Improving Dynamically Personalized E-Learning by Applying a Help-seeking Model

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Abstract. This paper describes Yourbook, a personalized blended web-based e-learning application being developed in the University of Malaya to assist students completing introductory programming course for undergraduate studies in computer science faculty. The name is inspired by the famous social website Facebook since students are very familiar with the user experience (UX) of this famous website. In our web-based solution we are using Representational State Transfer (REST) software architecture. We are building our services on the back-end using Hypertext Preprocessor *(*PHP), and front-end using open-source JavaScript library Yahoo! User Interface Library (YUI). We are introducing a new model to enhance the current adaptive e-learning systems by taking in consideration some learning theories which have been introduced many times in educational psychology. Yourbook is mainly considering help-seeking strategy which is identified as a very important strategy in self-regulated learning (SRL). Through the paper we are arguing why we have chosen this specific educational theorem to serve in adaptive systems, and how the system will be designed to achieve our goals in enhancing the educational process.

Keywords: Adaptive learning, Overlay student model, Help-seeking, Concept network, Self-regulated.

1 Introduction

The importance of e-learning is increasing with time, and the realization of this importance is being noticed by users. For a long time there has been a need to create more dependable systems that can help in running the educational process, and move it forward. Many systems were created to support learning; one that has evolved and contributed to e-learning systems is adaptive e-learning system, which has played an important role among e-learning systems. The source of power in adaptive learning that it exploits the findings from different aspects related to computer science, psychology, and education to create systems that take in consideration student's needs and preferences [1]. The differences between students can be viewed from different

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point of views, that is, knowledge differences, different characteristics; different learning styles, and different cognitive styles [2]. Many adaptive systems created to accommodate different adaptation perspectives [27][28][29][30] .This can influence the effectiveness and efficiency of learning in a big way. Programming concepts are required to be adaptive. Concepts can vary in perspective, and each concept can have different levels. For example, the concept of defining variables is usually easy to be grasped by students, but a bit more advanced concept is harder to be perceived. A closer look will reveal that each concept can have different levels. For example the concept of "if" statement can be extended to include more complicated structures as "if else". These difficulty levels can be viewed as levels of knowledge that goes vertically (.i.e. from defining variables to if statement and so on), and horizontally (.i.e. from simple if statement to nested statements). Although adaptive systems have proved to be a very effective way for learning, we will pay more attention in this paper on psychological aspects in help-seeking to improve the current systems. Considering student knowledge level adaptive solutions, how can we help the student to move from one level to another? We don't want the targeted student to be stuck in one level. It is more important to make him move faster from one level to another. Especially since courses being delivered has limited time frame.

It has been shown that moving from one level of task to another requires more information to be understood . Apparently adaptive systems deals with this aspect partially by providing information to student according to his/her level of knowledge, characteristics, and preferences. Unfortunately many systems pay more attention to technical aspects. In this paper psychological part will be mainly taken into consideration. More specifically we will consider help-seeking [8] as an effective way to support and enhance the learning process. There have been very rare systems that take this psychological aspect in consideration. Bringing this aspect into e-learning systems is not the major issue, but we need to identify where this aspect can be beneficial, and when. In our research we are investigating help-seeking from different perspectives, and our research questions are:1- Can we employ the strategy of help-seeking to increase the interaction between students, and improve the learning experience once applied to adaptive e-learning systems?, 2- Can we classify students to avoidant help-seeking students, and adaptive help-seeking students by mining their behaviors on the system and employ educational psychology of help-seeking to develop tools that can reveal their help-seeking patterns?. Section 2 reviews some work related to adaptive systems, and help- seeking. Section 3 describes our system. Finally section 4 concludes the paper.

