Exploring Long-term Behavior Patterns in a Book Recommendation System for Reading

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ABSTRACT

This study explored the behavior of students who used a book recommendation system, specifically the My-Bookstore system, over a five semester period. This study addressed two main research questions, the first being related to *the most frequent behaviors and behavioral patterns*. The results showed that "visiting" behavior and "book recommendation" behavior were the two most frequent behaviors in the first and last semesters. In addition, there was a tendency for the recommendation behavior to increase over the five semesters, implying that the My-Bookstore system can facilitate the book recommendation behavior. The second research question concerned the influences of *incentive models on the recommendation behavior*. The findings demonstrated that the coin reward incentive in the game has a short-term impact on student recommendation behavior. However, those functions that have an internally tightly-coupled relevance to book recommendation (e.g., "choosing recommended books" as a store management incentive, and "checking histories" a social interaction incentive) act to give the My-Bookstore program better long-term effects on the students' book recommendation.

Keywords

Book recommendation system, Incentive models, Behavior analysis

Introduction

Book recommendation between students has the potential to enhance reading interest and ability (Chien, Chen, Ko, Ku, & Chan, 2015). The recommendation process encourages students to share and discuss what they have read, thus helping to create and foster a good reading atmosphere within the class (Larson, 2009). A book recommendation system can provide students with an opportunity to review what they have read by retelling, based on their own individual understanding and perspectives, which can greatly improve their literacy skills, reading comprehension and recollection (Carico, Logan, & Labbo, 2004). However, the benefits of a book recommendation system are reliant upon extensive and frequent student interaction, which requires overcoming the difficulties of *organizational complexity and limited interaction.* The former relates to the problem of class time allocation. It is difficult for teachers in the classroom to clear space on the agenda for a book recommendation activity and ensure that all students have an equal chance to express their opinions. The latter refers to the time needed in order to reinforce the effect of social interaction. In small class size elementary classrooms, there might not be enough student interaction for peer-to-peer book recommendation.

Strategies proposed to overcome these two difficulties include activities designed to reduce the complexity and enhance the efficiency of social interaction, such as book talks, storytelling, and dramas (Pilgreen, 2000; Gardiner, 2005; Atwell, 2007). Although these activities can greatly help to facilitate classroom book recommendation, they still require the teacher to expend a lot of effort on logistical organization, such as setting up tables, group allocation, and maintaining classroom order. Recent developments in information technology however, have opened the door for teachers to provide tech-support support for the development of communication tools and book recommendation systems (Hamilton & Cherniavsky, 2006, Larson, 2008) in the classroom, include message board discussions (Wolsey, Biesenbach-Lucas, & Meloni, 2004), blogs (Huffaker, 2005; Ray, 2006), and social networking systems. With the support of technology, teachers can efficiently plan activities to help students express their opinions to their peers, both in and out of school time (Hancock, 2008). These technology-supported activities can serve as a stage, on which students can express ideas, perspectives, and thoughts to their classmates, and help to foster the development of a learning community for reading and book recommendation (Wolsey, Biesenbach-Lucas, & Meloni, 2004; Larson, 2009).

One example is to use potential of technology for promoting the behavior of book recommendation. The My-Bookstore system (Chien, Chen, Ko, Ku, & Chan, 2011), which incorporates incentive models into a recommendation system, is designed to help students describe their favorite books and recommend them to their classmates. Although a previous study has demonstrated that such a system can enhance student learning in

terms of word usage and reading perception (Chien et al., 2015), little attention was paid to investigating the students' behavior patterns over a long period of time. Investigating student behavior when using such a book recommendation system is critical because not only do the findings enrich our understanding of how an effective system works, but also sheds light on how to stimulate and maintain positive behaviors. The purpose of this study is thus to conduct a long-term empirical study using the My-Bookstore system as an example. In addition, to acquire a more comprehensive understanding of student behavior, we not only analyze the frequency of certain behaviors, but also trace their sequence. In this way, subtle changes in behavior can be revealed, even if the frequencies remain similar. The two research questions to be answered in this study are: (1) What are the frequent behaviors and behavioral patterns of students participating in a book recommendation system? (2) What incentive models for such a book recommendation system can significantly facilitate students' recommendation behavior?

