

Social Education: Opportunities and Challenges in Cyber-Physical-Social Space

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WE are making good progresses in our impact and reputation over the last year. According to the latest data released by Scopus on February 11, 2019, our CiteScore hits its historical high to 3.94, and TCSS ranks 8th out of the 226 journals (top 3.54%) in the field of social sciences. This is a solid improvement compared with the corresponding data in 2017 (CiteScore: 2.36, Rank: 17/226, top 8%). Thanks and congratulations to our authors, reviewers, and members of our editorial board. The current issue includes 17 regular papers and a brief discussion on social education.

Scanning the Issue

1. Event Triggered Social Media Chatter: A New Modeling Framework

Michael Muhlmeyer, Jiheng Huang, and Shaurya Agarwal

This paper develops a new modeling framework for the event-triggered social media chatter and discusses various microscopic and macroscopic approaches and the need for an integrated model. It also proposes the idea of a basic reproductive rate R_0 applied to social media information spread under a marketing-model-based framework. Two case studies are presented from compiled Twitter data as examples of event-based social media triggers (#shooting) and social movements (#MeToo). Encouraging results are discussed in the end to support and validate the proposed framework.

2. Online Public Shaming on Twitter: Detection, Analysis, and Mitigation

Rajesh Basak, Shamik Sural, Niloy Ganguly, and Soumya K. Ghosh

This paper mainly studies the online public shaming detection issue in Twitter. They automate it from the perspective of victims and explore primarily two aspects, namely, events and shamers. Shaming tweets are categorized into six types: abusive, comparison, passing judgment, religious/ethnic, sarcasm/joke, and whataboutery, and each tweet is classified into one of these types or as nonshaming. It is observed that out of all the participating users who post comments in a particular shaming event, majority of them are likely to shame the victim. It is also the shamers whose follower counts increase faster than that of the nonshamers in Twitter. Based on categorization and classification of shaming tweets, a Web application called BlockShame is designed and deployed for

on-the-fly muting/blocking of shamers attacking a victim on the Twitter.

3. Joint Task Difficulties Estimation and Testees Ranking for Intelligence Evaluation

Chi Zhang, Yuehu Liu, Li Li, Nan-Ning Zheng, and Fei-Yue Wang

This paper studies the testing tasks evaluation and testees ranking problem. The authors assume that a testee may have a probability to pass a certain task so as to allow certain uncertainty, and design two models to solve this problem. The first one assumes that the test outcome follows a certain Bernoulli distribution; while the second one assumes that the test outcome follows a certain Bernoulli distribution with Beta distribution type *a priori* knowledge. Then, they form the original problem into likelihood estimation problems and solve them by using coordinate descent algorithms. Numerical test shows that Beta distribution type *a priori* knowledge is needed, when they only carry out a limit number of tests due to time and financial budgets. All these findings are useful to designs of tests for artificial intelligence (AI) systems.

4. A Fuzzy Approach to Text Classification With Two-Stage Training for Ambiguous Instances

Han Liu, Pete Burnap, Wafa Alorainy, and Matthew L. Williams

This paper mainly studies cyberhate classification, since the spread of hate speech via social media can have disruptive impacts on social cohesion and lead to regional and community tensions. They propose a modified fuzzy approach with two stage training for dealing with text ambiguity and classifying four types of hate speech, namely, religion, race, disability, and sexual orientation, and compare its performance with those popular methods as well as some existing fuzzy approaches, while the features are prepared through the bag-of-words and word embedding feature extraction methods alongside the correlation-based feature subset selection method. The experimental results show that the proposed fuzzy method outperforms other methods in most cases.

5. A Novel Hybrid-Jump-Based Sampling Method for Complex Social Networks

Lianggui Liu, Lingmin Wang, Wei Wu, Huiling Jia, and Yu Zhang

This paper proposes a new hybrid jump (HJ) sample by introducing an HJ strategy into metropolis-Chasting random walk (MHRW) during the sampling progress. They use a

breadth-first search to obtain a data set without repeated node quickly from a list of jump nodes, where they adopt uniform (UNI) sample to get the average degree of the original network. Then, a 3-D average degree distribution model is designed to determine the optimal value of the jump parameter in HJ. Finally, they set the condition to execute the HJ strategy in each step of sampling progress. The experimental results demonstrate that the performance of HJ is better than the other representation sampling methods both in strong-tie networks and weak-tie networks.

6. Conditional Coordination Games on Cyclic Social Influence Networks

Wynn C. Stirling

The combination of conditional game theory and Bayesian network theory provides a framework within which to formalize a theory of coordinated decision making under social influence. As originally developed, however, conditional game theory applies only to acyclical networks involving unilateral influence propagation. This paper extends the theory to account for networks with cycles, where agents are able to exert multilateral influence on each other. The Markov convergence theorem establishes conditions for convergence to steady-state coordinated decisions. The authors demonstrate its use with a bilateral collaboration scenario and provide the mathematical analysis for several canonical network topologies.

