Context-awareness based Peer Recommendation in the e-Learning Context

基于境脉感知的同伴推荐研究

郑燕林 ◎ 著

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目前主要从事CSCL、泛在学习（ubiquitous learning）系统设计与开发、网络环境下知识管理能力发展相关研究。近年来，共发表中英文学术论文50余篇，其中包括SSCI、EI、ISTP、CSSCI检索论文。

This research is supported by the project "Research on the Construction and Application of Teaching Practice Community oriented to Knowledge Management under Networks Environments" (No.CCA090126), from National Education Science Foundation of China.

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I would like to dedicate the book to my grandmothers, who can never read English but can tell me many old stories with love and memories. I would like to express gratitude to my parents for bringing me up and always accompanying me with their love and encouragement. I have to

express my appreciation to my younger sister for her smiles, love, encouragement, and her patience in taking care of my daughter. Finally, from the bottom of my heart, I will thank my husband and lovely daughter who make it possible for me to catch the whole meaning of my life.

Abstract

Recommender systems are important learning support systems in e-learning settings. Personalized recommendation is a kind of important learning service for the improvement of learning performance by providing personalized learning contents and peer recommendation for online learners. This study initially proposes a three-dimensional context-awareness model for personalized recommendation, especially for peer recommendation in e-learning.

It is widely recognized that peer interaction is valuable for improving learning and achievement. This study proposes the use of context-awareness to help learners in distributed e-learning settings find the suitable peers for collaboration on the suitable knowledge, at the suitable time, and in the suitable way.

Based on the recognition of the e-learning context that involves knowledge context, social context and technical context, this study describes a three-dimensional context-awareness (CA) model for peer recommendation, including CA to knowledge relevance, CA to social proximity, and CA to technical access. By matching the peer-seeker and the peer-candidate with respect to these three dimensions, the CA information is promising as an aid to the peer-seeker in finding suitable peers.

The importance of activity context is highlighted in the CA-supported peer recommendation mechanism that comprises three basic modules: context monitoring, context filtering and CA visualization. A rational articulation will help to computationally model and manage contexts. This study

suggests a five-dimensional (who, what, how, when, where) approach to modeling learning activity contexts. Two case studies are included in present study. One is designed to examine learners' perceptions toward the CA model. The other is designed to explore concrete CA-supported peer recommendation flow by using a prototype weblog system as the test bed.

This book is organized as follows. Chapter 1 introduces the research background and purposes of this study. Chapter 2 recognizes the theoretical foundations for this study. Chapter 3 explores the e-learning context. Chapter 4 discusses peer interaction in the e-learning context, and suggests that effective peer interaction should be built on the considerations of knowledge relevance, social proximity and technical access between participants. Chapter 5 proposes a three-dimensional CA model for peer recommendation. Chapter 6 describes a CA-supported peer recommendation mechanism, which is based on mining learners' activity contexts in e-learning spaces. Chapter 7 presents a prototype case study (PeerFinder), which implements CA in a weblog system. Further discussion is provided in Chapter 8. This section discusses the extensibility and flexibility of the CA model, and the feasibility and validity of CA implementation, and argues that the CA model can be used in a much wider context beyond peer recommendation. The last chapter summarizes this study and discusses future research directions.

In brief, this book mainly discusses the construction of the three-dimensional CA model, the CA-based peer recommendation mechanism and the design of CA-based recommender systems.

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Chapter 1 Introduction

1.1 Research Background

Human interactions for experience sharing and cooperative problem-solving are critical to collaborative learning (Cho, Stefanone & Gay, 2002). Moore (1992) summarized three types of interactio in distance education: learner-content, learner-instructor, and learner-learner, in which, the learner-learner interaction was highlighted as an extremely valuable, and sometimes even essential resource for learning. Peer interaction has the potential for improving learning and achievement, increasing learners' motivation and engagement time on tasks, contributing to increased self-esteem, locus of control, liking and acceptance of others, as well as the ability to relate to others, and the development of teamwork skills (Webb, Nemer & Zuniga, 2002). Peer interaction can help learners develop cognitive skills (Cazden, 1988; Kuhn, Shaw & Felton, 1997; Anderson & Soden, 2001) and social skills (Shaw, 1981; Soller et al,1998).