Book recommendation system - My-Bookstore

Design principles

My-Bookstore is a book recommendation system designed to encourage book recommendation among elementary students in a classroom environment (Chien et al., 2011). The development of My-Bookstore is underpinned by two design principles, the "open student model" (Bull & Kay, 2007) and a theory "learning community" (Bruckman, 2006). Based on the open student model students are helped to understand what they have learned with the support of technology, leading to enhanced self-awareness, self-reflection, and self-improvement (Chen, Chou, Deng, & Chan, 2007; Bull, Gardner, Ahmad, Ting, & Clarke, 2009; Chen, 2012). This "open" model is beneficial to students (Bull, 2004; Vélez, Fabregat, Bull, & Hueva, 2009). The visualization of a collection of student work (or portfolios) serves as a window to understand their learning effort, progress, and achievements (Paulson, Paulson, & Meyer, 1991; Chang & Chen, 1998).

In contrast, the learning community refers to a group of learners who share common goals and attitudes, and accomplish learning tasks by communication, discussion, and collaboration (Gabelnick, MacGregor, Matthews, & Smith, 1990; Bruckman, 2006). In a sense, a classroom is a small social arena, where a student's concepts, beliefs, and behavior are affected by their classmates (Alsop & Hicks, 2013). For instance, if a student finds that reading is interesting and meaningful, his/her behavior and attitude might be imitated by the other students, subsequently spreading to the whole class. Thus, in the "My Bookstore" system, each student runs their own "bookstore", which, when taken altogether become a bookstore "community," helping to create a positive reading atmosphere.

These two design principles have guided the development of the My-Bookstore system. In the My-Bookstore system each student acts as a manager running his/her own bookstore, and can recommend the books that he/she has read to other students. In the My-Bookstore system, "stocking" of the bookstore is done by means of students recording the books they have read, and "selling" means recommending the books they like to others. In other words, the books in the My-Bookstore system are a concrete representation of the student's reading profile, a record of what each student has read, and a useful medium to recommend books to their peers.

Book recommendation

In the system, there are four ways to make a recommendation: star-ranking, picture-drawing, writing, and sound-recording (see Figure 1). The recommendation process can be divided into three steps: (1) the students first read a book borrowed from the classroom library, which when record in the system, will automatically show up in their historical bookcase; (2) students can comment about the books they have read by means of the four recommendation choices mentioned above; (3) student can monitor which of the books they have recommended are accepted by their peers.

It was found in a previous study that most of the students using the My-Bookstore system were willing to recommend their favourite books (Chien et al., 2015). Furthermore, of the four recommendation choices, the most popular was the start-ranking function (96% of students used this function), because its simplicity made it easy for even young students to complete the task. The second most popular was picture-drawing (43%) because drawing is a natural way for children to express ideas. The least two popular functions were writing (25%) and sound-recording (19%), probably because students lacked sufficient experience in writing, recording, and self-expression.

