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A personalized auxiliary material recommendation system based on learning style on Facebook applying an artificial bee colony algorithm

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ABSTRACT

Facebook is currently the most popular social networking site in the world, providing an interactive platform that enables users to contact friends and other social groups, as well as post a large number of photos, videos, and links. Recently, many studies have investigated the effects of using Facebook on various aspects of education, and it has been used as a learning platform for sharing auxiliary materials. However, not all of the auxiliary materials posted may conform to the individual learning styles and abilities of each user. This study thus proposes a personalized auxiliary material recommendation system based on the degree of difficulty of the auxiliary materials, individual learning styles, and the specific course topics. An artificial bee colony algorithm is implemented to optimize the system. The results indicate that this method is superior to other schemes, and improves the execution time and accuracy of the recommendation system in an efficient manner.

1. Introduction

In recent years, social networking sites (SNSs) have become very popular around the world, promoting relationships among users and helping individuals to share their ideas, messages, events, and interests with friends [1,2]. The most popular SNSs currently include Facebook, Twitter, MySpace, Plurk, and Google Plus. Most of these provide users with e-mail and instant messaging services, as well as profiles, including information such as personal background, and interests. Moreover, social networking sites have become very popular as e-learning tools, and provide a novel platform for constructing knowledge via collaborative learning [3].

Facebook is the most widely-used social networking site, and supports a number of interactive features to build relationships with individuals and various social communities [4]. One reason for its success may be that the site provides more resources to users than other social networking sites, such as MySpace and Friendster, and allows developers to add to these with the use of relatively simple application programming interfaces [5,6]. According to data on the official Facebook website, there are now more than 800 million active users, with each member having 130 friends on average, and an average user being connected to 80 community pages, groups and events [7]. The site offers users a personalized webpage that can be used to give information about their background and interests, and supports multiple forms of communication, such as e-mail, instant messaging and a wall on which users can post their own personal messages, which their friends can then comment on. Moreover, users can also create an activity, and invite their friends to join it [8,9].

Facebook is used for many purposes in addition to maintaining relationships, including education, entertainment, work, and political activism [10]. Recently many studies have explored the application of Facebook to education, and the results

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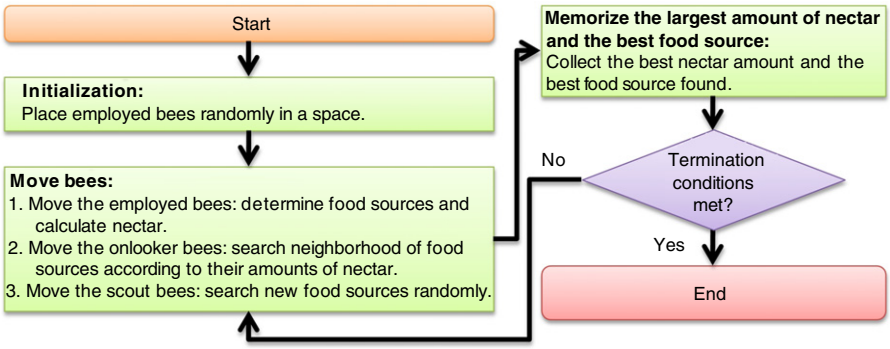

Fig. 1. Flow chart of the ABC algorithm.

indicate that social networking services can promote emotional communication and help people to build and maintain relationships [11]. For example, Garrison and Kanuka indicate that learners can build knowledge, gain meaningful learning experience and enhance their elaborative faculties through the community-based learning that can occur in this context [12], while Kabilan et al. show that students can use Facebook to develop their creativity and communication skills [13]. Social networking services are thus widely seen as appropriate for use in collaborative learning projects, which encourage students to engage in communication to enhance their creativity. Facebook has also been used as a virtual classroom for language learning, and has now become both a communication and entertainment platform for many, if not most college students [14].

Integrating multimedia materials into an interactive system on a social network can enhance students' learning motivation and promote their learning performance [15,16]. Facebook provides a personal wall for users to share ideas and multimedia materials with friends, such as articles, pictures and videos [17]. These walls are thus a convenient platform for sharing auxiliary materials for many professional courses, although such materials may not meet the learning needs of all the individuals involved. In addition, the auxiliary materials are unlikely to be based on the individual learning styles of the learners, which can reduce their effectiveness. A few studies have already examined systems to combine multimedia materials and Facebook functions by using Facebook development tools [18]. However, to avoid learners being overwhelmed with unsuitable material, it is necessary to develop an auxiliary material recommendation system that can consider the learning styles of users and the difficulty of the materials in order to make more effective use of this potentially very powerful platform.

Recommending suitable materials by using the learning styles of users and the difficulty of the materials is a complex combinatorial problem that needs to take into account many design parameters. Various approaches have been proposed to deal with such combinatorial problems, and in recent years artificial bee colony algorithms have attracted increasing interest [19]. Karaboga suggested that the performance of an artificial bee colony algorithm is better than, or at least similar to, that of a particle swarm optimization algorithm (PSO), genetic algorithm (GA), and evolution strategy (ES) [20].

In this study, we constructed an auxiliary learning materials recommendation system on Facebook based on both visual and verbal learning styles, according to the results of a learning style questionnaire [21]. The difficulty of auxiliary materials was also considered, based on constructivist theory, in order to recommend appropriate materials and achieve better personalized learning [22]. The proposed auxiliary materials recommendation system can record students' course interests by observing user behavior with regard to the learning activities on Facebook, and an artificial bee colony algorithm can then select appropriate auxiliary materials based on their difficulty, user interests, course topics and a learner's individual learning style, thus enhancing the learning effects of the system.

2. Artificial bee colony (ABC) algorithm

Karaboga proposed the ABC algorithm to find near-optimal solutions [18]. The ABC algorithm uses swarm intelligence to solve optimization problems [23]. Swarm intelligence, such as that seen with particle swarm optimization and the ant algorithm, mimics the foraging behavior of a group of organisms in the real world to solve large-scale optimization problems [24–28]. Swarm intelligence has been successfully applied to various fields, such as scheduling problems, nonlinear problems, network security, and e-learning problems [29–32]. The procedure of the ABC algorithm is shown in Fig. 1.

First, the algorithm uses employed bees to search randomly for food sources. The amount of nectar at each selected food source is equal to its fitness value. Second, each employed bee finds a new food source near the original one and shares the information with onlooker bees. Third, based on the probability of the amounts of nectar at the food sources, an onlooker bee chooses a food source area, shown in (1):

$$P_i = \frac{F(\theta_i)}{\sum_{k=1}^{E} F(\theta_k)} \tag{1}$$