SENTIMENT DISCOVERY AND ANALYSIS AS A MEAN OF STUDENT EXPERIENCE IMPROVEMENT

Olivera Grljević, Zita Bošnjak  
Faculty of Economics Subotica, University of Novi Sad, Republic of Serbia

ABSTRACT: Sentiment analysis has found broad usage helping institutions to better understand the choices, intentions, and behaviors of an individual acting as a buyer, consumer or service user. However its utilization in the domain of higher education is scarce. Therefore, the paper provides an insight into most relevant research and diversified applications of sentiment analysis in higher education, describing its unexploited potentials and benefits, such as leveraging students’ attraction/retention, evaluating the institution’s competitiveness or tracking performance indicators over time.

JEL CLASSIFICATIONS: I, I2, I23, C880

KEYWORDS: Sentiment analysis, higher education, data mining


CORRESPONDING CONTACT: oliverag[ats]ef(dot)uns(dot)ac(dot)rs
postal address: Segedinski put 9-11, 24000 Subotica, Republic of Serbia

http://dx.doi.org/10.15208/pieb.2017.05

1. Introduction

The significant increase of publicly available content on the Internet that expresses opinions in either explicit or implicit way impose the need for their extraction and analysis so advantage of it could be taken to improve a business, understand customer behavior and buying habits, preferences and sentiment¹ in real time.

Large quantities of data are hard to manage, and their processing requires lot of time, so data mining methods and techniques are inevitable when adequate filtering, exploiting and analysis of data is required while searching for useful data and information of high quality Liu (2012). Their application in the analysis of social media sites was named social media analytics – SMA. It enables companies to evaluate the data collected from social media sites gaining deeper insight into the database of their customers - including emotions, sentiment and opinions - and to take advantage

¹ The term sentiment in this paper is used to denote the attitudes and feelings of an individual expressed by words, and distinction should be made from sentiment expressed by gestures or postures. Nevertheless, the distinction of sentiment from the mere media of transferring it (words, gestures, etc.) should be made.
of this insight in optimizing marketing messages, brand positioning, and product/service development. The main goals and benefits of the SMA application are profit leveraging, reduction of customer support costs, customers’ feedback on products/services, and improved customer satisfaction and public opinion on products/services or the company as a whole.

In the paper the application of sentiment analysis in higher education is described, pointing out the many potentials of its broader utilization in this domain. The paper is structured as follows. In the next section major issues and research challenges of sentiment analysis are discussed. Section 3 provides overview of key areas of education, in particular higher education, where sentiment analysis is applicable, and summarizes its benefits. In the last section of the paper, some concluding remarks are provided.

2. Sentiment analysis

One aspect of SMA is sentiment analysis. Sentiment analysis is the research area focused on the analysis of public opinion, sentiment or emotions towards specific entity. This entity can be an individual, event, or a specific topic. In (Nasukawa & Yi, 2003), sentiment analysis is described as capturing favorability, while in the paper (Yi, Nasukawa, Bunescu, & Niblack, 2003) authors emphasize the extraction of sentiment on a specific topic. Sentiment analysis identifies sentiments expressed in text posts, and analyses them in order to discover opinions, identify the expressed sentiments and classify them according to their polarity (Medhat, Hassan, & Korashy, 2014).

Despite the fact that linguistics and natural language processing are scientific areas with a lengthy background, the development of opinion mining and sentiment analysis has started quite recently, as prior to the advent of the World Wide Web and intensified usage of the Internet there were few publicly available posts with attributed opinions. The classification of sentiment in products reviews to those that express positive or negative sentiment is first described in 2003 in the paper (Dave, Lawrence, & Pennock, 2003), being one significant breakthrough in this area. A majority of research done after this first attempt had come to similar conclusions, pointing out that opinion mining tools should extract and analyze opinions on different aspects of products/services.