7. Modeling Behavioral Response to Vaccination Using Public Goods Game

Marzieh Soltanolkotabi, David Ben-Arieh, and Chih-Hang Wu

This paper describes modeling the efficacy of vaccination considering the cost and benefit of vaccination to individual payers. The model is based on the public goods game and is presented as a spatial game on a lattice. Using this model, individuals can contribute to the public health by paying the cost of vaccination or choose to be protected by the public who is vaccinated rather than pay the cost and share the risk of vaccination. Thus, in this model, individuals can choose to stay susceptible, can become infected, or choose to vaccinate once in each episode. This paper also presents the behavioral changes of the population and the cost to the society as a function of the cost of vaccines, cost of being infected and the “fear factor” created by the public media.

8. FBVA: A Flow-Based Visual Analytics Approach for Citywide Crowd Mobility

Xiaonan Luo, Yuan Yuan, Zhihao Li, Minfeng Zhu, Ying Xu, Liang Chang, Xiyang Sun, and Zi'ang Ding

This paper proposes to model the crowd mobility as a dynamical system and characterize the irregular mobility data with a novel local coherence of sparse field (LCSF) algorithm. The proposed algorithm makes it possible to measure the separation behavior of trajectories in an irregular and sparse topology network. This paper also designs and implements a visual analytics system to facilitate situation-aware analysis of a huge amount of crowd mobility and their socialized behaviors. The effectiveness of the proposed approach is demonstrated by case studies based on a real-world data set.

9. A Novel Hybrid Clustering Algorithm for Topic Detection on Chinese Microblogging

Xiao Geng, Yanmei Zhang, Yuhang Jiao, and Yinan Mei

This paper proposes a three-layer hybrid algorithm to tackle the problem of traditional clustering algorithms being difficult to handle the large-scale microblogging data with various topics and high noise. In the first layer, they use the K-means algorithm in which the initial center selection is optimized to group the microblog texts efficiently. They then subdivide big clusters and isolate noise text to get purer clusters. In the second layer, they adopt the agglomerative nesting (AGNES) algorithm to merge the small clusters referring to the same topic. Then, they exclude most noise, reducing the further impact on the K-means in the third layer which corrects the erroneous merging occurring in AGNES. Experiments show that their algorithm outperforms some related traditional algorithms on the clustering of real microblogging data set and performs well in topic detection.

10. Clustering-Algorithm-based Rare-Event Evolution Analysis via Social Media Data

Xiaoyu Sean Lu, MengChu Zhou, Liang Qi, and HaoYue Liu

This paper concentrates on the intensity of information volume and proposes an innovative data processing method based on clustering algorithms. The proposed method can characterize the evolution of a rare event in the real world by analyzing social media activities in the virtual world. This exploration contributes to study changes of social media activities in the time domain. Social media data collected from Twitter during its arrival time span are adopted to evaluate the feasibility and effectiveness of the proposed method. It confirms that a strong correlation between a rare event and social media activities does exist. Also, it uncovers that a time difference does exist between the real and virtual worlds.

11. Sustainable Collaborator Recommendation Based on Conference Closure

Wei Wang, Jiaying Liu, Zhuo Yang, Xiangjie Kong, and Feng Xia

This paper develops a sustainable collaborator recommendation system (SCORE) by utilizing the weak tie relationships brought by academic conferences for sustainable collaborator recommendations. Through defining and quantifying the conference closure, the authors incorporate the conference co-attending relationships into collaborator recommendation system inspired by the principles of “diversified recommendations.” Experimental results on attendees of ten academic conferences show that SCORE outperforms the state-of-the-art collaborator recommendation systems in accuracy and sustainability. Their model can be used to improve the sociability of academic conferences by recommending sustainable collaborators to conference attendees.

12. Leveraging Social Network Analysis for Characterizing Cohesion of Human-Managed Animals

Dixon Vimalajeewa, Sasitharan Balasubramaniam, Bernadette O'Brien, Chamil Kulatunga, and Donagh P. Berry

This paper explains an approach to evaluate animal importance to a group by considering the variability in group-level structural information, which is computed by joining the animal- and group-level social network analysis measures node centrality and network entropy, respectively. Moreover, two other metrics, animal social interaction range and nearest-neighbor frequency matrix are computed to help address the general challenges in graph-based social network analysis. Finally, the authors derive the joint distribution of animal importance of the group in detecting atypical social behaviors. Their study shows the entropy-based animal importance metric's superior performances when evaluating animal importance to the group compared to the existing metrics.

