed to provide the opportunity for students to engage with the platform and become familiar with its functionality. To support student success, students were encouraged to attend office hours in which the questions that were posed on Piazza could be elaborated on by the instructor and teaching assistants.

Data collection methods

To understand the potential emotional impact of Piazza on students, data was collected from students in class with a stress inventory and a group survey and from posts in the Q&A form of the Piazza course-specific website.

The stress inventory was used to establish whether students' experiences of stressors related to academic life and whether a platform like Piazza could be an additional source of stress. We added a question that addressed features specific to Piazza (abundance of notifications, pressure to check online content) to probe whether these features could potentially stress students. It was added to a general stress inventory both to assess its impact relative to other stressors and to ask about Piazza initially without guiding students to think in depth about this specific platform.

Next, a group survey was administered with the intention of collecting more robust data indicating whether students experienced specific problems related to Piazza. Open-ended questions allowed for a richer set of data detailing both positive and negative experiences with the platform and indicating whether or not students experienced negative emotions due to the "always on" phenomenon, as suggested by the researchers.

Student stress inventory. During Week Two of the undergraduate course students were invited to complete an inventory measuring the prevalence of stressors in their environment, including stressors related to Piazza (see Appendix A) which included a subset of the Student-Life Stress Inventory (SLSI) used by Gadzella (1994). An additional question was included to assess whether or not the presence of online notifications was a potential source of stress:

I experienced pressures due to receiving notifications or checking websites (email, class website, Piazza).

The modified SLSI was administered as a Google Form survey with the link provided to students. Responses were not mandatory for any question on the form. This inventory was administered in addition to the Small Group Perception Survey.

Small Group Perception survey. During Week Two of the undergraduate course, students were invited to participate in a Small Group Perception (SGP) survey about their experiences with piazza at the end of a class period. In groups, students viewed a Google Forms survey that collected non-mandatory, anonymous responses (see Appendix B).

Complete Piazza website data. At the end of the course, complete student data from the course's Piazza website was obtained by contacting the Piazza support team. This dataset contained all information about how many posts students had read, the content of each post, and timing data (along with other variables which were not used).

Procedure

All data was collected during Spring quarter 2018. No data from students under the age of 18 was collected during this study.

Student stress inventory. At the end of a class period during Week 2 of the undergraduate course, students were provided a link to a Google Form with questions from a shortened, modified version of the Student-Life Stress Inventory. Students were given approximately five minutes to complete the survey.

Small Group Perception survey. A researcher from the Center for Teaching and Learning entered the classroom at the end of a class period. Students were asked to create groups containing four to five students. All consenting students were invited to participate.

Complete Piazza website data. Institutional Review Board approved data provided by the Piazza support team was used to investigate student usage patterns and topics of conversation during days preceding a homework assignment and days following a homework assignment. From the Statistics tab on the course Piazza website, usage statistics were viewed for the undergraduate class. Peaks in usage were correlated with dates on the syllabus to confirm what was driving student use of Piazza. Data for creating word clouds was collected by downloading the content of all top-level posts across the dates of interest.

Results

Student Stress Inventory

There were 142 students who completed the shortened stress inventory. Each question received 141-142 responses. Based on mean response data, students were least affected by lack of resources (29 students responding "Often" or "Most of the time") and most affected by pressure due to competition, deadlines, and overload (88, 119, and 89 students respectively responding "Often" or "Most of the Time"). An additional survey question was included:

I experienced pressures due to receiving notifications or checking websites (email, class website, Piazza).

Student responses to this question appeared bimodal, with 38/142 responding “Rarely” and 35/142 responding “Often”. Several students reported experiencing fear, anxiety, and worry under stressful situations; fewer students reported experiencing anger.

Small Group Perception Survey (SGPS)

Forty-one survey responses were collected, indicating that multiple students from some groups may have responded. Some responses included multiple lines of text, which were analyzed as individual responses. There were several responses indicating positive experiences with Piazza. Students reported their questions were answered, they received feedback from instructors, found code for Gradescope, and stayed aware of class and assignment information. There were also several responses indicating negative experiences with Piazza. Students reported receiving too many emails/updates and noted too many posts, difficulty finding information, and inefficient search functionality. A few students noted “unhelpful/bad” answers from students, lack of responses from instructors, and long wait times.

