Cases on Innovations in Educational Marketing:

Transnational and Technological Strategies

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Chapter 12
Using Text Mining for Improving Student Experience Management in Higher Education

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EXECUTIVE SUMMARY

The objective of this case study is to illustrate how text mining of open-ended responses from a student survey could yield valuable information for improving student experience management (SEM). The concept of student SEM was borrowed from the notion of customer experience management (CEM), which aims for ongoing improvement of customer relations through understanding of the customer's point of view (Pine & Gilmore 1998). With the advance of text mining technology, textual data that were previously underutilized are found to be valuable in CEM. To illustrate how text mining can be applied to SEM, we discuss an example from a campus-wide survey conducted at Arizona State University. The purpose of this survey was to better understand student experiences with instructional technology in order for administrators to make data-driven decisions on its implementation. Rather than imposing the researchers' preconceived suppositions on the students by using force-option survey items, researchers on this project chose to use open-ended questions in order to elicit a free emergence of themes from the students. The most valuable lesson learned from this study is that students perceive an ideal environment as a web of mutually supporting systems. Specifically, online access should be augmented by use of laptops and availability of course materials, whereas virtual classes should be balanced by human interactions.

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ORGANIZATION BACKGROUND

Arizona State University (ASU) is the largest public research university in the United States under a single administration, with a 2009 student enrollment of 68,064 (ASU, 2009c). ASU is composed of four campuses spanning across the Phoenix Metropolitan Area (Tempe, West, Polytechnic, Downtown). In 2009 the total endowment supporting ASU is $407 million whereas the total assets of ASU Foundation worth $645 million (ASU, 2009b).

ASU was founded in 1885 as the Tempe Normal School by an act of the Thirteenth Territorial Legislature. Its name was changed to the Normal School of Arizona in 1901 and became Tempe State Teachers College in 1925. In 1945, the school was under control of the Arizona Board of Regents and was renamed Arizona State College. These changes resulted from expansions of the curriculum and degree offerings. By 1958 the school performed all the functions of a regular university. As a result, a statewide ballot led the school to adopt the current name Arizona State University. Although research endeavors preceded attainment of university status in 1958, the development of new academic programs and library holdings and the conferral of doctoral degrees in the 1960s led the Carnegie Foundation to grant ASU Research I status in 1994 (ASU, 2009d).

In 2002, Dr. Michael Crow became the university's 16th president. President Crow outlined his vision for transforming ASU into a "New American University," an open and inclusive source of learning opportunities for all types of. Crow has stated that ASU is in a unique position to evolve together with the city into one of the great intellectual institutions in the world. In order to build a New American University, ASU has undergone some radical changes over the last few years. Like many universities, ASU has added new buildings, hired new faculty and brought in new students. For instance, ASU admitted its largest and highest-quality freshman class ever in fall 2003 and has developed nationally recognized programs in a number of fields, including accounting, astrobiology, design science, creative writing, music, ecology and evolutionary biology, electron microscopy, nanotechnology, psychology, solid-state science, and supply chain management. In addition, ASU has embarked on an aggressive capital building effort. The university is adding one million square feet of research infrastructure, and is continuing its development and expansion of the West, Polytechnic and Downtown campuses (ASU, 2009a). More importantly, the core essence of New American University is open and inclusive. The preceding efforts might not yield the expected results if student experience is not well understood. Thus, under the leadership of Dr. Crow, the management style of ASU has become more data-driven, research-based, and student (customer)-oriented.

SETTING THE STAGE

Customer Experience Management

This case study illustrates the value of text mining of open-ended responses from student survey as a data source for improving student experience management (SEM). The concept of student SEM was borrowed from the idea of customer experience management CEM), which was introduced by Pine and Gilmore (1998, 1999). Before the introduction of this concept, American corporations were either production-oriented or market-oriented. Based on the belief that the process is as important as the product, Pine and Gilmore asserted that successful businesses are those that understand the customer's point of view so that ongoing improvement of customer relations is possible (Pine & Gilmore 1998). Pine and Gilmore (1999) differentiated between selling a product/service and selling an experience: "when a person buys a service, he purchases a set of intangible activities carried out on his behalf. But when he

buys an experience, he pays to spend time enjoying a series of memorable events that a company stages—as in a theatrical play—to engage him in a personal way" (p.2).

Greenberg (2004) used his experience in International House of Pancake (IHOP) to vividly illustrate what "selling experience" means. Greenberg and his wife visited an IHOP in Manassas, Virginia, only to find a long line of customers at the restaurant waiting to be seated. Looking at the tag assigned to them by the staff, his wife saw that it had a name ("Ashley Judd") instead of a number. Then they heard the waitress call for "Tom Cruise." The assignation of "celebrity tags" amused the waiting customers and a potentially frustrating delay became an enjoyable experience.