2 Research Background

There have been many proposals that consider adaptability to build more effective systems. Some of them paid attention to adaptive navigation [5], which helps the user to locate relevant information in the context of hypermedia [6][7]. Another system on the other hand discusses the student's characteristics aspect such as cognitive style [4][26], where user interface change dynamically according to the cognitive style of the learner. And lately some of systems created to deliver materials according to student's knowledge level [3], where the contents of the system changes according to

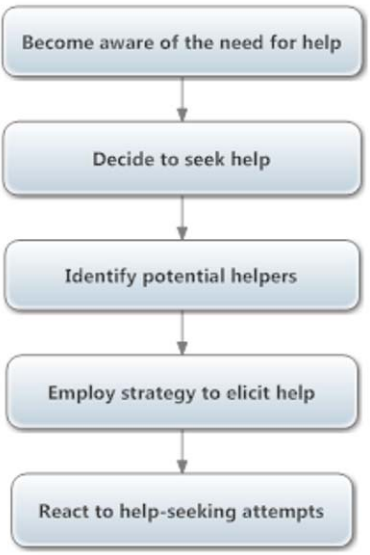

Fig. 1. Representation of Help-Seeking Process Model (Nelson-Le Gall 1981).

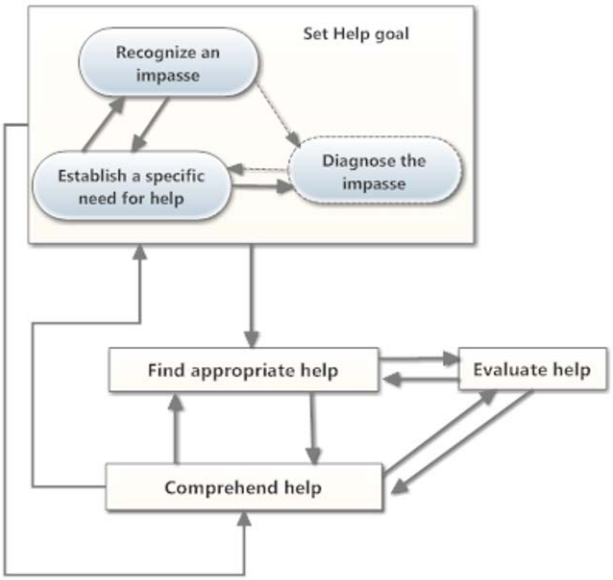

Fig. 2. Cognitive Model of help-seeking (Mercier and Frederiksen 2007).

the learner knowledge level. These systems were developed to support personalizing the system according to user preferences and needs. In the following paragraphs we review some important studies about help-seeking from the educational psychological perspective, mostly. Since these models are rarely utilized in e-learning systems, this

review will help us to clarify the system design and will show the importance of this aspect.

Help-seeking in early researches is considered an activity that causes a loss in self-respect and should be avoided. It can be used as an index of dependency [9]. A conceptual model was suggested which changed the view of help-seeking from self-threatening behavior to effective alternative for dealing with current obstacles [10]. Illustration in Fig. 1 shows the conceptual model suggested by (Nelson-Le Gall 1981). The first step obviously shows when the help-seeker decides to ask for help, which is after being aware of the need for help and follow that with the corrective action.

Learning patterns are discussed in the help-seeking context and are classified mainly into avoidant help-seeking and strategic help-seeking. Avoidant help-seeking learners do not approach others to ask for help even though they realize that they need help. On the other hand strategic help-seeking learners actively use opportunities around them to reach their goals, advices and hints are adapted easily by this latter type. It is essential to mention that adaptive help-seeking can be in two forms "instrumental" and "executive" [9].

Patterns of help-seeking are associated with the characteristics of the learner. For better understanding of these characteristics, achievement goal orientation should be clarified. Achievement goal orientation is classified into mastery goal orientation and performance goal orientation [12][13][14][15]. Connecting the characteristics of learners to the patterns of help-seeking, mastery goal orientation is correlated to adaptive help-seeking [16]. Usually these learners are not feeling shy or embarrassed asking for help. They are confident enough to concentrate on mastering the skills rather than thinking of what the society think about them, in contrast to performance goal oriented people are tend to avoid help-seeking [17]. Performance goal orientation can be either performance-approach goal or performance-avoid goal [18]. Performance oriented learners in general tend to hear complements about their work, and they avoid hearing criticism. As a result they avoid help-seeking.