Responses about emotional reactions to Piazza were mixed, with several responses indicating no effect on students’ emotions. Some responses noted positive emotions, such as happiness, relief, and satisfaction. Some responses noted negative emotions, such as anxiety, anger, worry, annoyance, frustration, and stress. Where multiple responses were provided by a group, each individual response was separated to create a unique item. Each item was first coded as Positive, Negative, or Neutral. Positive items were further coded as Happiness, Relief, or Helpful if responses reflected these particular emotions/assessments. Negative items were further coded as Stress/Anxiety, Pressure, or Overwhelmed/Frustrated if responses reflected these particular emotions/assessments. Of 56 total responses, 15 were classified as Positive, 25 as Negative, and 16 as Neutral. Of the Positive responses, 5 reflected happiness, 7 reflected relief, and 2 mentioned helpfulness. Of the Negative responses, 13 reflected stress or anxiety, 2 reflected pressure, and 3 mentioned feeling overwhelmed or frustrated.

To further illustrate the content of student responses, word clouds were created for all responses to each of the three questions. A small number of non-meaningful words with frequency 1 were removed for clarity (N = 2). Word clouds are shown in Figure 1. The word “questions” appears prominently in all of the word clouds. Example responses are shown below to illustrate the role this word plays for the majority of responses within an item.

SGPS: What are some positive experiences that you had using Piazza in this course?

“I get to benefit from others asking and answering questions.”

“Could ask questions to tutors/professors directly.”

“It’s easy to get questions answered most of the time.”

SGPS: What are some negative experiences that you had using Piazza in this course?

“Some questions clutter the website since they are redundant or bad.”

“Unorganized. Questions are unanswered.”

“Getting so many emails about people posting questions that are not relevant to me”

SGPS: Did using Piazza in this course ever affect your emotions? If so, what emotions did you feel?

“Occasionally. If some questions were never left answered, we would feel a little bit irritated and dissatisfied”

“Anxiety to get questions answered quickly”

“I feel relieved when my questions get answered...”

To further understand the content patterns shown in the word cloud (see Figure 1 below) representing negative student experiences, responses were counted for frequently mentioned topics. The researchers identified 13 responses describing too many emails and/or notifications, 8 describing negative student behaviors (e.g., students deleting posts, posting incorrect answers), 7 describing long wait times for responses from the instructional team, and 4 noting poor search functionality on the Piazza website.



Discussion

Student Stress Inventory

Overall, students at this university are experiencing stress from a variety of sources. Responses to many of these questions indicate general trends, with most students responding with either consistently high or low numbers to different questions. For example, students gave consistently low scores to the question about lack of resources, and high scores to the question about pressure due to competition, deadlines, and overload. Student responses to the question about stress from notifications/websites appeared bimodal. This indicates students may be responding differently to this stressor, with some students coping effectively and others having difficulty coping. This pattern is confirmed by the variety of responses to the SGP survey, where some students reported a lack of emotion or only positive emotional experiences with Piazza, while others reported experiencing negative emotions, such as stress and anxiety.

Small Group Perception Survey

Students reported both positive and negative experiences using Piazza. In response to the question about positive experiences, students indicated they were using the forum to discuss homework questions and logistics. This is similar to how students used Piazza in other courses. It is clear students value this source of information, especially as a way to communicate with the professor and the TAs. Responses to the question about positive experiences indicate students were experiencing some of the negative patterns detailed in the introduction above: abundance of notifications; rapid progression of discussions; and abundance and urgency of information. Although a few students mentioned problems with incorrect student responses and long wait time for instructor responses, more complaints were related to the number of posts and the notifications they generated. This supports the suggestion Piazza is a potential stressor for students because the frequency of posts could create a sense of urgency to stay aware of new content. Responses indicate, overall, students are experiencing both positive and negative emotions in response to using Piazza. Although some groups reported both positive and negative emotions, many responses were on only one dimension of emotion (positive, negative, or neutral/none). This indicates some students who were active users of Piazza did not experience stress, while others did.