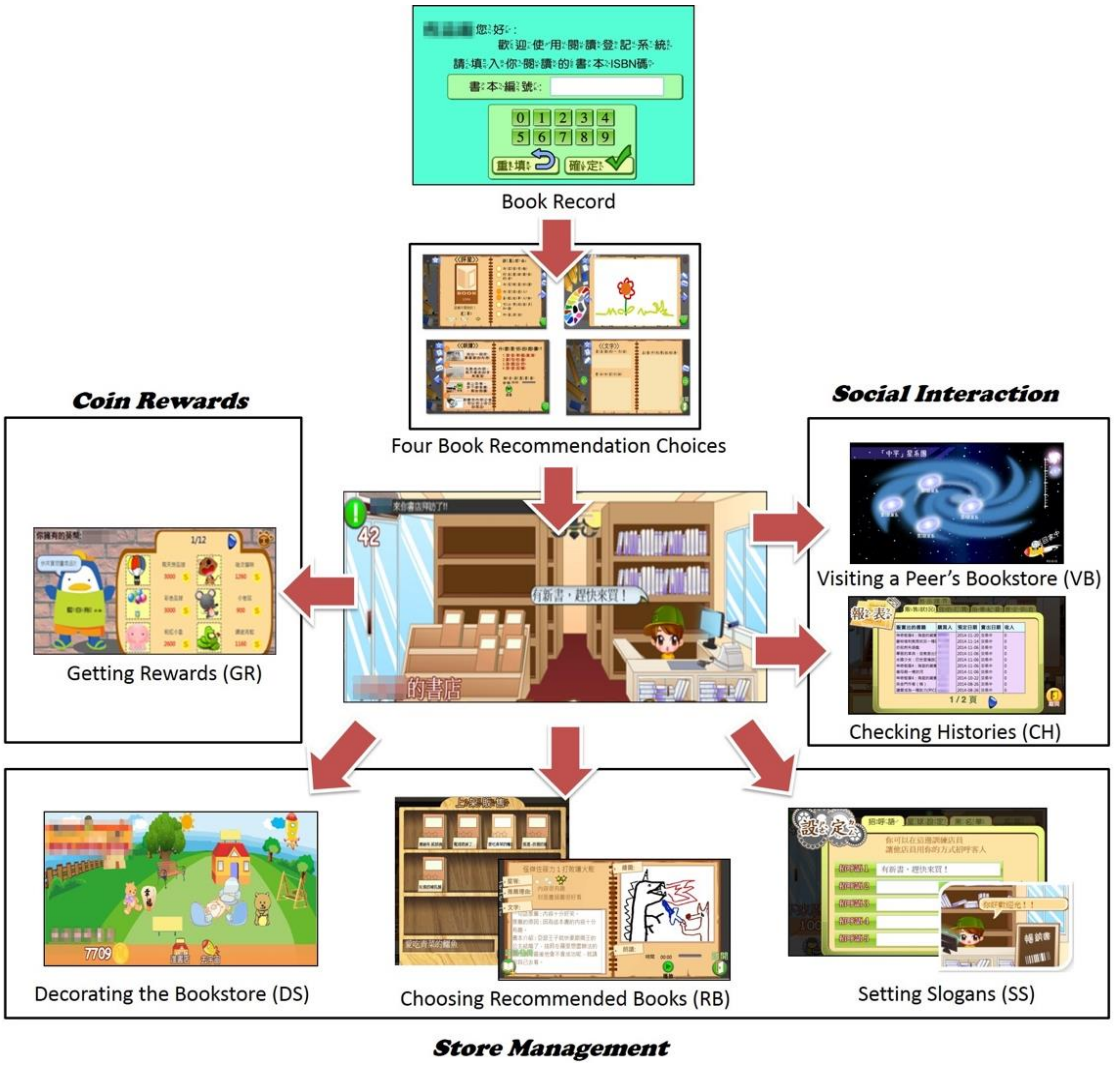

Figure 1. Screenshots of the My-Bookstore system

Three incentive models

Three types of incentives (see Figure 1) were developed for application in the My-Bookstore system: virtual coin rewards, store management, and social interaction. The coin reward incentive allows students to earn virtual coins (i.e., called Book-Coins) as a reward for enthusiasm and effort. Book-Coins are earned by successfully recommending books to their classmates and can be used by the students to purchase new decorations for their bookstores.

The store management incentive allows students to create their own unique bookstores. They can decide how to alter the appearance of their bookstore and how to decorate them. In addition, they can also write "slogans", phrases to be spoken by a virtual worker when someone enters the bookstore, for example "Welcome to my bookstore!" As a bookstore manager, the student has to take responsibility for the marketing income, and establish a plan for book recommendation, because each bookstore has limited bookshelves for book recommendations. In other words, they need to plan and prepare the best choices for book recommendation.

The social interaction incentive is designed to offer opportunities for students to recommend books to each other. For example, the "visiting" function allows students to visit their classmates' bookstores. This provides students with the opportunity to become aware of their peer's reading status, for example by seeing what books their classmates have read and their opinion of these books. Another function related to social interaction is a checklist of interaction histories. A student can check the list to find out how many people have visited their bookstore, and who has accepted their book recommendations.