Another well-known example is Starbucks. When Starbucks former CEO Howard Schultz was conceptualizing the proper marketing strategy for the company, he asked an interesting question: "What would happen if you took the quality coffee bean tradition of Starbucks and merged it with the charm and romance of the European coffeehouse?" (cited in Michelli, 2006, p.2) The implication is that the company should focus on customer experience in addition to the product and service quality. Every café or restaurant is capable of selling a variety of coffees to customers. Obviously, the success of Starbucks is not solely due to its coffees; rather, it is the enjoyable experience for which the Starbucks customer is willing to pay. In a typical American Starbucks café, customers are encouraged to stay as long as they wish. Far from being just a coffee shop, Starbucks has included an array of pastries, CDs, and many other items in its retail offerings (Forbes, 2005). Starbucks captures the emotional capital of their customers by creating a welcoming atmosphere that it has become a favorite meeting place. Wireless internet access is provided in many locations. Furniture at Starbucks is comfortable and conveniently arranged for individual reading or for chatting in pairs or small groups. In fact, DiJulius III (2008) suggested it would be possible for Starbucks to stop selling coffees and simply charge people admission for using their place to meet..

Despite the fact that CEM was introduced only a decade ago, it has become a fashionable acronym open to wide interpretation and confusion (Musico, 2009). One common misconception is that CEM is nothing more than a variant of custom relationship management (CRM) or customer service, but indeed there is a subtle difference between CEM and conventional CRM/customer service. Customer relationship management, by definition, is a strategy of managing a company's interactions with existing and potential customers in order to enhance marketing, customer service, and technical support (Thomson, 2009). Schmitt (2003) was so critical of CRM that he called CRM "the devil in disguise" (p.9). In his view, CRM is generally equated with databases and software programs used in call centers. CRM focuses on information the company perceives as important, such as transactional records (e.g. when the customer bought what; how much the customer spent in which store). These data are usually used for shaping customer behaviors. However, CRM data cannot be used to discern whether the customer has established an emotional bond with the brand. To remedy this, CEM subscribes to a different philosophy. Smith and Wheeler (2002) assert that CEM "is not about customers being loyal to you. It is about you being loyal to the customers. You earn loyalty by giving it" (p. 27). Simply put, CRM is about how a customer views a company whereas CEM is about how the company views the customer (SearchCRM.com, 2010). Instead of amending unpleasant experiences after the fact or manipulating the customer to act in the company's interest, CEM attempts to create enjoyable experiences for customers by listening to them. Some analysts related to CEM as CRM 2.0, which emphasizes the spontaneity of the customer ecosystem. With the explosive growth of communication technology, empowered customers are increasingly adamant about making their own choices and controlling the interactions

between themselves and companies with which they do business. For example, rather than passively receive information from the vendor, many customers of Kana software Inc. successfully use blogs and wikis to change the knowledge-creation process itself (Lager, 2007).

One of the widespread slogans of CEM is: "If you can't measure it, you can't manage it." Therefore, it is no surprise to see that CEM is quantitative in nature. One common metric used to indicate positive customer experience is the Net Promoter Score (NPS) (Lager, 2007; Sevier, 2009). Nevertheless, with the advance of text mining technology, previously underutilized textual data can be valuable in CEM. Take call center data as an example: when Hewlett-Packard (HP) took over Compaq, HP discovered that Compaq's call center operators kept records with notes on customer interactions, business process issues or text from customer e-mails. In response to this opportunity, HP employed text mining to identify the concerns of its most valuable customers and to develop new customer service strategies based on these common threads (SAS Institute, 2008).

Student Experience Management

Experience management is a fairly new concept to educators because traditionally educators do not view students as customers. Sevier (2009) argued that CEM can be readily transformed into SEM by clarifying what it is that colleges and universities sell to students. He asserted that what schools sell is the sum of all the student experiences before, and opportunities he or she has after, graduation. Following this line of reasoning, it is logical to employ a tool to manage the experience of the students. Sevier used "the Depot" at Abilene Christian University (Texas, USA) to demonstrate the benefits of SEM. A series of focus groups uncovered student frustrations with the existing system of bill payment, parking ticket settlement, and other related services. In response, administrators set up a new office called "the Depot," a one-stop shop that provides students with convenient services, including financial aid, billing, registrar, ID cards, parking, dining services, and many others.

Student experience is multi-faceted -it includes the academic experience, the campus life experience, the resident life experience, the athletic experience, and many others. The academic experience can be split into 13 sub-elements (Sevier, 2009), including class availability, flexibility of class scheduling, advising, honors, registration, classroom and lab experience, technology, internships and co-ops, study abroad, academic assistance/tutoring/remediation, library, career planning and placement, and grad placement. For this case study, the researchers chose to focus on technology only.