Students reported feeling stress, anxiety, pressure, and frustration related to Piazza use. This means that the technology may not be universally helpful, or, at least, its usefulness comes with consequences for some students. We do not know how much this stress may be contributing to a negative environment for students, or how much it is adding to the existing stress created by deadlines, competition, for example. Importantly, while emotions could be inferred from student responses to the other two SGPS questions, emotion words like *anxiety*, *frustration*, *happiness*, and *relief* appeared only in response to the question about emotions (the word *stress* did appear twice in response to the question about negative experiences). Although students report experiencing these emotions, they were not discussed in typical survey responses or in the content of Piazza posts.

Complete Piazza Website Data

The summaries of student discussions preceding and not preceding a major deadline for the course indicate students are primarily posting about details of the assignments. There is no obvious indication of the presence of emotions, including stress. Students do not necessarily discuss their feelings in a Q&A forum like Piazza, and perhaps not through other media accessible by instructors (although students do express emotions and stress through other platforms such as anonymous university Facebook Confessions pages (see Hayman, Smith, & Storrs, 2018). This means if instructors are concerned about potential negative consequences of technology, they should look for other indications of student stress, including self-reported data about emotions.

Limitations

Student responses to the SGP are self-reported, indirect measures that may not accurately describe students' experiences. We currently do not have a direct way of measuring stress or other emotions in a classroom setting or while students are accessing online forums outside of the classroom.

Conclusions and Further Research

Some students did seem to experience stress related to Piazza. This relatively new technology could be either revealing a source of stress that was already present (pressure to finish an assignment by a deadline, confusion caused by multiple questions about an assignment), or it could be creating a new source of stress that was not previously relevant for students; specifically, the feelings of anxiety created by a need to constantly monitor a source of potential information. Some students may benefit from coaching or suggestions about how to use Piazza. For example, the instructor could recommend that students check the discussion only occasionally. This recommendation could, however, be at odds with instructor-created incentives to actively participate. Additionally, stress for some students could be reduced by assurances that important content will be posted in a separate location so that students know they will not miss critical assignment information if they fail to check Piazza at the correct time. The knowledge that online forums like Piazza can be stressful for some students creates a responsibility for instructors to address this in some way.

The discussions among the authors and the data generated by this research resulted in several potential topics for further research:

- Does incorrect information propagate through the Piazza discussion board? If so, how quickly, and who spreads incorrect information?
- Do teaching assistants and instructors post conflicting (or incorrect) information on Piazza? If so, does this affect student morale and/or engagement with the discussion forum? If yes, how?
- Does Piazza interfere with work/life balance for instructors and teaching assistants? If so, to what extent and what can be done to mitigate?
- Do teaching assistants feel stressed when using Piazza? Do late hours or weekend hours correlate with increased stress?
- Do teaching assistants feel pressured to be available at all times?

- Does Piazza replace or enhance discussion in the classroom, especially in the presence of podcasts? Is the instructor engaging with students on Piazza instead of during class time?

This last question raises a very important issue. In the presence of increasing technology, especially online educational content, what is the role of the classroom? At the university of the study, many classes are podcasted, meaning that video of the instructor, lecture slides, and classroom discussion (recorded from an instructor's microphone and microphones throughout the classroom) are available to all enrolled students for online viewing. If students can obtain classroom content online and can replace office hours with questions asked on Piazza, what motivates students to attend class? How should instructors use classroom time and what is the value of in-person communication?

One of the major outcomes of this research is that the instructor is reconsidering their approach to using Piazza for the next term. The instructor plans to state in the course syllabus that he will open a Piazza site for any student who wishes to engage in this tool. However, he will ask his teaching assistants not to respond to questions, but to monitor the discussions only to ensure all users are abiding by the university policy on discourse. This way, students may be encouraged to interact with the teaching team in person by attending office hours and/or discussion sections.

Another important issue raised is that of professionalism: in a corporate environment, employees do not contact management multiple times per day with a series of questions (especially immediately preceding a deadline). Behavior that is encouraged or built into discussion forums such as Piazza may not serve students who will soon be entering a professional workplace. Instructors who actively participate on Piazza may be setting unrealistic expectations about how much communication can be expected in an environment where a student/employee is expected to learn and work independently while researching problems before asking for assistance.