Sentiment analysis is applicable in almost all areas. Industries surrounding sentiment analysis has benefitted from the development of commercial applications and their spreading usage, which in turn has motivated further research. The crucial reason for large interest in sentiment analysis, the author in Liu (2012) sees in the fact that for the first time in human history, there are vast amounts of opinionated texts publicly available on social media sites and World Wide Web. Without these free form data, numerous research efforts would have been impossible. Therefore, the emerging and rapid growth of new technology of sentiment analysis has been simultaneous to the breakthrough of social networks and social media, whereas research on sentiment analysis currently takes the central place in social media research. Sentiment analysis highly influences not only the natural language processing, but also the domains of management, politics, economics and social sciences, being all heavily influenced by public opinions.

Sentiment analysis is based on data mining techniques and methods. Data mining is one of the best ways to process and analyze large amounts of data available on the Internet, for it allows an objective characterization of the social behavior of individuals, groups or organizations (Yi, Nasukawa, Bunescu, & Niblack, 2003). The concept of data mining refers to the analysis of historical data in order to identify patterns in their trends that will allow the construction of predictive models or
discovering knowledge about users. Data mining techniques that are the foundation for largest number of opinion mining applications are classification, regression and ranking. Most research in this area deals with the issue of text classification according to the polarity or orientation of expressed opinions in reviews to positive, negative and neutral ones.

Sentiment analysis opened a vast amount of issues and research challenges. In any data mining task the greatest effort is required to prepare the data for the analysis, and the data preparation phase is thus the most time consuming one. Opinions and feelings in the data available from the Internet carry their specificities that further hinder the data mining process. They are written in natural languages, having an unstructured form, often include polarity or different sentiment orientation and gradation (McGlohon, Glance, & Reiter, 2010). In addition, in the development of a sentiment analysis application it is important to resolve the issues related to the language on which texts are written and to the way language specificities influence the preparation of the data.

Objective sentences express facts, while subjective sentences express feelings, opinions or beliefs. The presence of subjectivity in sentences is strongly associated with the domain. As stated in Read (2005), the domain dependency is partially due to the differences in the vocabulary, as identical terms may carry quite different sentiment in various domains (for e.g., a suggestion "Read a book" may carry a positive sentiment when stated within the book review, but rather negative when it is part of a movie review). Furthermore, as described in (Feldman, Rosenfeld, Bar-Haim, & Fresko, 2011), a classifier trained on a set of reviews relevant to a certain group of products often would not exhibit the same classification performance when applied to reviews on different product groups. Because of this strong domain dependency, associated with sentiment analysis, it is necessary to create relevant resources for the domain of interest, predominantly the annotated corpora. The corpora is a collection of texts (unstructured data), subject to sentiment analysis. Its annotation is a process of enrichment of the original data set with additional metadata or other relevant information (syntactic, lexical, semantic information), depending on the theoretical or empirical goal of analysis, (Hovy & Lavid, 2010), (Wissler, Almashraee, Monett, & Paschke, 2014)

The annotated data, would enable the further application of different machine learning algorithms, particularly supervised classification algorithms, as well as their evaluation.

3. Benefits in higher education achieved by the application of sentiment analysis

Sentiment analysis has found its application in certain service sectors, such as financial, health or tourism, but only few research has been conducted on the application of sentiment analysis in higher education, such as Hosterman (2013), (Lewis & Nichols, 2013), (Zeng, Hall, & Jackson Pitts, 2013), (Altrabsheh, Cocea, & Fallahkhaier, 2014), (Altrabsheh, Gaber, & Cocea, 2013), (Marques, Krejci, Siqueira, Pimentel, & Braz, 2013). The majority of research efforts in the area of higher education aimed at improving intelligent tutoring systems. Recent studies have shifted their focus to sentiment analysis in higher education as a mean for identifying strengths and weaknesses of individual courses or subjects, as well as revealing real time student problems resolvable by devoting special attention to them during a semester and lectures. In the sequel, a brief overview of typical applications of sentiment analysis in education is given, along with their benefits to educational process and/or student experience.
3.1. Tutoring systems and sentiment analysis

Students trained by students-tutors achieve better results compared to those trained by an intelligent tutoring system, unless the component that can handle and predict emotions is included into the software (Litman & Forbes-Riley, 2004). This finding is the foundation for many improvements made in nowadays tutoring systems, while development of systems that handle emotions provided numerous benefits.