Methodology

Participants

A total of 204 first-grade (aged 7-8 on average) elementary students at a suburban elementary school in Taiwan participated in this study. This school was selected because approximately one-third of the students were from families with a low or middle level socioeconomic status. The lessons learned from this study can be applied to other schools with a similarly diverse student populations in the future. The students participated in this study for two and a half years (from February 2011 to June 2013, a total of five semesters). In the first year, the students were divided into seven classes (with seven different teachers). In the second year, with the exception of a few who had transferred to other schools, students were divided into eight classes (with eight different teachers) based on the school's management policy.

Procedure

In order to facilitate access to books, which is an important element of a promotional reading activity (Pilgreen, 2000), a small library was set up in every class. Each class library had at least two hundred books. The books were selected by participating teachers as suitable for the students. In addition, the participants used the system in a one-to-one environment (Chan et al., 2006), with every student given access to a touch-screen tablet computer so that they could use the My-Bookstore system. They were allowed to take these devices home. Every classroom had internet connection capability for system access.

The participants (both students and teachers) attended a reading activity in the morning - the Modeled Silent Sustained Reading program (McCracken, 1971; Pilgreen, 2000; Gardiner, 2005; Chien et al., 2011), where they were allowed to read extracurricular paper books for 20 to 30 minutes, four days a week (see Figure 2). After the reading activity, students were free to use the My-Bookstore system without any requirements as to the number of books they must read or recommend.

Figure 2. Reading activity and the use of the My-Bookstore system

Data collection

Data were collected and student behavior was logged within the My-Bookstore system using the User-Behavior-Time format, where User indicates the name of the student, Behavior refers to the specific functions used in the My-Bookstore system (see Table 1), and Time is the time stamp showing date: hour: minute: second. Data analysis was then conducted based on the system logs.

Data analysis

Two methods of data analysis were employed, based on the aforementioned system logs: frequency analysis and sequential analysis (Jeong, 2005; Bakeman & Gottman, 1997). First, frequency analysis was carried out to find the frequency and percentage of each behavior demonstrated by all students, so as to present an overall picture of system use. Second, sequential analysis was conducted to emphasize the patterns of behavior based on the time sequence, in an attempt to gain insights leading to an understanding of the relationship between these behaviors (Chen, 2014; Hou, 2012). This approach was adopted because it not only focuses on the characteristics of

particular behaviors, but also on the characteristics of the interactions or transactions among those behaviors over time. This approach has been used in early works to investigate student behavior patterns, and it offers insights into understanding the relationship between these behaviors (Jeong, 2005; Bakeman & Gottman, 1997).

Table 1. Description of the specific behaviors

Incentive	Behavior	Description
Book Recommendation	Making book recommendations (MR)	• Use the star-ranking (one to three) to recommend a book, and click on the appropriate reasons. • Draw a picture related to the book read with the drawing function of My-Bookstore. • Write down your favorite sentence or paragraph from the book read; give the reason you like this book. • Voice the opinions about or read aloud from your favorite paragraph with the sound recording function of My-Bookstore.
Social Interaction	Visiting a peer's bookstore (VB)	• Click on the portrait button in the galaxy system to view a classmate's bookstore in My-Bookstore.
	Checking histories (CH)	• Use the historical interaction checklist interface to find out which classmate has accepted your book recommendations.
Store Management	Decorating the bookstore (DS)	• Arrange new decorations or move existing ones to another place.
	Choosing recommended books (RB)	• A new recommendation can be added to the bookshelf so that the contents can be publicly viewed by visiting classmates. • A previous recommendation can be removed from the shelves.
	Setting a slogan (SS)	• Certain sentences can be set as messages for the virtual character to speak when someone comes the bookstore.
Virtual Coins reward	Getting rewards (GR)	• Use "Book-Coins" to purchase new bookstore decorations from the store.

Results and discussion

Behavior frequency analysis

Table 2 shows the frequency and percentage of different behavior demonstrated over the five semesters. Overall, the behavior of "visiting a peer's bookstore (VB)" was the most frequent over all of the semesters (52% to 34%), followed by "making book recommendations (MR)" (18% to 29%), "decorating one's personal book store (DS)" (11% to 14%), and "getting rewards (GR)" (8% to 11%). The results also showed an increased trend in the MR behavior over the five semesters, implying that the target behavior (i.e., MR) was successfully promoted.

