E-learners' personality identifying using their network behaviors

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ABSTRACT

Automatic identification of learners attributes is the main trend in development of e-learning environments and providing personalized learning path. Many learners' characteristics may be considered to provide personalized learning that fit into individual's needs. Understanding individual differences in learning is an important issue in educational psychology. Many studies attest that learning process can be more effective by considering personality traits. In this paper, we propose a fuzzy inference system, ALPIS, to identify the Big-Five Personality from learner's network behaviors. The proposed system had been implemented through MATLAB fuzzy tools. We conducted an experimental study in real e-learning environment with 53 students (29 male and 24 female) to evaluate the ALPIS performance. Comparing to the conventional inventory-based psychological analysis (NEO-FFI) we demonstrate that learners' personality can be predicted with reasonable precision based on their online behaviors.

Experiments have shown that ALPIS is able to automatically detect learners' personality with accuracy at least 78% on medium Agreeableness category and 97% on low extroversion category. Because of using learners' behaviors ALPIS provides a reasonable precision in personality detection.

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1. Introduction

Many e-learning systems have been developed to adapt learning content to an individual's attributes. Personality is a learner attribute that affects on learning achievement. Providing more dedicated and personalized training is a desired property for e-learning systems. However, little researches have been done to conduct proper analysis for explaining the learner's network behaviors from their personality. Many educational psychologists have claimed that personality influences the way learners actively involution in their learning processes as well as whether they take responsibility for self-direction and discipline (Kim, Lee, & Ryu, 2013). The relationship between personality and academic performance has been examined in the context of distance and online education (Butler & Pinto-Zipp, 2006; Irani, Telg, Scherler, & Harrington, 2003; Kanuka & Nocente, 2003; Kim & Schniederjans, 2004; Lee & Lee, 2006). Although results have been mixed, but generally support a significant relationship between personality and performance. Kim and Schniederjans (2004) found a significant relationship between performance and each of the Big Five dimensions except extroversion; Lee and Lee (2006) found a relationship

between personality and interaction in web-based threaded discussion; and Butler and Pinto-Zipp (2006) found several significant relationships which were consistent with personality traits. Pavalache-Ilie and Cocorada (2014) investigated the relations between some of the student's personality characteristics and some dimensions of online learning (preferred learning methods, student's needs, relations with the teacher and classmates). The obtained data suggest that the introverts prefer to learn and contribute to an online discussion forum while the extroverts would rather take part in the face to face classroom environment. In Kim et al. (2013), the relation between a learner's personality traits has been tested and the effects of these traits on learning preferences have been analyzed. Also, Feldman, Smart, and Ethington's (1999) noted that achievement is a function of the fit between personality type and environment. Vermunt, Bronkhorst, and Martínez-Fernández (2014) emphasizes individual differences in the use of learning strategies in higher education. The relationship between academic performance and personality traits has been described by Ackerman and his co-worker (Ackerman, 1999; Ackerman & Beier, 2002; Ackerman & Heggestad, 1997; Goff & Ackerman, 1992).

According to above brief discussion, identifying learners' personality will help the designer create customized educational materials tailored to each individual. The system's information about learners' characteristics has implications on selecting the teaching strategies. Knowing the personality type of each learner

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can help to identify their learning preferences and strengths, which can be utilized in instructional designs and making the learning process more effective and improving students' performances.

Psychometric instruments, such as NEO-FFI, are the most used instruments to identify people personality but some researches (Castillo, Gama, & e Breda, 2005) explain that the information about the learners acquired by psychometric instruments encloses some uncertainty because this results acquired from self-reports (Castillo et al., 2005).

On the other hand, peoples' values and preferences are often reflected in their personality traits. They could explain the occurrences of certain individual behaviors. Personality is hypothesized to lead to beliefs related to the behavior (Devaraj, Easley, & Crant, 2008). In the other words, analyzing outer behaviors can be used to personality analysis since behavior is the expression of personality.

Hence, identifying learners' personality based on their outer behaviors, using automatic approaches, tend to be more accurate since they analyze data derived from an interval of time, instead of data collected at a particular point in time and by self-reports (Bai, Zhu, & Cheng, 2012).

According to our knowledge, there is no research in literature to identify learners' personality based on their network behaviors in e-learning environment. But some researches have been done in social networks environment context. Gosling experimented on the description of personality in social networks (Gosling, Augustine, Vazire, Holtzman, & Gaddis, 2011). He introduced a mapping between personality and network behaviors. They used self-reported Facebook usage and observable profile information and finally gave the correlation factor between personality and online behavior. Orr et al. (2009) discussed the relation between shyness and use of social networks. They discovered that shyness was significantly positively correlated with the time spent on these networks and negatively correlated with the number of friends. Bai et al. proposed an automatic and objective personality prediction system based on user's behaviors on social networks (Bai et al., 2012).