Text Mining

In recent years educational data miners have recognized that research questions in the private sector and in higher education are indeed similar, and thus business analytical tools should be applicable to higher education (Luan, 2002). Some educational researchers (e.g. Luan, 2002) have mapped corresponding research questions between industry and higher education. For example, customer profile analysis is equivalent to student profile analysis. Web log analysis for website enhancement is similar to Web traffic analysis for online course improvement. Research on retaining loyal customers is almost exactly the same as student retention research.

While data mining is often used to analyze structured data, which is a small percentage of existing data sources, text mining is the ideal tool for tapping into under-utilized, unstructured data. As a survey-based researcher in political science, Nie was impressed by the effort survey researchers devote to developing open-ended questions and transcribing the responses, but was disappointed by how little use is actually made of the resulting data (SPSS Inc, 2006). One of the reasons why open-ended responses are underused is that ana-

lyzing such data is time-consuming and human coders must be well-trained in order to yield accurate classifications. With advances in computing technology, automated text analysis can alleviate much of the preceding problem.

While data mining procedures are designed for structured, numeric data, text mining is primarily for unstructured or semi-structured data. Weiss, Indurkhya, Zhang, and Damerau (2005) asserted that text mining and data mining for solving pattern-recognition and prediction problems are the same type of method, whether the data are structured or not. Thus, they contended that there is nothing unique about text mining that makes it different from data mining. If data mining is a suitable candidate for educational research by translating business-oriented questions into institutional research questions, there is no reason that text mining should not be widely adopted for advancing educational research.

Text Mining is typically defined as a process of extracting useful information from document collections through the identification and exploration of interesting patterns (Feldman & Sanger, 2007). It utilizes the technology of natural language processing (NLP), which is a subfield of artificial intelligence (AI) and computational linguistics (CL). The focus of NLP is on the automatic analysis of human language using algorithms that can handle "fuzzy" structures. Based on AI and CI theories, NLP aids text mining in information retrieval (Singhal, 2001) and automatic summarization (Mani, 2001). NLP aims to deal with the complexity and multiple connotations of natural languages. A single word can mean different things in different contexts. For example, "books" in the phrase "he books tickets" is completely different from the same word in the phrase "he reads books." Relying on a computer to conduct text analysis could be dangerous if the software is not well-written. As a remedy, text mining employs NLP in an attempt to "understand" the data in the same way that a human coder would.

Although text mining and information retrieval (IR) share the common ground built upon NLP, IR is not equated with text mining. Information retrieval is a branch of science developed in the 1950s and 1960s that aims to search for information in documents (Weiss et al. 2005). Specifically, common applications of IR are found in library systems and search engines. In the former the objective is to provide users with access to books, journals, and other documents, whereas in the latter, Web search engines, such as Google and Yahoo, return Web pages according to the key phrases entered by users. First, using pre-determined labels to retrieve information is in sharp contrast to the exploratory character of text mining. Text mining does not assume a pre-established taxonomy. Rather, the discovery engine examines the corpus each time a query is made and is therefore potentially capable of discovering previously unknown relationships and network nodes (Haravu & Neelameghan, 2003). More importantly, returning a list of search results in IR, which may or may not be relevant to the subject matter under study, does not make a substantive contribution to new knowledge discovery, a major goal of text mining. For example, it is estimated that Google, arguably the most powerful search engine, could return only 30% relevant documents out of all results. In other words, every time an inquirer conducts a search, more than 70% of the documents in the output are irrelevant (Rzhetsky, Seringhaus, & Gerstein, 2008). A successful text mining process, which aims to extract relevant information, is composed of the following three steps:

1. *Extraction*: As the name implies, this is the process of gleaning information to serve as the building blocks for categorization from the textual data. A typical extraction process returns three types of results, namely, terms, types, and patterns. Terms are words or phrases that carry important connotations. During the extraction process, many

frequently recurring but trivial words, such as "a," "an," "the," "is," "am," "are," "however," "although," "but," etc., are ignored. Types are semantic groupings of terms. For example, consider the "teacher" type groups terms: "professor," "faculty," "instructor," and "trainer." Patterns are composed of a combination of terms and built-in types (SPSS Inc., 2006).