The spot light over the cognitive skill of help-seeking originated from the fact that it is an essential self-regulated strategy, which is important in maintaining and activating thoughts, behaviors, and affects in order to achieve goals [11]. The most important characteristic of self-regulated learners is that they can employ available resources around them to eliminate obstacles slowing down their improvement.

Fig. 2 shows a suggested and used help-seeking model designed to measure the individual differences in a graduate students' help-seeking process in using a computer coach in problem-based learning [19]. The process explained in the model is axiomatic for self-regulated learners which takes place in 5 steps [20]: (1) Analyzing the current task and interpreting the requirements according to their knowledge and beliefs, (2) Setting task-specific goals, selecting, adapting, and even inventing strategies to reach their goal, (3) Monitoring their achievement toward goals, and generating feedback about effectiveness of their strategies, (4) According to their assessment of their progress, they can adjust their strategies and efforts, (5) Motivational strategies being adopted to keep themselves on track. It has been revealed that self-regulated learners are instrumental adaptive-help seekers, with the ability to use others as resources to overcome troubles in their learning [21][22]. Hence, we want this cognitive model to also support non-regulated learners by adding new sub-processes for supporting help-seeking; identifying help-seeking patterns, provide

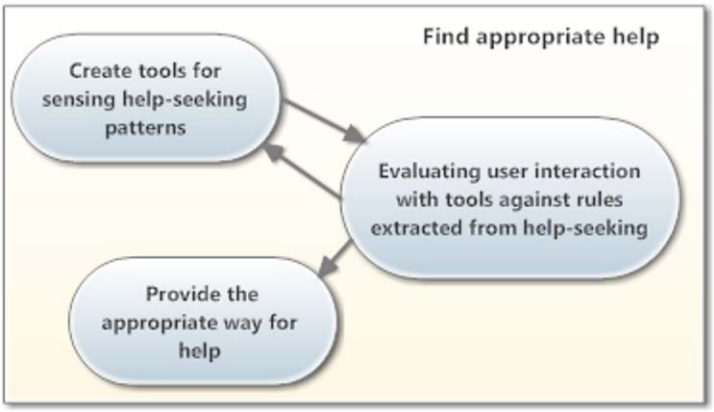

Fig. 3. Sub-processes added to find appropriate help.

appropriate help, and by running the whole of this model automatically by the system. Different characteristics for students should be considered when help is provided. Providing help at the correct time is not the only concern.

3 Suggested System

Adaptive systems that concentrate on student knowledge always try to deal with the current difficulties faced by the student. There is a high possibility that this is the time for student to seek help.

Help at the correct time is not the only concern. Learner characteristics play a main role. Advices for self-regulated learners about the best resources for supporting their learning process can be adopted easily by them. Regarding avoidant help-seeking we can run the model in Fig. 2 automatically so that we can stimulate this cognitive process for them, by taking in consideration the possible characteristics that may hold them back from asking for help. But we cannot make sure that the help-seeking process will be stimulated. Therefore there is a need to advise the teachers to pay attention to these students. In this research we are not arguing about the best way the teacher can deal with avoidant help-seeking type, but it is worth mentioning that there have been many researches to deal with this, for example help-seeking among peers taking in consideration goal structure and peer climate [23].

To plug in the functionalities we are expecting from the system, we have added extra sub-processes in the cognitive model in Fig. 3 as the second step "Find appropriate help". In this paper we are introducing a few tools to serve our second research statements, but research for this model will be open to choosing the best tools that can reveal help-seeking patterns by exploiting help-seeking psychology findings. Also research will be open to the best ways to evaluate user interactions to decide what the learner's help-seeking patterns are.