Table 2. The frequency and percentage of behavior-codes over the semesters

Semester		Book Recommendation	Social Interaction		Store Management			Virtual Coin Reward
		MR	VB	CH	SS	RB	DS	GR
1st	freq.	6275	18106	1708	1108	1033	3873	2795
	(pct.)	(18%)	(52%)	(5%)	(3%)	(3%)	(11%)	(8%)
2nd	freq.	9221	19660	2342	1622	1259	4387	2303
	(pct.)	(23%)	(48%)	(6%)	(4%)	(3%)	(11%)	(6%)
3rd	freq.	9117	20622	2430	1462	887	5079	5295
	(pct.)	(20%)	(46%)	(5%)	(3%)	(2%)	(11%)	(12%)
4th	freq.	8946	11406	1889	1151	1024	4239	3328
	(pct.)	(28%)	(36%)	(6%)	(4%)	(3%)	(13%)	(10%)
5th	freq.	5411	6389	979	773	407	2673	1963
	(pct.)	(29%)	(34%)	(5%)	(4%)	(2%)	(14%)	(11%)

- Book Recommendation
  MR: Making book recommendations
- Social Interaction
  VB: Visiting a peer's bookstore
  CH: Checking histories
- Store Management
  DS: Decorating the bookstore
  RB: Choosing recommended books
  SS: Setting a slogan
- Virtual Coins Reward
  GR: Getting rewards

In addition, the results for behavior frequency pointed out that the two most frequent user behavior were "visiting other's bookstores" (VB) and "making book recommendations" (MR). The former showed a decreasing trend, whereas the latter demonstrated an increasing trend. Although the VB behavior showed a tendency to decrease, it was still the most common behavior each semester. In addition, the decrease of VB is almost transformed into the proportional increase of the target behavior (i.e., MR). This finding seems to suggest that initially, social interaction incentives played the role of "motivator" to sustain students' participation, but this gradually transformed into the role of "facilitator", promoting the target behavior. The lack of change in the frequency is not equivalent to a lack of change in behavior, because there are subtle differences in behavioral sequences. Thus, there is a need to examine the results with behavioral sequential analysis.

Behavioral sequential analysis

The behavioral patterns for the first and fifth semesters obtained through the sequential analysis matrix calculations are illustrated in Figure 3 and Figure 4, respectively.