2. *Categorization*: In text mining, categorization refers to the process of grouping related concepts, themes, or common threads. This process is data-driven and iterative. Specifically, some concepts are proposed based upon the initial findings of the text patterns. Afterwards, all subsequent responses are scanned to check whether any text falls into the existing categories. New categories may be created and existing ones may be updated during this process. But categorization is not mutually exclusive; the same passage can be assigned into several categories. This overlapping of memberships enables the next step, namely, concept linking (SPSS Inc., 2006).
3. *Concept linking*: In conventional statistical research, it is common for researchers to formulate a new hypothesis by visually inspecting a correlation matrix to determine potential linkage between variables. By the same token, after grouping responses into several concepts, the text miner can examine the relationships among these themes using concept maps. The classic examples of hypothesis generation via concept linking are a series of studies conducted by Swanson (1986, 1989b). Based on the idea of concept linking, Swanson carefully scrutinized the medical literature and identified relationships between some apparently unrelated events, namely, consumption of fish oils, reduction in blood viscosity, and Raynaud's disease. His hypothesis that there was a connection between the consumption of fish oils and the effects of Raynaud's syndrome was eventually validated by experimental studies (DiGiacomo, Kremer, & Shah, 1989). Using the same methodology, the links between stress, migraines, and magnesium were also postulated and verified (Swanson, 1988, 1989a; Thomas, Thomas, & Tomb, 1992). Since then, numerous studies set the goal of mimicking Swanson's process of hypothesis generation (e.g. Banerjee, Hu, & Yoo, 2005; Bekhuis, 2006; Weeber, et al., 2001, 2003).

CASE DESCRIPTION

To illustrate how text mining can be applied to SEM, an example from a campus-wide survey conducted at Arizona State University is discussed here. The purpose of this survey was to allow administrators to make data-driven decisions on implementation of instructional technology. As technology advances, universities across the United States struggle to find ways to incorporate the resulting changes in the educational experiences provided to students, while continuing to provide quality learning environments. Educators want students to find success after graduating and are cognizant of the benefits and importance of embracing new technologies. Universities are challenged to use technology to improve quality of instruction and academic success in addition to preparing students for careers that demand increasing knowledge of technology (Penuel, 2006). A study conducted by the EDUCAUSE Center for Applied Research examined the increasing role of information technology in the lives of undergraduate students (Caruso & Kvavik, 2005). Of all respondents, 90 percent reported use of broadband Internet access, with 98.4 percent reporting use of computers for email, writing documents, and browsing the Internet for coursework (2005). Additionally, students reported spending an average of 11-15 hours per week using computers (2005). Information technology is becoming increasingly important in the lives of all students and universi-

ties are assuming at least part of the responsibility, not only for delivery of current technology to students, but also for training them on how best to incorporate these technologies into their lives. However, existing technological policies and infrastructures of a university may not have kept pace with the explosive growth of technology and might not be capable of providing the students with an experience that enhances learning in an enjoyable manner. For example, many so-called "hybrid courses" are nothing more than a Blackboard site hosting the syllabus posted by the faculty. Technologically savvy students who have formed numerous virtual communities on their own via Facebook, MySpace, wiki, blog, and other Web 2.0 technologies are unlikely to be impressed or engaged by dated or underutilized technology.

Although the university intended to make user-driven decisions regarding integrating education with technology, a survey with mere force-option items was considered insufficient due to the fact that Web 2.0, which facilitates use of social software (e.g. Wiki, Google apps), has been shifting the tectonic plates of the Internet (Carpenter & Steiner, 2007). As discussed in the section "customer experience management," today many tech savvy customers use blogs and wikis in their own way to generate a customer ecosystem. By the same token, students also manipulate these technologies on their own terms, such as "Rate my professors." Further, like CEM, SEM should focus on how to create an enjoyable and ideal learning environment (as perceived by the students) rather than merely undoing negative experiences. Hence, the university sent students a survey with both force-option and open-ended items in an attempt to understand what they would consider an ideal learning environment in terms of educational technology. The focal point of this article is the analysis of open-ended responses by text mining.

Email invitations were sent to all currently enrolled students (n=62680). Of these email addresses, 62,095 were valid addresses; 708, a mere 1.12%, were returned as undeliverable. Eight thousands eight hundred and seventy-two students responded to the survey over a 3-week period, with 5,344 responding within the first 7 days. Since non-response bias has been acknowledged as a major threat to the validity of survey research (Ranney, Tveite, & Bradbury, 2006), two reminder letters were sent to non-respondents. The first reminder prompt was sent to the remaining sample pool on day 8. Two thousands one hundred and seventy-one students responded between day 8 and 14; a second prompt was sent on day 14. The overall response rate was 14.28%.

This article concentrates on one particular open-ended item only. For this question, concerning student attitudes on what would constitute an ideal learning environment in regards to instructional technology, the number of non-empty responses is 4,071. The software module employed in this project is *SPSS Text Analysis for Surveys* (SPSS Inc., 2006).

RESULTS AND CURRENT CHALLENGES

Themes

The following table is the final list of common themes with respect to the ideal learning environment extracted by text mining:

The meaning of each theme will be explained as follows. It is important to point out that these categories are not mutually exclusive. There is some degree of overlapping among these categories and therefore conceptual linking is possible.