This potential subversion of independent learning brings up a final issue of concern: Piazza's rapid and prolific dissemination of information could encourage students to behave as helpless or passive learners, failing to check the appropriate resources or struggle with content because easy answers are so readily available. This can undermine learning processes that are vital to not just students' success in the classroom, but also to long-term learning and fostering a sense of curiosity and independence. It is even possible that this undermining of independent learning could be one reason for the stress that some students experience with Piazza.

References

- American College Health Association. (2018). American College Health Association-National College Health Assessment Spring 2018 Reference Group Data Report (abridged): The American College Health Association, *Journal of American College Health: J of ACH*, 57(5), 477. <https://doi.org/10.3200/JACH.57.5.477-488>
- American Psychological Association (2017). Stress in America: Coping with Change. *Stress in America™ Survey: Part I*. Washington, D.C. Retrieved from <https://www.apa.org/news/press/releases/stress/2016/coping-with-change.pdf>
- Andresen, M. A. (2009). Asynchronous discussion forums: success factors, outcomes, assessments, and limitations. *Journal of Educational Technology & Society*, 12(1), 249 -257. EJ833430
- Baker, Z. G., Krieger, H., & LeRoy, A. S. (2016). Fear of missing out: Relationships with depression, mindfulness, and physical symptoms. *Translational Issues in Psychological Science*, 2(3), 275-282. <http://dx.doi.org/10.1037/tps0000075>
- Boice, R. (1991). New faculty as teachers. *Journal of Higher Education*, 62(2), 150-173. <https://doi.org/10.1080/00221546.1991.11774113>
- Boksem, M. A., Meijman, T. F., & Lorist, M. M. (2005). Effects of mental fatigue on attention: An ERP study. *Cognitive Brain Research*, 25(1), 107-116. <https://doi.org/10.1016/j.cogbrainres.2005.04.011>
- Bork, R. J. H., & Rucks-Ahidiana, Z. (2013). Role ambiguity in online courses: An analysis of student and instructor expectations. (CCRC working paper No. 64). New York: Columbia University, Teachers College, Community College Research Center.
- Bransford, J. D., Brown A. L., & Cocking R. R. (2000). *How people learn: Brain, mind, experience, and school*. Washington, D.C.: National Academy Press.
- Chick, N., Karis, T., & Kernahan, C. (2009). Learning from their own learning: How metacognitive and meta-affective reflections enhance learning in race-related courses. *International Journal for the Scholarship of Teaching and Learning*, 3(1). <https://doi.org/10.20429/ijsotl.2009.030116>
- Chen, G., & Chiu, M. M. (2008). Online discussion processes: Effects of earlier messages' evaluations, knowledge content, social cues and personal information on later messages. *Computers & Education*, 50(3), 678-692. <https://doi.org/10.1016/j.compedu.2006.07.007>
- Deng, L., & Tavares, N. J. (2013). From Moodle to Facebook: Exploring students' motivation and experiences in online communities. *Computers & Education*, 68, 167-176. <https://doi.org/10.1016/j.compedu.2013.04.028>
- Dhir, A., Yossatorn, Y., Kaur, P., & Chen, S. (2018). Online social media fatigue and psychological wellbeing-A study of compulsive use, fear of missing out, fatigue, anxiety and depression. Retrieved from: <https://www.sciencedirect.com/science/article/pii/S0268401217310629#bib0080>
- Folkman, S. (2013). Stress: Appraisal and coping. In *Encyclopedia of behavioral medicine*. New York: Springer.
- Gadzella, B. M. (1994). Student-life stress inventory: Identification of and reactions to stressors. *Psychological Reports*, 74(2), 395-402.
- Gettman, H. J., & Cortijo, V. (2015). "Leave me and my Facebook alone!" Understanding college students' relationship with Facebook and its use for academic purposes. *International Journal for the Scholarship of Teaching and Learning*, 9(1). <https://doi.org/10.20429/ijsotl.2015.090108>
- Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. New York: Springer.
- Liu, Z., Pataranutaporn, V., Ocumpaugh, J., & Baker, R.S. (2013). Sequences of frustration and confusion, and learning. In *Proceedings of the 6th International Conference on Educational*