Regarding the first sub-process we have defined, we need to create tools that can help us to determine the help-seeking attitudes, and these tools will be inspired from the

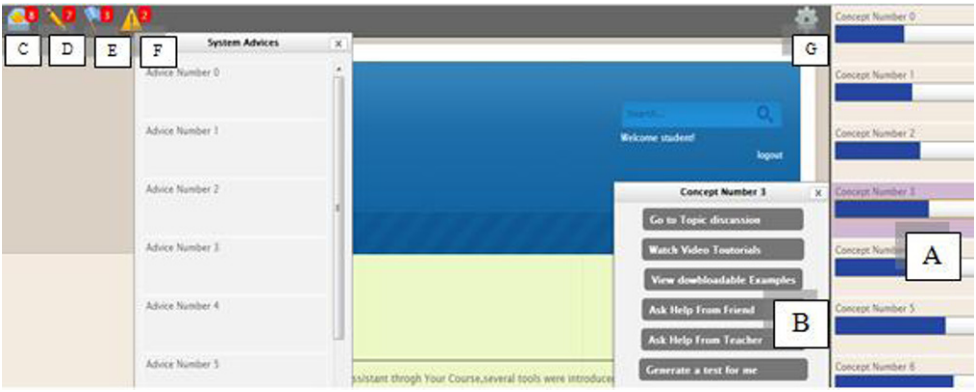

Fig. 4. Yourbook student home page.

psychology point of view. Let's start by defining instrumental help-seeking type as (HS), and avoidant help-seeking type (HA), performance goal orientation as (PGO), Mastery goal orientation as (MGO). Beside that we will divide (PGO) to (PGOpap) which belongs to performance-approach goal and (PGOpav) which belongs to performance-avoid goal. We will consider these two types mainly (.i.e. HS and HA). In our context we do not apply the model for example to problem solving, where executive help seeking is a very valid case, help will be on concepts understanding. First rule we can extract from the definition of avoidant help-seeking that if the learner has a low score in specific concept, and he/she is not turning into help (.i.e. by using the asynchronous tools provided with friends and teacher, or by posting questions to concept forum, etc..), then there is a high possibility that this is type HA. On the other hand more active learners on the system have a high possibility to be HS type. PGO as stated before is an indication for HA type, and MGO is an indication for HS. We will create a tool that can be integrated with any action in the system to give the choice for the learner to conceal his/her name for that action. For example, if a student wants to make a comment or post a question he/she will be given the choice to use a nickname, use his real name or skip this step, given that skipping will be the default choice. What is good about this tool is that student can use as many nicknames as he/she wishes. We are expecting that MGO will skip this step, while PGOpap will chose to show their real name, and PGOpav to hide their names. We expect also the latter type to be encouraged to seek for help, since hiding the name will lessen the worry about self-esteem which is a significant reason for help avoiding.

A tool for creating contests by students also implemented and we are expecting PGOpav not to participate since they avoid challenges and obstacles to maintain their self-perception of ability relative to others [18]. By contrast we expect PGOpap and MGO to participate, because the former care a lot about looking smart, showing good ability, and outperforming others, while the latter tend to be deeply engaged in the learning activities and development of competence.