Recent studies about e-learning by means of the Internet have begun to concentrate on the question of whether computer mediated communication enables learners to engage in social interactions with others despite

geographical dispersion. Especially, the role and function of peer interaction within computer-mediated learning has turned to be a hot topic either for researchers or developers. Computer-mediated communication (CMC) has created new opportunities for synchronous and asynchronous discussions among geographically dispersed individuals (Walther, 1996; Mason & Bacsich, 1998; Tolmie & Boyle, 2000). However, the distribution of all kinds of resources may complicate knowledge collaboration in e-learning environments compared with face-to-face learning settings. Clark & Brennan (1991) have developed a theoretical model in which successful communication relies upon common ground, which refers to the beliefs, presuppositions, and knowledge that are mutually shared by a speaker and listener. Common ground is gained when participants coordinate their activities to reach the mutual assumption that each utterance has been sufficiently comprehended by participants for current purposes. More conscious learning services are required to help learners locate the right collaborator for collaborating on the right knowledge, at the right time and in the right way in the e-learning context (Zheng, Ogata & Yano, 2004; Zheng & Yano, 2007, Zheng et al. 2007).

Recommender systems are widely used to provide personalized recommendations on products or services to users in the fields of E-commence, movies, music, books, and Web pages by collecting explicit feedback data or mining implicit feedback with the approach of content-based analysis, collaborative filtering, and data mining techniques. In recent years, there are also some recommender systems developed for personalized contents service in learning systems, which are often integrated into specially designed and developed learning content management systems (LCMS). In such recommender systems, learning

contents are suggested to different learners according to learners' different interests needs and therefore it is possible to increase the motivation to learn. Personalized learning contents recommendation is an important and hot topic in e-learning systems design and development research. However, few research efforts are focused on recommending suitable learning peers for learners in distributed e-learning environments and in fact, few e-learning systems have been designed with peer recommendation functions.

Reasonable and effective peer recommendation should be conduced from the comparison of peer-seekers and peer-candidates in multiple aspects involved within the e-learning context. What aspects should be considered for comparison? How to capture useful cues for considered aspects? With these questions, it is necessary to construct a reasonable and operatable mechanism for identifying, tracking, and analyzing key factors for peer matching.

Awareness is widely applied to increase collaboration opportunities and efficiency in computer-supported cooperative work (CSCW) (Dourish & Bly, 1992; Gutwin & Greenberg, 2002) and computer-supported collaborative learning (CSCL) (Gutwin, Stark & Greenberg, 1995; Ogata & Yano, 1998). Awareness can facilitate grounding by providing evidence about each participant's current state of activity and understanding. It is essential for identifying what kind of awareness should be taken into account for peer recommendation in e-learning environments.

1.2 Purpose of this Study

This study proposes the use of context-awareness (CA) to support peer recommendation in the e-learning context. For this purpose, it is necessary

to first explore the e-learning context itself. According to various theoretic frameworks that can be used to shape human learning, such as the socio-cultural theory (Vygotsky, 1980), knowledge-creation theory (Nonaka & Takeuchi, 1995), and the activity theory (Engestrom, 1987), there are many elements that may influence human interactions, such as social, cultural, historical, psychological or technical factors. Thus, it is necessary to reflect on human collaborations included in e-learning in a wider context.

This study identifies three component contexts that jointly construct the e-learning context, including knowledge, social and technical contexts. Peer recommendation is built on comparing and matching the preferences of peer-seekers and peer-candidates from knowledge, social, and technical aspects. Accordingly, a three-dimensional CA model is proposed that includes CA to Knowledge Relevance, CA to Social Proximity, and CA to Technical Access. CA to Knowledge Relevance investigates peer-candidates' knowledge interests, expertise and experiences with respect to some knowledge problem and is often used to match "who knows what" and "who needs to know what" in the knowledge dimension. CA to Social Proximity inquires the social distance between peer-seekers and peer-candidates, such as the nimbus of the peer-candidate in the learning space and his/her familiarity with current peer-seeker, aims for harmonization of "who is willing to collaborate" and "who is seeking collaboration". CA to Technical Access surveys technical access possibilities between peer-seekers and peer-candidates, and aims at eliminating or reducing possible technical obstacles in collaboration. A case study is designed to examine learners' perceptions toward the three-dimensional CA model, demonstrating the CA model can be acknowledged by learners.

The activity context is proposed as the mediator in the e-learning context. Learners' activities, including learning activities and assessment

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