- Data Mining*. (pp. 114-120).
<http://www.educationaldatamining.org/EDM2013/proceedings/EDM2013Proceedings.pdf>
- Mazzolini, M., & Maddison, S. (2003). Sage, guide or ghost? The effect of instructor intervention on student participation in online discussion forums. *Computers & Education*, 40(3), 237-253.
[https://doi.org/10.1016/S0360-1315\(02\)00129-X](https://doi.org/10.1016/S0360-1315(02)00129-X)
- Minnes, M., Mayberry, J., Soto, M., & Hargis, J. (2017). Practice makes deeper? Regular reflective writing during engineering internships. *Journal of Transformative Learning*, 4(2), 7-20. Retrieved from: <https://jotl.uco.edu/index.php/jotl/article/view/195>
- Piaget, J. (1974). Cognitive development in children: The Piaget papers, *Journal of Research in Science Teaching*, 2,170-230.
- Piazza (2018). Ask. Answer. Explore. Whenever. Retrieved from <https://www.piazza.com>
- Ribeiro, I. (2018). Stress and quality of life among university students: A systematic literature review. Retrieved from
<https://www.sciencedirect.com/science/article/pii/S2452301117300305>
- Riordan B. C, Flett J.A.M, Hunter J.A, Scarf D and Conner T.S. Fear of missing Out (FoMO): the relationship between FoMO, alcohol use, and alcohol-related consequences in college students. *Journal of Psychiatry Brain Functions*. 2015; 2:9. <http://dx.doi.org/10.7243/2055-3447-2-9>
- Sankar, P., Gilmartin, J., & Sobel, M. (2015). An examination of belongingness and confidence among female computer science students. *ACM SIGCAS Computers and Society*, 45(2), 7-10. <https://doi.org/10.1145/2809957.2809960>
- Vellukunnel, M., Buffum, P., Boyer, K. E., Forbes, J., Heckman, S., & Mayer-Patel, K. (2017). Deconstructing the discussion forum: Student questions and computer science learning. In *Proceedings of the 2017 ACM SIGCSE Technical Symposium on Computer Science Education* (pp. 603-608). doi: 10.1145/3017680.3017745
- Washington, T., Bardolph, M., Hadjipieris, P., Ghanbari, S., & Hargis, J. (2019). Discussion Boards: The good, bad and the ugly. *Turkish Journal of Distance Education*, 20(4).
- Wiki (2018). Wiki. Retrieved from: <https://en.wikipedia.org/wiki/Wiki>.
- Wu, X., Tao, S., Zhang, Y., Zhang, S., & Tao, F. (2015). Low physical activity and high screen time can increase the risks of mental health problems and poor sleep quality among Chinese college students. *PLoS ONE* 10(3): e0119607. <https://doi.org/10.1371/journal.pone.0119607>
- Zajacova, A., Lynch, S. M., & Espenshade, T. J. (2005). Self-efficacy, stress, and academic success in college. *Research in Higher Education*, 46(6), 677-706.
<https://doi.org/10.1007/s11162-004-4139-z>

Appendix A

Modified student-life stress inventory

Section 1

Students responded using a 1-5 scale:

1 = Never, 2 = Rarely, 3 = Occasionally, 4 = Often, 5 = Most of the time

- As a student, I have experienced daily hassles which affected me in reaching my goals.
- As a student, I have experienced lack of resources (money, transportation, access to books, etc.).
- As a student, I feel I was denied opportunities in spite of my qualifications.
- I have experienced conflicts produced by two or more undesirable alternatives.
- I experienced pressures as a result of competition (on grades, work, relationships).
- I experienced pressures due to deadlines (assignments due, making payments, etc.).
- I experienced pressures due to receiving notifications or checking websites (email, class website, Piazza).
- I experienced pressures due to overload (attempting too many things at one time).
- I worry a lot about everything and everybody.
- I have a tendency to procrastinate (put off things that have to be done).
- I worry and get anxious about taking tests.

Section 2

Students responded using a 1-5 scale:

1 = Never, 2 = Rarely, 3 = Occasionally, 4 = Often, 5 = Most of the time

When under stressful situations, I have experienced:

- Fear
- Anxiety
- Worry
- Anger
- Guilt
- Grief
- Depression

Appendix B
Small Group Perception survey

Questions:

1. What are some positive experiences that you had using Piazza in this course?
2. What are some negative experiences that you had using Piazza in this course?
3. Did using Piazza in this course ever affect your emotions? If so, what emotions did you feel?