13. GDTM: A Gaussian Dynamic Topic Model for Forwarding Prediction under Complex Mechanisms

Qian Li, Liangyun Liu, Ming Xu, Bin Wu, and Yunpeng Xiao

This paper focuses on the formation and evolution of the external as well as internal driving mechanisms, and develops a GDTM for forwarding prediction by incorporating all the information of nodes and edges. First, based on the diversity of communities each user located in, Latent Dirichlet Allocation traditional text modeling method is applied into user following relationships and user interacting relationships modeling. Second, time factor is introduced and the dynamic topic model is proposed to model user behavioral attributes. Finally, combining with external and internal factors, a probabilistic graph model is used to model forwarding behavior. Experimental results indicate that the model can not only detect the latent communities but also can improve the performance of forwarding prediction effectively.

14. BEEF: Balanced English Explanations of Forecasts

Sachin Grover, Chiara Pulice, Gerardo I. Simari, and V. S. Subrahmanian

This paper addresses the problem of automatically extracting balanced explanations from predictions generated by any classifier, which include not only why the prediction might be correct, but also why it could be wrong. Our framework, called BEEF, can generate such explanations in natural language. After showing that the problem of generating explanations is NP-complete, the authors focus on the development of a heuristic algorithm, empirically showing that it produces high-quality results both in terms of objective measures with statistically significant effects shown for several parameter variations and subjective evaluations based on a survey completed by 100 anonymous participants recruited via Amazon Mechanical Turk.

15. A Two-stage Intervened Decision System with State-Dependent Random Inspection Mechanisms

Tingnan Lin and Hoang Pham

This paper develops models for a multiunit two-stage intervened decision making system with majority voting rule. The decision process of the system is divided into an inspection stage and a result submission stage. During the inspection stage, there are two possible states for each decision unit. Each decision unit will be visited at most twice by the supervisor and the result for the visit depends on the state

of the decision unit. The result provided by each decision unit can be submitted any time during the second stage and there is a check point during this stage to make the process finish earlier. The final decision of the system will be made at the end of the second stage. The proposed system can be applied in various applications in real life.

16. Crowd Behavior Evolution With Emotional Contagion in Political Rallies

Pei Lv, Zhujin Zhang, Chaochao Li, Yibo Guo, Bing Zhou, and Mingliang Xu

This paper presents a novel crowd behavior evolution method with emotional contagion in political rallies. The authors first analyze the most representative political rally scenes and model them into two kinds of abstract scenario. Then, an improved emotional contagion model is proposed by combining the Susceptible–Infected–Recovered model and individual personality under different political viewpoints. Finally, the crowd in a political rally is driven to move according to the new potential moving direction generated by emotional contagion and the original direction of the individual together. The experiments show that the proposed method can intuitively demonstrate the emotional changes of those individuals with different political perspectives and reasonably simulate the crowd movement under the political rally scenes.

Social Education: Opportunities and Challenges in Cyber-Physical-Social Space

According to the works of Jean Piaget and Lev Vygotsky, learning stems from not only learners' independent exploration and knowledge construction but also their culture and social interactions. A broader understanding of the mind, cognitive development, and learning philosophies has aroused to enhance teaching and learning practices. Social education is then defined as such a scientific field of study that examines complex interplay of learning, human attributes, and social behaviors. This field continues to evolve with the radical and transformative technological advancement (including the recent booming in AI). Many new concepts, infrastructures, technologies, and devices are emerging to support innovative ways of authentic teaching and learning that can take place anytime and anywhere. All of those lead to a brand new definition of education—Cyber-Physical-Social Education (CPSE) with the following dimensions to empower the next generation of digital citizens.

1) Cyber-enabled intelligent educational framework, tools, and materials

Increasingly, powerful and pervasive information, computation, AI and communication technologies have been creating transformational opportunities for education and learning by promoting ubiquitous cyber-based learning environments. The interactions between real learning and virtual learning then gives a rise to a new research area—Parallel Intelligence in Education, or Parallel Education. Ambitious development of new framework, tools, and materials in this area will soon connect people, institutions, information, and instrumentation across disciplinary, organizational, and cultural barriers on a global scale, potentiate cognitive, and metacognitive gains at all ages and in various settings, and make education 24/7.

2) Educational informatics

Schools, colleges, universities, and other instructive bodies hold a lot of information. The analysis not only offers insights that can enhance the operational adequacy of the educational organizations but also provides schools and educators new, significant bits of knowledge into student conduct and performance. The work in this area involves, but is not limited to, tools and methods on data collection (e.g., sensor design and deployment in various learning contexts), data analysis (e.g., data mining for learning correlation), and data utilization (e.g., the integration of the aforementioned two for learning augmentation and personalization).