1. **Class structure:** Class structure means how a class should be conducted, such as the mode of the class (physical or online) and installation of technology.
2. **Online access:** As the name suggests, "online access" is concerned with connection to the Internet, availability of online resources, and online classes.

Table 1. Themes extracted by text mining

Theme	Frequency
Class structure	1363
Online access	857
Technology	578
Laptop	317
Course material	285
Interaction	185
Video	75

3. **Technology:** This category refers to technology in a broad sense, including PowerPoint, static HTML pages, and projectors. Although "video" and "laptop" can also be classified into "technology," those two are treated as separate categories because potential applications of webcast (video) and mobile devices have become major concerns in the university strategic plan.
4. **Laptop:** This includes both conventional laptops and tablet PCs.
5. **Course materials:** This theme is concerned with how course materials are delivered.
6. **Interaction:** This refers to human interactions between faculty and students, and among students.
7. **Video:** With the rise in popularity of podcasts, it is surprising to see that "video" instead of "audio" emerges as a major theme. This will be discussed in detail later.

Concept Maps

Relationships among themes or concepts are presented in concept maps, as shown in Figures 1-7. In each map, there is a reference point so that the relative positions to the focal point of other concepts can be formulated. For example, in Figure 1, "class structure" is the focal point of interest and the strength of its associations with other concepts are presented. The strength of the relationship is indicated by the thickness of the line. A thick black line symbolizes the strongest relationship, a thick gray line shows a strong relationship, and a thin gray line denotes weaker relationship. Finally, the size of the circle signifies the popularity of the concept. The digit beside the label is the number of observations that are shared by the focal concept and the related concept. For instance, 1363 observations are classified into the category "class structure" and 323 observations belong to both "online access" and "class structure."

Figures 1 and 2 indicate that there is a strong link between class structure and online access. Where students desire more online classes and access to online course materials, there is also an implicit desire for changing the traditional class

Figure 1. Concept map of class structure

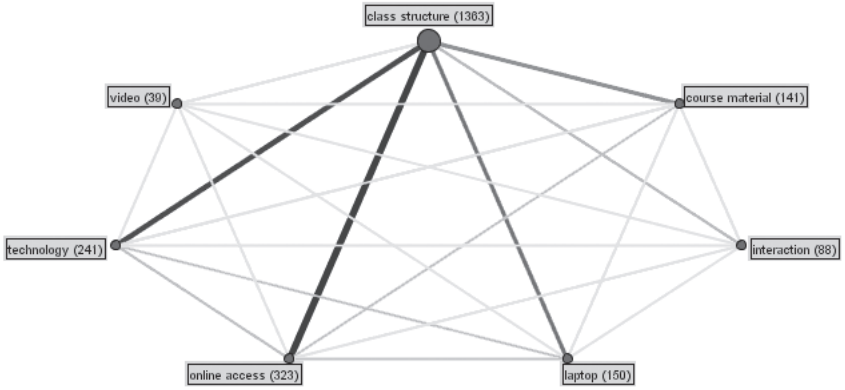
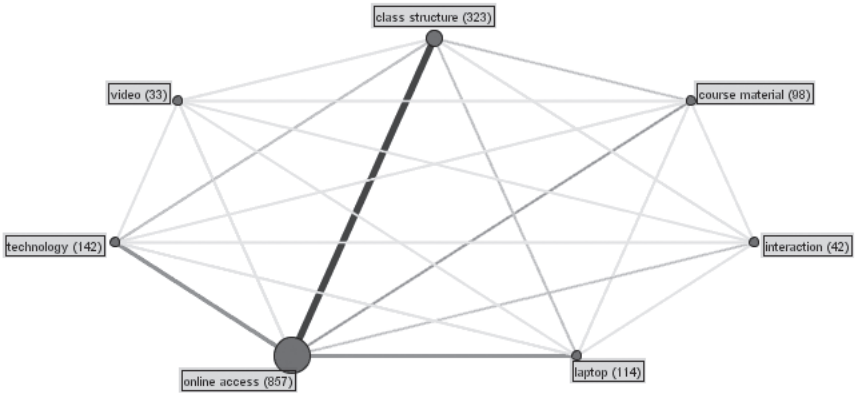


Figure 2. Concept map of online access



structure. For example, some students felt that course materials and lectures notes should be made available online beforehand, and thus more class time could be devoted to learning the material instead of simply copying notes. Some students felt that it should be possible to communicate with professors regardless of whether they were physically present in a classroom or not. They also believe that professors should make grades available online and have discussions online, as well as in class, in order to enhance the learning experience. In short, the demands of the availability of online access and the virtual classroom go together. Not surprisingly, online access is strongly associated with technology. Specifically, students see the need for supporting technologies for online access provided by the university, such as *Blackboard* (an online course management system) and wireless networking. The following are some typical examples:

"In my ideal learning environment all classes would incorporate some online element. For example, lecture courses would podcast their lectures so that if any student missed a class the lecture would be available. Also I feel that the library system pays a lot of money for internet database content; so I feel professors should be better trained to use more of this content to replace the textbooks. Professors and TA should also be encouraged to blog additional information and resources about what was covered in class."