Authors in (Nielsen, Ward, Martin, & Palmer, 2008) have dealt with annotating corpus made up of questions and answers from pupils in the 3rd to 6th grade of primary schools, in order to analyze their level of understanding of basic scientific concepts. Different tags were assigned to contents, which have modeled different degrees in which pupils understood the aspect described in the text: an assumption, a statement, a conclusion, a contradictory statement, a contradictory conclusion, a contradiction in itself, different argument, and the mark that the subject has not yet been taught. Although the student population was not concerned by the survey, the appropriate analogy might be drawn. The authors believe that the findings discovered by the analysis of the enriched corpus can significantly improve not only the performance of intelligent tutoring systems by providing better answers and explanations, but also the functioning of document summarizing systems.

In the study presented in (Grafsgaard, Wiggins, Boyer, Wiebe, & Lester, 2013), the annotation included several dialogue tags: a statement, a question, a positive feedback, a directive, hint, answer, acknowledgment, lukewarm feedback, negative feedback, correction, a confirmation request, request for feedback, and the tag “other”, referring to sentences in the dialogue that were not labeled otherwise. The authors stated that non-verbal communication (posture and gesture) are a good indication of affective and motivational states. The following gestures have been included into the research: placing one hand on the cheek, placing both hands on the face and postural changes measured as the distance of the head from the workstation. Three important postural changes has been identified: the ”center” postural position, being the average distance between the head and the workstations, and depending on whether the student was moving away or approaching the workstation during the dialogue, postural changes were labeled as “far” or “near”, respectively. The corpus was a confluence of a dialogs of 42 students with their tutors. The authors found a significant correlation between non-verbal communication, students’ questions, tutors’ answers, tutors’ directives, and positive feedback from tutors. For e.g. it was discovered that students placing both hands on their face during the dialogue usually exhibit lower productivity. The research findings could be incorporated into intelligent tutoring systems to trigger appropriate actions of the system by certain gestures so thus leverage students’ achievements.

In order to improve tutoring systems authors of the paper (Litman & Forbes-Riley, 2004) take a different approach to the analysis of the emotional states of students during conversations with tutors. The corpus was a confluence of 149 student-tutor dialogues. The emotions articulated in the text were annotated. Authors divided all emotions to the class of high- and low-level emotions. Negative, positive or neutral emotions were considered as high-level emotions. Negative emotions were usually expressed by a specific syntax - an interrogative sentence or ambiguous statements, in which students expressed confusion, boredom, frustration, uncertainty or sadness. Positive emotions were accompanied with confidence and enthusiasm. Neutral emotions were related to those parts of the dialogue in which students had not showed either a strong positive, or a strong negative emotion. Low-level emotions included weakly stated positive or negative emotions, as well as mixed emotion - in cases when in the same statement positive emotions were related to one aspect, and negative to some other, or both emotions were present. In addition to the
classification of emotions, the corpus was associated with domain labels, denoting whether the expressed emotions referred to topics in Physics, which were in the focus of the research, or to the teaching process itself (attitudes towards a tutor, way of communication, etc.). Annotators were provided with the list of terms associated with positive and negative emotions. If an emotion would be noted that was not defined in advance, the annotators should mark it separately. The enrichment of corpus with information about the domain-specific emotional words could enable deeper analysis of students’ emotional states, and the detected emotion-domain-word relations could be a starting point for identifying a student-tutor gap or problems in teaching.

3.2. Sentiment analysis of student posts on discussion forums

Understanding the sentiment of students hidden in messages posted on forums can help in identifying students who have difficulties in completion of the course, to optimize the search for help, identifying positive and negative actions of instructors, and in providing valuable feedback.

