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Modeling and analyzing of conformity behavior: A fuzzy logic approach

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ABSTRACT

Modeling students' classroom behaviors can help educators and researchers better understand these behaviors, and further guide students toward well behaviors. Conformity refers to the tendency to change individual behavior to match group behavior. Through observation and experience, educators have accumulated much linguistic knowledge for describing and understanding students' conformity behavior and influence. This paper presents a fuzzy logic approach for modeling participants' classroom behaviors. The simulation results about two observed college classes show that the constructed fuzzy logic system is congruent with the observed participants' classroom behaviors. Existing findings, as well as new findings, are verified through further simulation and analysis. The proposed fuzzy logic system helps educators quantitatively analyze and understand students' conformity behavior in classroom.

1. Introduction

Modeling helps people better understand real world systems. Understanding and guiding students' classroom behavior is always the concern of educators and researchers. The researches in social psychology indicate that individual behavior is influenced by environment, other people, and group. *Conformity* is an important type of social influence. It refers to the tendency to change one's belief or behavior to match the behavior of others [1]. In literature, *conformity behavior* is also referred to as *herd behavior* [2,3] or *collective behavior* [4].

Educators and researchers have long been interested in how students' individual behavior in classroom is influenced by environment and group behavior. Through observation and experience, they have accumulated much linguistic knowledge for describing and understanding such influence, e.g., (a) if the group learn in earnest and the teacher teaches well, then each individual tends to learn in earnest; (b) if the group learn in earnest, but the teacher teaches averagely, then each individual still tends to learn in earnest.

Among various modeling methods, fuzzy modeling is one of the most effective quantitative approaches for transforming human linguistic data into mathematical formulas and vice versa. It offers a unique advantage, i.e., the close relationship between linguistic description and resulting mathematical model [5].

Therefore, this paper presents a fuzzy logic approach for modeling participants' classroom behaviors. The constructed fuzzy logic system is simulated with MATLAB. Simulation results about two observed classes show that the fuzzy logic system is congruent with the observed participants' classroom behaviors. Existing findings, as well as new findings, are verified through further simulation and analysis.

This paper mainly makes the following contributions: (i) presenting a fuzzy logic approach for modeling participants' classroom behaviors; (ii) providing a significant attempt to quantitatively analyze and understand students' conformity behavior in classroom; and (iii) discovering several new findings based on simulation results.

2. Related work

2.1. Conformity research

The research on conformity can be traced back to Sherif's pioneering experiment: a guess in the dark [6]. Asch conducted a series of conformity experiments [7–9]. Throughout these experiments, he wanted to examine: (a) what extent do social forces alter

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people's opinions; (b) which aspect of the group influence is most important, the size of the majority or the unanimity.

Social psychology researches on conformity indicate that the size of the group, the unanimity of the group opinions, and individual's commitment to the group can all affect conformity [1].

Rosander and Eriksson [10] investigate conformity behavior in use of the Internet. Their research indicates that half the participants are subjected to conformity manipulations. The result shows the participants a clear conformity to erroneous majority alternatives. They also discuss underlying reasons for such conformity.

Chen [2] refers to conformity as *herd behavior*. He claims that when people use the product evaluations of others to indicate product quality on the Internet, online herd behavior occurs. He presents four studies examining herd behavior of online book purchasing.

In sum, there are many studies addressing conformity in use of Internet [10], online purchasing [2], financial market [3,11], etc. This paper attempts to study college students' classroom behavior from conformity point of view.

2.2. Fuzzy logic and modeling

Fuzzy logic is one of the most appropriate quantitative methods describing an observed system. The description and characterization is built on natural languages. Natural languages are undoubtedly the most convenient and effective expression means for human, since they undergo thousands of years of historical development.

In 1965, professor Zadeh published his seminal work on fuzzy sets [12], in which he detailed the mathematics foundation of fuzzy set theory. In 1973, he proposed the theory of fuzzy logic [13].

Tron and Margaliot [5] utilize fuzzy modeling as a tool for assisting human observers in the difficult task of transforming their observations into mathematical models, which advocates a new application of fuzzy modeling. They demonstrate unique advantages of fuzzy modeling using an example of territorial behavior of fish.