"Tons of wireless internet. Personal laptops that are student-owned (they would be ultra-cheap if the school purchased thousands) and of the students' preference of OS (Mac, Windows, Linux). Technology integration from the very beginning, for everyone (not just sci, math, engineers). Free software (MATLAB and all the others that that cost an arm and leg). Lecture via podcast (for those missed 7am classes)!"

Figure 3 depicts the concept map for technology. It is important to point out that although many students see a positive role for technology in online access and class structure, some raised concerns about the potential problems with technology. For example, one student said that while everyone should have access to digital technology, a class should treat technology as a tool, never the main method of teaching. Also, some students found that classmates bringing their computers to class are more enthralled with Instant Messaging and browsing the Internet than with the lecture.

The concept map for "laptop" is shown in Figure 4. "Laptop" is separated from "technology" as a standalone category for two reasons. First, it

Figure 3. Concept map of technology

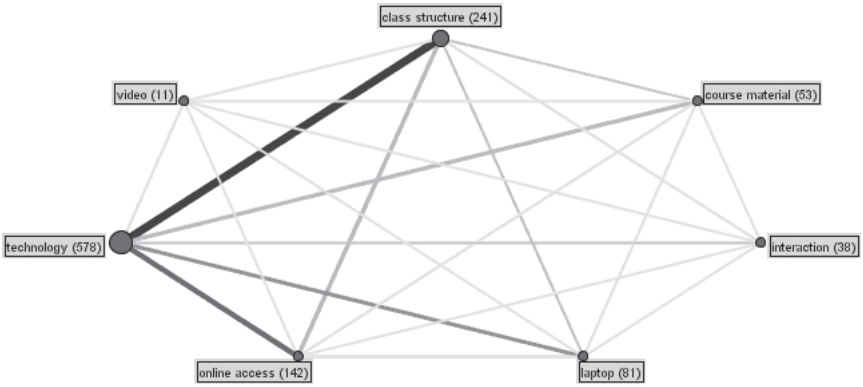
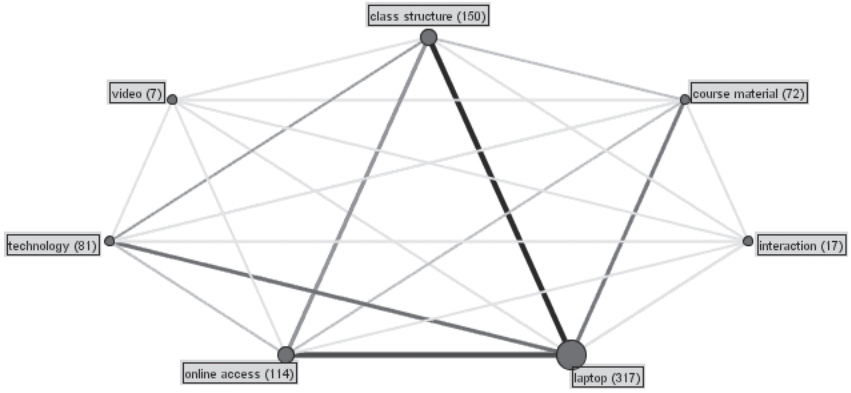


Figure 4. Concept map of laptop

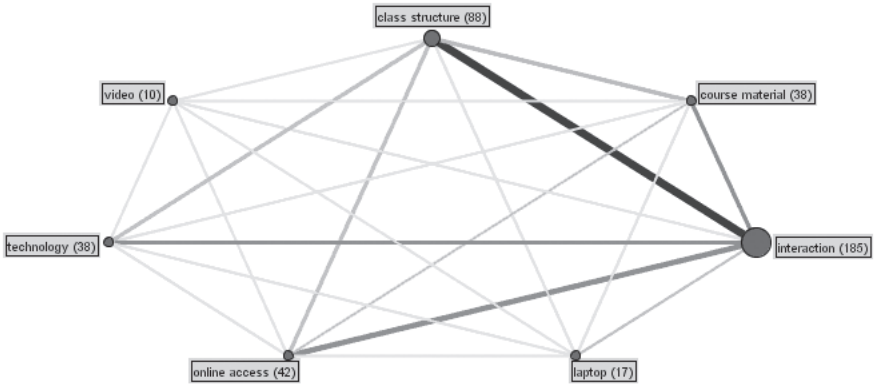


is owned by students rather than by the university. Second, the popularity of laptops among students creates a pressing demand of ubiquitous online access in general and access to course materials in particular. Some students bluntly said that they brought their laptop to the class to look for further information on the Internet about the subject matter in the lecture because they feel that the materials posted by the instructor pale by comparison.