Messages posted on forums related to subjects in the field of computer science are in the focus of research presented in papers (Wyner, Shaw, Kim, Li, & Kim, 2009), (Kim, Shaw, Wyner, Kim, & Li, 2010) and (Yoo & Kim, 2014). As there was no consensus on the labeling of emotional content, the authors (Wyner, Shaw, Kim, Li, & Kim, 2009) have identified a set of context-independent emotional states that students were reported to the forum of the course in Informatics at the undergraduate level in terms of: tension, frustration, confidence and kindness. Tension is evident in parts of a dialogue where negative emotion toward a student or an instructor is stated. Students express frustration when they feel hopeless, anxious, when they have difficulties, and when certain actions are repeated without a real progress. Labeling confidence is divided into two aspects: a high degree of confidence is present in case of asking straight questions and providing clear answers and a low level of confidence is expressed by asking dim questions and providing vague answers. Kindness is described through four levels and accordingly annotated in the corpus as: positive - phrases typical for a decent speech, negative - phrases typical for informal communication, bold writing - when a student questions the validity of the answer, or issuing a directive, and confiding - generalization in a question instead of directly seeking assistance (questions like "Does anyone else had a similar problem?"). Additional annotated attributes refer to the type of response (question/inquiry or response/statement), the person who left a message in the forum (a student, an instructor or an assistant), or the person who left the message being replied to. Besides the annotation of tension, frustration and confidence, the authors of papers (Kim, Shaw, Wyner, Kim, & Li, 2010) and (Yoo & Kim, 2014) included also the annotation of information role (request for information - sink and provision of information - source). Analysis of annotated corpus revealed certain knowledge, such as that frustration is more common in long discussions and that it is associated with lower grades, or that a high degree of confidence is significantly correlated with satisfying performance, which can be used in predicting the performance of students, identifying problems at the very beginning of the semester, or pointing to the need for providing students with some other forms of support.

The authors of the paper (Wen, Yang, & Rose, 2014) conducted a research on what sentiment expressed on forums on specific courses can tell about a possible quitting the course during a semester. Data on three courses held on Coursera.org site were used for the analysis, and the most relevant words for the course having positive or negative sentiment, were extracted. In order to understand the influence of sentiment on the level of users, the so called survival analysis was conducted to examine the ways in which the opinion of a forum member expressed during a week.
could predict his/her future involvement on the forum. The results revealed the same trend in all three courses: the higher sentiment coefficients were associated with few students who had quitted the course. During the analysis, the author was able to identify sentiment words closely related to the course, which can help in the detection of some advantages and disadvantages of a given course.

3.3. Application of sentiment analysis on students’ feedback

In paper (Altrabsheh, Gaber, & Cocea, 2013) the authors proposed the utilization of the Sentiment analysis for Education system for downloading students’ feedback information on the subject/course they were attending in real time. The authors believe that the implementation of such a system can significantly help students in solving the problems faced during courses. The presented system analyzes the positive and negative students’ feelings towards lectures they are attending, by means of Support Vector Machine and Naive Bayes algorithms, either by applying them separately or in conjunction, and summarizes the results of the analysis so they can be used to improve relationships with students.

In the paper (Altrabsheh, Cocea, & Fallahkhair, 2014), the authors examined how knowledge about the sentiment of students who are at risk of quitting a course primarily due to boredom or confusion, may be used to encourage their involvement in a teaching process. It was demonstrated on the collected data set, that elimination of the neutral sentiment class in the training phase produced better results, and that the Support Vector Machine and the Complement Naive Bayes classifiers were the best analytic methods for a given data set.

3.4. Application of sentiment analysis in higher education in the Republic of Serbia

Attracting and retaining students is one of the crucial issues of operation and existence of higher education institutions. Sentiment analysis of students’ online reviews can reveal sources of students’ (dis)satisfaction, identify potential bottlenecks, and track market trends. Universities and faculties can benefit from such analysis to become successful in targeting and attracting new students, to improve their services, or from the perspective of the university, to explore the impact of the public mood in the selection of individual faculties or study programs.

Due to the very pronounced demographic decline in the Republic of Serbia the generation of secondary school pupils who will enroll to faculties in 2020 counts almost as much as the expected number of available placements for students admission to higher education institutions, indicating that there will be a strong competition in attracting each student. Only those institutions that will manage to attract a sufficient number of students will be able to successfully do business.