3) Social media crowdsourcing for education

Learning is social where students learn a great deal through the interactions with their peers. Mutual exploration, meaning making, and ample feedback among peers produce intellectual synergy of many minds to bear on a problem and the social stimulation of mutual engagement in a common endeavor. In nowadays, such collaborative social learning takes various forms, particularly with the booming in social networks, social media, and crowdsourcing. Those changes also present challenges in contextual integrity, privacy, and trust, which are worth of increasing research efforts. In this editorial, we will focus on two critical issues, which, in our belief, can further promote the effectiveness and efficiency of CPSE, in which computational social systems will play a critical role.

Big Data for Education

Education has become increasingly concerned about force-fitting every learner into one teaching model assuming they learn in the same way. The need, importance, and potential benefits—as well as the difficulties for obtaining the resources—for providing a more personalized learning framework that better fits learners' educational needs can be hardly overstated. It is, in fact, the first of the 14 Grand Challenges set by the National Academy of Engineering for the 21st century. The fundamental step in developing such a personalized framework is learning analytics, from descriptive, predictive, to prescriptive analytics—different ways of collecting and analyzing data generated by learners on their social interactions with various contexts in order to understand and optimize learning environment. There are many types of social learning data that is typically collected via smart sensors and/or crowdsourcing. For example, the patterns in each student's engagement level, moods, use of classroom resources, social habits, attention span, academic performance, and more might help educators to guide student learning in the way that suits him or her the best. However, the methods and tools to discover and understand such patterns from the data are limited. The effective collection, analysis, and fusion of such data to empower better decision making in teaching and learning is still an unprecedented challenge.

The following provides four research directions that we believe would help overcome those difficulties in data mining and data fusion for education.

- 1) Each type of social learning data and its correlation to learning behaviors and/or performance require substantial investigation both theoretically and practically.

- 2) The variability and complexity of data in terms of educational settings, contents, and domains call for various AI techniques to better derive and utilize insights from educational data analytics on a large scale. In particular, it is worth of broadening angles to explore data, isolating and adjusting confounding factors, developing models with the balance of fit and generalizability, and aligning statistical thinking with scientific thinking.
- 3) Although the information gathered from massive crowdsourcing platforms and social media sites allows to derive a very comprehensive set of learning information, there are a variety of issues and challenges that need to be addressed, ranging from ethics to development mechanisms for data classification, mixture, filtering and processing, and to enforce users privacy and security.
- 4) Sensors are really the front end of vast data streams. Although a variety of sensors have been using to monitor and track students behaviors in learning, the fundamental improvements to the existing mechanical, electrical, and optical sensing modalities remain an interesting research topic in order to offer the desired accuracy, precision, and quality control of sensory data.

Cross-Disciplinary Nature of Education

The global shift from an industrial age to a knowledge economy has significantly changed the role of education to cultivating creative professionals who develop and apply new knowledge in real-world social settings rather than memorize the facts and procedures. This paradigm transformation makes it necessity to move discipline-based educational research (DEBR) toward interdisciplinary and cross-disciplinary approaches. The synergy between education and other discipline fields, such as cognitive science, educational psychology, anthropology, sociology, computer sciences, information sciences, neurosciences, and instructional design, etc., provides new ideas, new methodologies, and new ways of thinking about learning called learning sciences.

- 1) Executive functioning is one of the cognitive theories that describe the constellation of numerous mental processes and skills that help human beings plan for and respond to the tasks, challenges and opportunities they face. Several interrelated cognitive components of performance often differentiate high- and low-scoring individuals in learning. Therefore, a better understanding of students' executive functions in the context of their learning can certainly guide our instructional design that target students' specific areas of difficulty and play to some of their strengths.
- 2) Metacognition—awareness and monitoring of ones learning processes—has been increasingly recognized as a critical skill to successful learners. DEBR shall draw heavily on psychological studies of students' cognitive development to reveal the deeper underlying bases of how knowledge construction works, based on which educational materials and tools that emphasize higher order thinking are designed.
- 3) From Seymour Paperts Logo to Jeannette Wings computational thinking, more and more researchers

realize the vital of integrating computers and technology into all-discipline education. Thinking computationally is a fundamental skill for everyone, not just computer scientists. More importantly, the collaboration among educators, computer scientists, and subject experts shall move beyond computational thinking to a perspective of computational action that empowers learners' ability to develop computational solutions in the context that is relevant to the learners.

Technological advancement has given education a new definition—CPSE, resulting in fundamentally new ways of teaching and learning. Various opportunities and challenges arise, which calls for practical strategies for collaboration across DEBR and the learning sciences. While keeping pace with the technological evolution, CPSE continues to prepare a diverse science and engineering workforce, who in turn further advance the technology to a new era. Two initiatives, iSTRAMS and iCDIOS, extension of well-known STEM and CDIO, respectively, have been launched 5 years ago along this direction in Qingdao, China. Primitive results indicate that CPSE will help technology, education, and human beings to jointly form a healthy and happy educational ecosystem.

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