It is important to point out that although many students embrace online access, the virtual classroom, and instructional technology, they do not ignore the human aspect in the class structure. Many of the survey respondents still regard face-to-face interaction with faculty and other students as an indispensable experience in learning, as shown in Figure 5. Also, in their view an ideal learning environment would be an academic setting in which students could participate in many cultural and social activities, and in which they could network and share ideas more fully than what is currently possible in an electronic-only format. The following are some typical responses with respect to human interaction:

"A small class with a great instructor. I don't think all this technology, much as I love it, makes that much of a difference. Sure, it's needed for lots of things. Heck, I study statistics, so I need lots of computing power. But it's all for naught if I don't

Figure 5. Concept map of interaction



have good teachers. I would rather the university focus on that first."

"Smaller classes with more engaged professors. Many professors think that by using high tech presentations they will reach more students, but many of the professors overlook the need to use that technology to teach us something. I would like fewer laptops in the classroom, they are a distraction much more often than they are useful, and I would like the professors to consider podcasts of their lectures, but that may be detrimental to class attendance."

Again, Figure 6, the concept map for course materials, shows its stronger associations with class structure, online access, technology, and laptop. Interestingly, while most students were concerned with the issue of accessing course materials for their own courses, especially the *Blackboard* system, one forward-looking student suggested that the university adopt the open courseware model initiated by MIT so that all course materials can be freely accessible.

It is surprising to see that "video" instead of "audio" emerged as a common theme in the survey. Apple Computer has created a service allowing any university to distribute course content (both audio and video) for free via their *iTunes* software. Several universities, including Stanford, Berkeley, and the University of Michigan have already taken advantage of this service, making podcast versions of lectures available to anyone who accesses the respective sections of iTunes. Since June 2006 Arizona State University has been partnering with Apple Inc. to develop the *iTunes University*, a platform to podcast lectures in MP3 format. At present, a variety of audio courses are available through iTunes. It was expected to see "audio, "iTunes," "iPod," or "MP3" as common themes for students; however, it is clear that "video," instead of "audio," is the predominant interest in the domain of multimedia technology for survey respondents. In addition, there is a strong association among video, class structure, and online access. Simply put, many students would like to access lectures via online channels in video format. These findings suggest that further research with regard to the role of video and audio in instructional technology, as well as students' perceptions of these technologies.

In summary, the preceding text mining example extracts categories from the open-ended responses using algorithms of natural language processing. The importance of these categories, as measured by the frequency of occurrence in proper contexts, is ranked in a table. More importantly, text miners can visualize inter-relationships among these categories via the concept maps.

Figure 6. Concept map of course materials

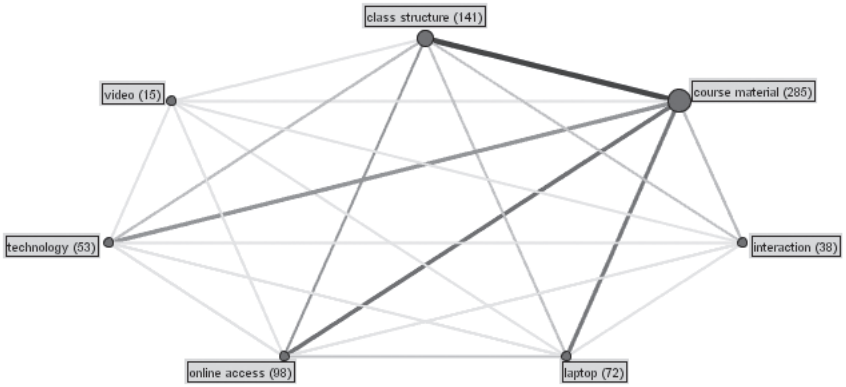
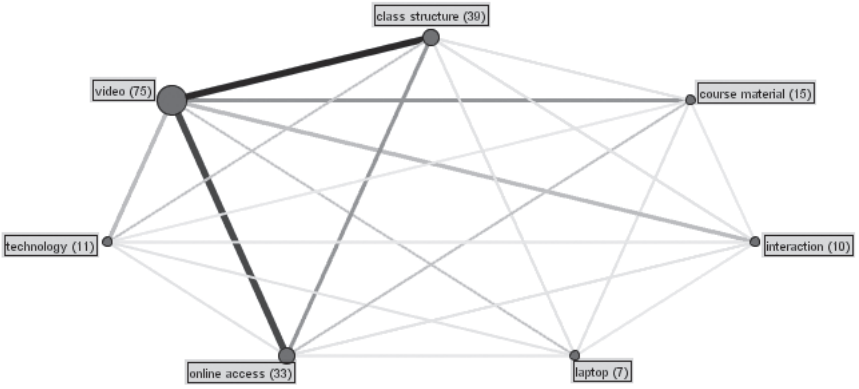