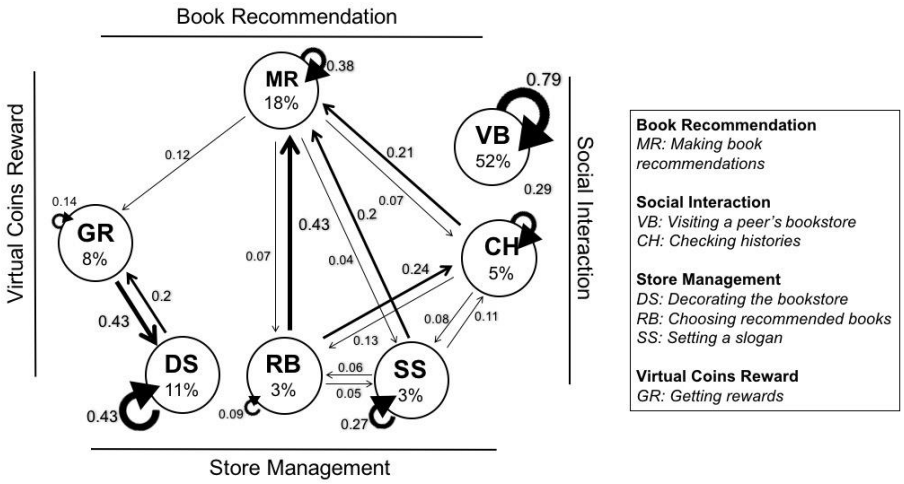

Figure 3. Sequential status of the seven behaviors in the first semester

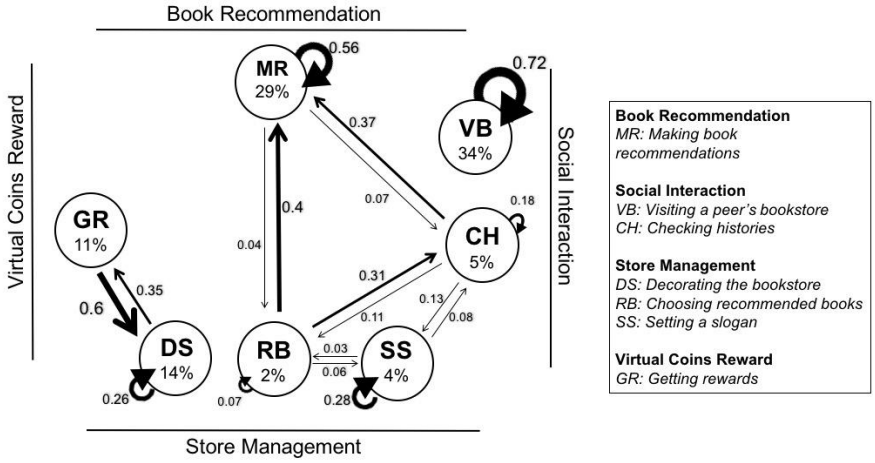

Figure 4. Sequential status of the seven behaviors in the fifth semester

Virtual coin reward incentive

As shown in Figure 3, the behavior pattern goes from "making book recommendation" (MR) to "getting rewards" (GR) in the first semester. In addition, the patterns of "getting rewards" (GR) → "decorating the store" (DS), and "decorating the bookstore" (DS)→ "getting rewards" (GR) were also significant. It seems that the incentives supplied by the virtual coin reward and decoration of the bookstore initially attracted the students' attention. The students who received the coin rewards tended to go to the store to purchase decorations. However, the pattern of MR→GR in the fifth semester was not significant, as shown in Figure 4, implying that the virtual coin rewards did not play a critical role for book recommendation over a long period of time.

A possible explanation was that the coin reward incentive is an external representation of how much effort the student has exerted. Although this approach is frequently used in game-based systems (Zichermann & Cunningham, 2011; Nicholson, 2012; Nicholson, 2013), the results demonstrate its limitations. The coin reward incentive might be suitable in the beginning, but is inappropriate over a long period of time. This finding can be interpreted based on the theory of interest development (Hidi, 2006), which argues that interest (e.g., in this case the reading and sharing of good books) can be developed starting from situational interest moving to individual interest (Hidi & Renninger, 2006). Specifically, individual interest involves personal preferences and characteristics. It develops slowly, but has long-lasting effects. Inversely, situational interest is evoked suddenly by certain stimuli in the environment, but has only a short-term effect (Hidi, 1990). Thus, for those students who do not have a personal interest in reading and book sharing in the beginning, situational interest (i.e., the rewards approach) can serve as a stimulus to cultivate the target behavior. The findings suggest that virtual coin rewards can be an effective incentive (triggered by the situation) in the beginning, but its influence will not last for a long time. This should be taken into account by designers who can take the opportunity to shape student behavior by first stimulating through situational interest and then by nurturing individual interest through well-developed guidelines for learning systems.

Store management incentive

Regarding the store management incentive, in the first semester, "decorating the bookstore" (DS) did not significantly contribute to the "making recommendation" (MR) behavior. However, the "setting a slogan" (SS) and "choosing recommended books" (RB) behaviors were followed by the book recommendation behavior (i.e., SS→MR and RB→MR), implying that both SS and RB were important components in the beginning. However, the results in the fifth semester told a different story: the pattern of SS→MR was no longer significant, implying that SS has a limited long-term impact on book recommendations. Rather, the major component of store management that really contributes to book recommendation is RB.