Chrysafiadi and Virvou [14] constitute a literature review on student modeling for the last decade. They review the prevailing student modeling approaches in designing computer-based educational software and tutoring systems. They notice that there is an increase in the adoption of fuzzy techniques and Bayesian networks in order to deal the uncertainty of student modeling.

Compared with aforementioned research work [2,5,10], this paper presents a fuzzy logic approach for modeling students' individual conformity behavior in college classroom.

3. A fuzzy logic approach for modeling participants' behaviors in classroom

The motivation of this paper is that an interesting conformity phenomenon is first discovered in college classroom by natural language. Therefore, a fuzzy logic system is constructed to describe participants' classroom behaviors from conformity point of view, as well as to study the factors that influence students' conformity behavior.

3.1. Phenomenon description and analysis

An interesting phenomenon is discovered in a same course for two classes: (a) a large class containing 120 students, and (b) a small class containing 90 students.

"These students are all sophomores. The academic performance of each class is almost at the same level. But the teaching effectiveness differs greatly. The large class is arranged in a big classroom with 180 seats. During a lesson, the students are seated dispersedly. The classroom is very noisy, and the class discipline is bad. The status of students' participating in the lesson makes the teacher's mood very bad. The teaching effectiveness is poor. However, the small class is arranged in a small classroom with 100 seats. During a lesson, the students are seated concentratedly. The class discipline is good. Most students listen to the teacher and take notes carefully. The teacher is in well mood. Therefore, the teaching effectiveness is good."

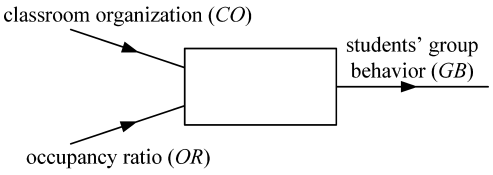

Fig. 1. The fuzzy logic model of determining *GB*.

Several factors cause the difference in teaching effectiveness. Firstly, a large classroom is really not suitable for a lesson. In a large classroom, if the students are seated dispersedly, it is not easy for the teacher to observe every student. Therefore, the teacher could not tune the teaching according to students' reflection. While in a small classroom, it is relatively easy for the teacher to observe the whole class. Secondly, if a classroom contains so many students, the class tends to be noisy. It is not easy for the teacher to maintain class discipline. Therefore, an individual student is more vulnerable to be influenced by other students. Thirdly, in a class with poor discipline, the teacher's mood is affected as well. The teacher feels not respected by students. The poor mood will naturally affect the teacher's thinking and disturb his teaching process.

3.2. The constructed fuzzy logic system

The above phenomenon can be identified as a phenomenon and behavior in social psychology, i.e., *conformity behavior*. This paper constructs a fuzzy logic system from the following two aspects: the *environment*, and the *participants' behaviors*.

The environment includes two factors:

(a) *Occupancy ratio* (*OR*): the ratio of class size to classroom capacity, $OR \in [0,1]$. *OR* has three fuzzy variables: *high*, *medium*, and *low*. The corresponding membership functions are: f_1, f_2, and f_3, respectively.
(b) *Classroom organization* (*CO*): the observed average organization level of the whole class, $CO \in [0,1]$. *CO* also has three fuzzy variables: *good*, *medium*, and *bad*. The corresponding membership functions are: f_4, f_5, and f_6, respectively.

The participants' behaviors include students' group behavior (*GB*), the teacher's teaching behavior (*TB*), and students' individual behavior (*IB*).

(a) *GB*: it represents the earnestness extent to which all students listen to the teacher in class as a whole, $GB \in [0,10]$.
(b) *TB*: it is a comprehensive index, which includes the extent to which the teacher can concentrate on teaching, and the popular degree of teacher's teaching, $TB \in [0,10]$.
(c) *IB*: it represents the earnestness extent to which an individual student listen to the teacher in class, $IB \in [0,10]$.

GB has three fuzzy variables: *well*, *general*, and *bad*. The corresponding membership functions are: f_7, f_8, and f_9, respectively. The factors which influence *GB* include *CO* and *OR*, as shown in Fig. 1.

The fuzzy logic rules determining *GB* are listed as follows.