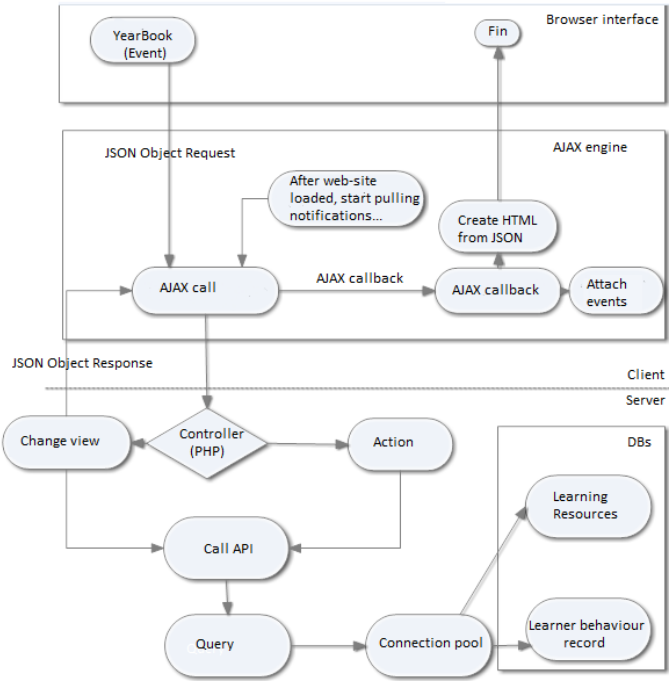

Fig. 5. Communication model between client and server.

All what have been mentioned so far in this section are hypothesis extracted from the help-seeking context, and help-seeking patterns for students will be hard coded in the system to serve our first goal in stimulating the instrumental help-seeking process. But later to evaluate and regulate our hypothesis students behavior mining will be performed to reveal the correctness of the tools we have presented and discover new behaviors that can determine online student help-seeking pattern.

Considering the student home page shown in Fig. 4, where main components are shown from A to F, component A shows the concepts being offered in the class. These concepts are offered according to the schedule being determined by the teacher. So concepts are locked according to the schedule plan, but still active student can move from one concept to another by taking automatically generated exams. He/she can notice the concepts scores shown by the graphical progress bars. We believe that this will help the student to assess his/her ability in some certain concept and set his/her help goal according to his score. Also this progress bars can help the system to assess student progress and his need for help at specific level. It is essential to mention that scores in this progress bars have specific meanings. For example it can tell if the student has problems in basic structure or more complicated structures. This serves as a hint for the user so that he/she can create sub-goals for learning the concept, and it directs the system to build the correct advice, consequently student then can establish a specific need for help, and at the same time the system is realizing this and moving to another step for defining what is the best way to deliver the help by going through the sub-processes we have defined before. The system keeps circulating between giving

advices and checking if assessments on tests are satisfying. The items shown on component A are clickable, and by clicking one of these items you can popup a menu (component B), which has helping tools for that specific concept. We have separated the forum and all other facilities to measure the interactions for each concept separately. As illustrated, student can navigate to the forum, and post or view questions and answers being posted there. Also there are tools for using asynchronous communication with teacher or specific student. Videos and downloadable examples can be viewed, which can show different contents according to the student level. The last tool in component B is for generating automatic questions. Each time it is used will generate a test according to student's level, which helps the student and the system to determine his/her level of progress. A Student can use component C to generate competitions with other students, and see the competition' tests results. Components from C to F subsequently show asynchronous messaging, tests generated by the lecturer, invitations to contests, and advices generated automatically using the sub-processes discussed previously.

Fig. 5 shows the communication between the client and server to always view the corresponding learning resources that accommodate the learner knowledge, keep track of user interactive behavior on the system, and provide advice to students. Concept network is used to present the domain knowledge [24], and concepts are locked according to the course sequence. Each main concept contains sub-concepts which are dependent on each other. The Leaner can progress vertically in main concepts, and horizontally in sub concepts according to learner knowledge. For student modeling, we are using overlay student model [25], where the presentation utilized for the domain knowledge is used for student modeling. All the behavior of the student is stored in the student model.

4 Conclusion and Future Work

The system suggested previously has two main goals. First is to stimulate the cognitive skill for instrumental help-seeking, and help the students to find the appropriate help accommodates their help-seeking pattern. Part of the first goal is to investigate the significance in concepts learning progress before and after applying help-seeking system features. The Second goal is to create tools to help in identifying student characteristics automatically and utilize it to serve the first goal. In addition, our second goal includes mining the tools implemented to check if it correctly predicts student help-seeking patterns, and mine other student behaviors on the system that may give an indication about student help-seeking pattern. In the future we are planning to develop more tools that may give us a better feedback about the student help-seeking pattern, and will implement help-seeking in other e-learning contexts.

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