Of the three behavior patterns related to the bookstore management incentive (i.e., DS, SS, and RB), only RB had a long-lasting impact on students. From the perspective of the open student model (Epp, & Bull, 2015; Bull et al., 2009), the major difference between the three behavior is the level of coupling between the "open student model" and "what the students do." The bookstore is thus a visualization of the student model, so taking good care of the bookstore is actually taking good care of their learning. The results reveal that RB is more effective in terms of instilling active and responsible management behaviors with a tightly-coupled relationship with the student model (i.e., books they read). In contrast, the other two behaviors (i.e., DS and SS) focus on increasing the attractiveness of the environment, and are only loosely-coupled to management. Specifically, neither "setting a slogan" (SS) nor "decorating the bookstore" (DS) are really relevant to book recommendation, and neither serve to maintain student behavior in the long run. This finding suggests that the management incentive can be regarded as self-regulation of the open student model. Thus, management incentives can be categorized as tightly-coupled or loosely-coupled, depending on the relevance of their interaction and regulation with the open student model. Designers should increase the coupling level of management incentives with the open student model (in this case it is the books that they have read).

Social interaction incentive

Regarding the social interaction incentive, in the first semester, the results showed that the pattern of "visiting a peer's bookstore" (VB) to "making a book recommendation" (MR) was not significant, but the pattern of "checking histories" (CH) to "making a book recommendation" (MR) was significant. The fifth semester results were the same. It can thus be stated that the major component of social interaction as it contributes to book

recommendation lies in CH (i.e., CH→MR). Students were interested in the historical interaction checklist, which they used to understand which classmate had accepted their book recommendations.

From the findings of behavioral sequential analysis, the "visiting a peer's bookstore" (VB) did not seem to play a critical role in promoting the target behavior. However, the results of behavior frequency indicate that VB could play a "motivator" role in sustaining students' participation. The role of VB can be confirmed as maintaining continuous participation, even though it did not contribute to the promotion of the target behavior. On the other hand, the behavior of "checking histories" (CH), which also belongs to the category of social interaction, did contribute to the promotion of the target behavior. From the perspective of social interaction, the major differences between VB and CH are the differences in approaches to facilitating self-reflection in the learning community: VB involves the self-reflection via the outside-looking approach (i.e., observing peers), whereas CG involves the self-reflection via an inside-looking approach (i.e., observing comments made by peers). In other words, the looking-inside approach can directly foster self-reflection. Thus, the findings seem to suggest that the use of the social interaction incentive would be an appropriate approach for fostering self-reflection.

Conclusions

This study addressed two research questions. The results related to the first (i.e., What are the most frequent behaviors and behavioral patterns of students participating in a book recommendation system?) showed "visiting other people's bookstores" (VB) and "making book recommendations" (MR) were the two most frequent behaviors in the first and last semesters. The results also revealed an increasing trend in the MR behavior over the five semesters, implying that the My-Bookstore system can facilitate the book recommendation behavior.

Regarding the second research question (i.e., What incentive models for such a book recommendation system can significantly facilitate students' recommendation behavior?), the findings demonstrated that the coin reward incentive has a short-term impact on student recommendation behavior. However, functions that have an internally tightly-coupled relevance to book recommendation (e.g., "choosing recommended books" (RB) in the store management incentive, and "checking histories" (CH) in the social interaction incentive) act to give the My-Bookstore program better long-term effects on the students' book recommendation.

This system was developed to encourage book recommendation behaviors through the incorporation of three incentive models, including virtual coin rewards, store management, and social interaction. A long-term empirical study over two and a half years was conducted to determine what the most frequent behaviors and behavioral patterns of students participating in the book recommendation system are. In addition, the issue as to which incentive models could most significantly facilitate students' recommendation behaviors was also discussed. The results indicated that: (1) My-Bookstore can facilitate student engagement in peer interaction and book recommendations; (2) the coin reward incentive has only a short-term impact on book recommendation behavior and the store management incentive and social interaction incentive have better long-term effects.

There are some limitations to this study that should be further investigated in the future. First, although this study has shown the patterns of students' behavior in using the My-Bookstore system, a systematic design of control groups is lacking. Second, quality analysis does not provide a rich picture of the complicated status of system usage, which is why we need qualitative analysis to further clarify the system impact on students' recommendation behaviors.

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