In contrast to the significant role of social networking sites and social media in markets of the USA and Western European countries, where they shape the marketing strategy of educational institutions, their role in Serbia is reduced merely to the Facebook pages or Twitter accounts of higher education institutions, leading to an insufficient exploitation of shared content and its sentiment analysis, available information on visits made, or the users.

In the research presented in Grljević (2016) sentiment analysis was applied with the aim of tackling the issue of successful student attraction based on a well-shaped knowledge on student behavior, their satisfaction and dissatisfaction with the higher education institution. The author developed the annotated corpus for the domain of
higher education in the Serbian language, using students’ online reviews of faculty stuff on all Serbian higher education institutions. This scientific contribution has created the foundation for future applications of sentiment analysis of contents written in the Serbian language in the domain of higher education.

The collected reviews were annotated for aspects (i.e. topics), sentiment polarity, sentiment intensity, negation, and sentiment expressions. Aspects refer to the topic of a review as follows: ‘Professor’, ‘Lectures’, ‘Relationship with the students’, ‘Subject’, ‘Lecture notes’, ‘Organization of the subject’, and ‘Other’ referring to anything out of the higher education scope. Sentiment polarity refers to the sentiment orientation of annotated text which can be positive, negative, or neutral. Students usually express different levels of emotions in the reviews. Annotation of sentiment intensity covered three different levels of emotions: high, medium, or low. Regarding the negation, the key words of the negation and the extent of the text under the influence of that keyword were annotated separately. Sentiment expressions are divided on positive and negative. They were annotated separately. The collection of marked sentiment expressions (positive and negative) was used to create sentiment dictionaries of positive and negative sentiment expressions. The author used three additional dictionaries: dictionary of negation keywords which shift the sentiment orientation, dictionary of intensifiers containing expressions that increase the intensity of expressed sentiment, and dictionary of neutralizers containing expressions that decrease the intensity of the expressed sentiment.

This enriched collection of texts (or online reviews), as well as the created dictionaries, were used as a basis for the application of data mining methods and techniques to reveal students’ sentiments on different aspects. Knowledge detected by applying this approach can help higher education institutions to become more familiar with public opinion, with the prevailing attitude about a particular professor or institution as a whole, to compare competing institutions by online reputation, identify bottlenecks, problematic aspects of business within the institution (e.g. the majority of students criticize the quality of lectures), as well as to track online reputation through time. Such knowledge represents a valuable basis for business decision making and setting up the marketing strategy of the institution.

**Conclusion**

Data mining methods and techniques have a significant role in discovering useful information of high quality hidden in large volumes of data over the Internet. It could be discovered through adequate filtering, exploitation and analysis. The application of data mining to social media contents, known as social media analytics, enables organizations to analyze the data they have collected from social media sites and this way understand their clients in-depth, including their preferences, emotions, and opinions. Research in the area of sentiment analysis has shown that social media are an excellent resource for discovering patterns and trends and for better understanding the customers’ behavior and preferences, so products or services could be proactively innovated. Experiences from other domains, as well as some references mentioned in the paper, suggest that sentiment analysis could be beneficial also for the domain of higher education. The analysis of social media contents generated by students in higher education could provide useful insight into their attitudes, opinions, and feelings towards institution, curricula, subjects, student-teacher relations, support provided by non-teaching staff, and other aspects of studying.

In the article we described in a systematic way the most significant research results in the area of sentiment analysis, showing its broad potentials in the specific area of higher education: for detecting advantages and disadvantages of the education
process from the perspective of certain courses, subjects, or teachers; for identifying challenges students are facing concerning learning contents, materials or exams; for gaining valuable feedback from students in order to improve some particular higher education service or the services level as a whole; etc.

References


Griljević, O. (2016). *Sentiment in the content of social networks as an instrument for improving the operations of higher education institutions* (Sentiment u sadržajima društvenih mreža kao instrument unapređenja poslovanja visokoškolskih institucija). University of Novi Sad.


Yoo, J., & Kim, J. (2014). Capturing Difficulty Expressions in Student Online Q&A Discussions. Proceedings of the 28th {AAAI} Conference on Artificial Intelligence, Québec City, Québec, Canada.