Figure 7. Concept map of video



SOLUTIONS AND RECOMMENDATIONS

The results of this study can assist administrators in making informed decisions with regard to formulating campus-wide strategies on instructional technology. Unlike studies that impose the researcher's preconceived ideas on the students by using force-option survey items, in this project the researchers let the themes emerge freely from the students. The previous survey analysis concentrates on the quantitative data collected from force-option items (DiGangi, Kilic, Yu, Jannasch-Pennell, Long, Kim, Stay, & Kang, 2007). Technology (equipment and applications, as well as use and integration) is clearly a priority expressed by the respondents. Therefore, it was concluded that technology, such as use and ownership of mobile phones, computers, and many other computing devices, is important to a successful college experience.

The text mining project partially concurs with the quantitative analysis, but it reveals additional insight. Because mobile device ownership and usage is viewed by many students as an integrated component of online access and the virtual classroom, the university has de-emphasized the importance of computer labs. Rather, the university encourages all users have their own mobile multimedia digital devices that possess the capability of connecting to the Internet, such as an iPod, a laptop, a tablet PC, or an electronic book reader, as opposed to using the old computing model, in

which desktop computers are stationed in a lab and shared by many students. To cope with this trend, the university has developed a program with Apple and Dell to encourage owning a laptop at the best possible price. With a laptop a student could potentially attend classes online and view online resources anywhere, anytime.

One salient difference between the text mining findings and the quantitative analysis is that responses to the text mining study indicated technology alone is not the final answer. In the opinion of the research team, the principal finding of this study is that students perceive an ideal learning environment as a web of mutually supporting systems. It is important to point out that "class structure," rather than use and ownership of technology, is the number one theme yielded from text mining. Technology alone would not improve learning if there is no structure to guide the proper use of technology. Participants' concern with class structure implies that current applications of instructional technology by faculty might be improper, or insufficient, or both. Indeed, this possibility is reinforced by another study conducted at the university regarding faculty adoption of Web 2.0 (Yu, Brewer, Jannasch-Pennell, & DiGangi,, 2010). It was found that full-time and tenured instructors devote less effort to producing Web 2.0 applications for teaching than their part-time and non-tenure counterparts. The implication for policy-making is that the initial promotion of technology use should not emphasize the production component, especially if the faculty support infrastructure is lacking. In response to the need to help faculty with class structuring or restructuring, various training programs for faculty have been under development at the university.

Further, the research team learned that online access is expected to be augmented by availability of course materials. Although the information students find on the Internet has long been known to be of questionable accuracy, the ease of a web search remains attractive. In response, the university is devoting efforts to developing new course management systems and databases in order to broaden the accessibility of academic-related materials. For example, currently Dublin City University and Arizona State University (2008) have been appointed as the lead academic partners in Global Grid for Learning (GGFL), a database containing a large collection of instructional materials, including text, graphics, and movie clips on various subjects. At the time of this writing, over 1.25 million resources from thousands of sources are available through Global Grid for Learning, including leading publishers and rights management organizations, such as Reuters, Corbis, Encyclopedia Britannica, and Cambridge University Press. The initiative aims to connect a billion digital education resources by 2018. Open source and open courseware are also under intensive development. Further, the university's technology support team has been providing new technology training to staff and faculty as necessary to improve skills and implement technology changes.

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KEY TERMS AND DEFINITIONS

Customer Experience Management: Customer experience management (CEM) is a set of coherent strategies that aims to understand the customer's point of view so that ongoing improvement of customer relations is possible.

Customer Relationship Management: Customer relationship management is a strategy for managing a company's interactions with existing and potential customers in order to enhance marketing, customer service, and technical support.

Data Mining: Data mining is the process of automatically extracting useful information and relationships from immense quantities of data using a cluster of techniques, including classification trees, neural networks, and K-mean clustering.

Natural Language Processing: Natural language processing (NLP) is a subfield of artificial intelligence (AI) and computational linguistics (CL). The focus of NLP is on the automatic analysis of human language with use of algorithms that can handle "fuzzy" structures.

Information Retrieval: Information retrieval (IR) is a branch of science that aims to search for information in documents using pre-determined taxonomies and terms. Common applications of IR are found in library systems and search engines.

Student Experience Management: Student experience management (SEM) is a concept borrowed from customer experience management. The applicability of CEM to SEM is based on the assertion that the products and services delivered to a student by the school include all the experiences that a student has and the opportunities he or she has after graduation, and thus SEM is also intended to provide students with positive experiences.

Text Mining: Text mining is a process of extracting useful information from document collections and open-ended responses from participants through the identification and exploration of interesting patterns.