Acquired data from learner behaviors may contain uncertainty and vague. Fuzzy sets theory is one of the most appropriate mathematical theories to deal with uncertainty. Fuzzy models can model both quantitative and qualitative information (Georgiou & Makry, 2004). In this context, we believe that fuzzy approach eliminates many uncertainties and vague for automatic identification of personality based on learner behavior. This approach uses expert knowledge about relation between learner's personality and his/her behavioral patterns. This makes the method more general and more easily reusable.

In this paper, a fuzzy system, that named ALPIS, is designed to identify learners' personality based on their behaviors. The Big five personality model (NEO personality model) that supports this approach is the personality model proposed by Costa and McCrae (1992).

The paper is organized as follows: in Section 2 the Big five personality model and NEO-FFI personality inventory are described. The designed fuzzy system is introduced in Section 3 and the experimental results are discussed in Section 4. Finally, the conclusion is given in Section 5.

2. The Big five personality model

Individual differences include some traits such as personality and demographic that account for differences attributable to circumstances such as experience and training (Agarwal & Prasad, 1999). Personality is a variable to link external variables to behaviors and lead to beliefs related to the behavior (Devaraj et al., 2008). Human personality may effects on many social activities such as

academic performance (Lounsbury, Sundstrom, Loveland, & Gibson, 2003), learning strategy preference (Conti & McNeil, 2011) and academic motivation (Komarraju & Karau, 2005). In the literature of personality and individual differences, Big Five Personality (BFP) factors is the best description of personality that referred as the "Big 5" or "NEO" including neuroticism, extroversion-introversion, openness, agreeableness, conscientiousness (Costa & McCrae, 1992; Petrides et al., 2010). Therefore this research employs the Big Five Personality factors to measure learner personality.

Neuroticism is a dimension of personality defined by stability and low anxiety at one end as opposed to instability and high anxiety at the other end. The term neuroticism has an inherent negative denotation (Costa & McCrae, 1992). Extroversion defined as a trait characterized by a keen interest in other people and external events, and venturing forth with confidence into the unknown and denotes activity, energy, and vigorousness (Zuckerman, 2005). Openness to experience is associated with creativity, intelligence, imagination, and autonomy. Openness refers to how willing people are to make adjustments in notions and activities in accordance with new ideas or situations (De Raad & Schouwenburg, 1996). Agreeableness refers to the tendency to be friendly, flexible, and cooperative. Agreeableness measures how compatible people are with other people, or basically how able they are to get along with others (Ewen, 2009). Conscientiousness refers to how much a person considers others when making decisions. Conscientiousness represents characteristics such as being thorough, in a task-oriented way, systematically and carefully (Ewen, 2009).

The NEO Five-Factor Inventory (NEO-FFI) developed by Costa and McCrae (1992), consists of 60 items, 12 for the factors of Conscientiousness, Neuroticism, Extroversion, Agreeableness and Openness to Experience. It was the most widely used measure of personality traits and has demonstrated good internal and external validity (Costa & McCrae, 1992). The NEO-FFI items rated on a 5-point scale that provides a quick, reliable, and accurate measure of the five domains of personality. The score of each item is 1 for strongly disagree, 2 for disagree, 3 neither agree nor disagree, 4 agree and 5 for strongly agree. A number of the items such as 1, 3, 8 and 12 are reversely scored. The score of each dimension is in [12,60] interval. Scores between 12 and 24 are low, between 24 and 48 are normal and between 48 and 60 are high on each dimension. For example, people who score high on Conscientiousness tend to be conscientious and well-organized; have high standards and always strive to achieve their goals.

3. Automatic learner's personality identifier system (ALPIS)

A common methodology in behavioral science is to use self-report questionnaires to gather data about people such as using NEO-FFI to measure personality. Most of these instruments depend on the use of self-report because it offers an efficient way to collect information. These instruments are a cheap and quick way, in terms of time and cost, to obtain data and can be easily implemented (Bersoff & Bersoff, 2000). However some disadvantages are associated with the use of self-report instruments. For example, they affect by social desirability biases. People tend to present themselves in a favorable manner, especially when they make judgments about attitudes that are negatively valued such as irresponsibleness. Some people often believe that problems that they encounter, especially interpersonal conflicts, are not due to any fault of their own. This lack of insight that is characteristic of individuals with personality disorders makes it even more difficult to obtain accurate personality information using self-report measures (Oltmanns & Turkheimer, 2006).

In order to obtain a more comprehensive perspective on an individual's interpersonal difficulties, several researchers have