

Exploring college students' online help-seeking behavior in a flipped classroom with a web-based help-seeking tool

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Today's generation often seeks help from each other in online environments; however, only a few have investigated the role of Internet technologies and the nature of online help-seeking behaviour in collaborative learning environments. This paper presents an educational design research project that examines college students' online help-seeking behaviour. The context was a large-enrollment science course that implemented a form of blended instruction – the flipped classroom. This paper proposes design guidelines for promoting help-seeking and discusses the application of these principles in the design of a web-based help-seeking tool (EchoLu). The study involved three iterations of implementation to continuously refine the web-based tool, and therefore to better address the help-seeking needs of students in the context. The revisions incorporated between iterations helped improve the embodiment of design principles and led to positive changes in students' perceptions. The triangulated data revealed students' interest in information-seeking as an additional form of help-seeking. The results of this study provide insight into the theories that informed the design of EchoLu and the design principles themselves. A new model illustrating processes involved in online help-seeking is discussed, and an emergent principle for online help-seeking is suggested.

Introduction

In any learning context, a learner needs to ask for help from a more knowledgeable person (e.g., peer or instructor) when facing an academic difficulty (Ryan, Gheen, & Midgley, 1998). This behaviour is referred to as help-seeking behaviour – a self-regulated learning strategy in which the learner determines when help is needed and how to receive that help (Nelson-Le Gall, 1985). A considerable amount of research has been conducted on students' help-seeking behaviour in face-to-face classroom contexts (e.g., Butler, 1998; Kitsantas & Chow, 2007; Magnusson & Perry, 1992; Ryan et al., 1998). However, help-seeking activities now take place beyond the boundaries of classrooms thanks to the rapid growth of computer and Internet technologies in the last decades. Today, students can locate specific information from online resources (e.g., Wikipedia), ask a peer or an instructor for help via web-based communication technologies (e.g., email, video chat, and online discussion), or receive assistance from a stranger in an online forum or a social networking site.

The increasing affordances of Internet technologies for help-seeking have inspired research examining the impact of web-based communication tools on the help-seeking activities of students (e.g., Cheng, Liang, & Tsai, 2013; Puustinen, Bernicot, & Bert-Erboul, 2011). These studies indicate certain advantages of online tools for help-seeking. Foremost is that students are not restricted to seeking help at a certain time or in a specific location; rather, they can post questions online as they encounter them and take more time to formulate their questions. However, further research is needed to improve the current understanding of students' help-seeking behaviour in online settings. The current body of help-seeking research is based on a face-to-face model suggested by Nelson-Le Gall (1981). The affordances of Internet technology introduce new possibilities to this model, such as searching for questions as a form of help-seeking about a particular concept. This suggests a strong need to examine both the tools and help-seeking behaviours of students in online settings.

Given the increasing interest and existing gap in online help-seeking research, this paper presents an educational design research project with the goal of exploring online help-seeking behaviour in a large-enrollment science classroom. In particular, this study aims to (a) generate principles for promoting help-

seeking; (b) create and evaluate a unique web-based help-seeking tool, called EchoLu, based on help-seeking principles; (c) reveal the processes involved in students' online help-seeking behaviour; and (d) inform and revise both help-seeking theory and the tool itself through iterative research in a real context.

Barriers to help-seeking

Although help-seeking is an important learning strategy positively associated with academic achievement (Kitsantas & Chow, 2007; Magnusson & Perry, 1992), not every student uses it. According to the help-seeking literature, several factors underlie students' avoidance of help-seeking. First, students can perceive help-seeking as a dependent behaviour which they might avoid because of their desire for greater autonomy over their learning (Butler & Neuman, 1995; Deci & Ryan, 1987). Such students are categorised as self-autonomous learners and are more likely to adopt mastery goals (Butler, 1998; Newman, 1990). Self-autonomous students infrequently ask for help to obtain small clues from others, through which they can pursue their learning goals with a minimal dependence, thus promoting long-term autonomy (Butler & Neuman, 1995; Newman, 1990).

Other students may perceive help-seeking as a threat to self-worth, resulting in avoidance behaviour (Karabenick & Knapp, 1991). The perception that help-seeking is a threat may result from the concerns imposed by the self and by the environment. First, students who are concerned with protecting their self-worth may believe that asking for help is evidence of their academic incompetence or lack of ability (Karabenick, 1998). For example, students may avoid seeking help in order to uphold a positive social image (i.e., social status-goal orientation) and maintain their self-worth (Ryan, Hicks, & Midgley, 1997). Furthermore, unsocial classroom environments may raise concerns about being judged by others and therefore may lead to higher perceptions of threat for help-seeking. For instance, students who avoid appearing incompetent (i.e., performance-avoidance goal oriented) are likely to avoid seeking help because of the potential judgments by others (Karabenick, 2003, 2004; Tanaka & Murakami, 2001). In short, perceptions of threat are an important barrier to seeking the needed help.

Supporting help-seeking in flipped classrooms

The present study focuses on college students' online help-seeking activities in a large science course that implemented a form of blended instruction called the flipped classroom. In flipped classrooms, students are provided with access to online and/or offline learning resources and tools to study the lectures themselves, usually at home (Woolf, 2010). Students are therefore encouraged to take responsibility for their own learning (Davies, Dean, & Ball, 2013). In flipped classrooms, in-class time generally is used for conducting problem-solving activities in groups. Thus, the flipped classroom model also flips the student role; passive listeners in traditional large-enrollment classrooms need to become active learning agents and take the primary responsibility for their learning. Such blended classes are likely to result in greater needs for help as students may need support to overcome academic difficulties such as understanding complex concepts and solving difficult problems when individual resources are ineffective (Mahasneh, Sowan, & Nassar, 2012).

Guided by the flipped classroom teaching model, the college science course was structured as follows: A learning management system and online podcasts were used to allow students to access course materials and study the lectures themselves outside the classroom, while in-class time was used to conduct group activities that were problem solving-oriented. In this course design, students were highly likely to have frequent questions during their individual study time. The web-based help-seeking tool, EchoLu, was developed to enable students to ask questions about the course content and receive the needed help while studying the lecture themselves outside the classroom. Providing a tool to receive answers to students' questions in a timely manner could contribute to their understanding of the concepts studied prior to class and therefore promote their learning both outside and within the classroom. Thus, help-seeking was likely to be an important strategy for student learning in the current study.

Below, the overarching educational design research (EDR) project framework is described. Key design principles are presented and operationalised in the design of the help-seeking tool, EchoLu. Next, the iterative design and data collection process used to evaluate and revise the EchoLu tool and underlying

help-seeking principles is described in detail. Finally, the implications for online help-seeking are discussed.

Methodology

EDR is the overarching framework for the current study. EDR involves continuous design and development of interventions to solve real-world educational problems (Kelly, 2003; McKenney & Reeves, 2012). As such, EDR involves close collaboration between the researcher(s) and the practitioner(s), and this collaboration is considered the key to the continuous refinement of educational solutions until the contextual problems are best addressed (Reeves, McKenney, & Herrington, 2011).

Adapted from the generic model proposed by McKenney and Reeves (2012), the present study included an initial micro-cycle and three meso-cycles. As shown in Figure 1, the initial micro-cycle involved the review of help-seeking literature to understand why students avoid help, which yielded key design principles to promote help-seeking. In the first meso-cycle (i.e., study 1), EchoLu, was designed and developed according to the help-seeking principles and then tested in a real context.

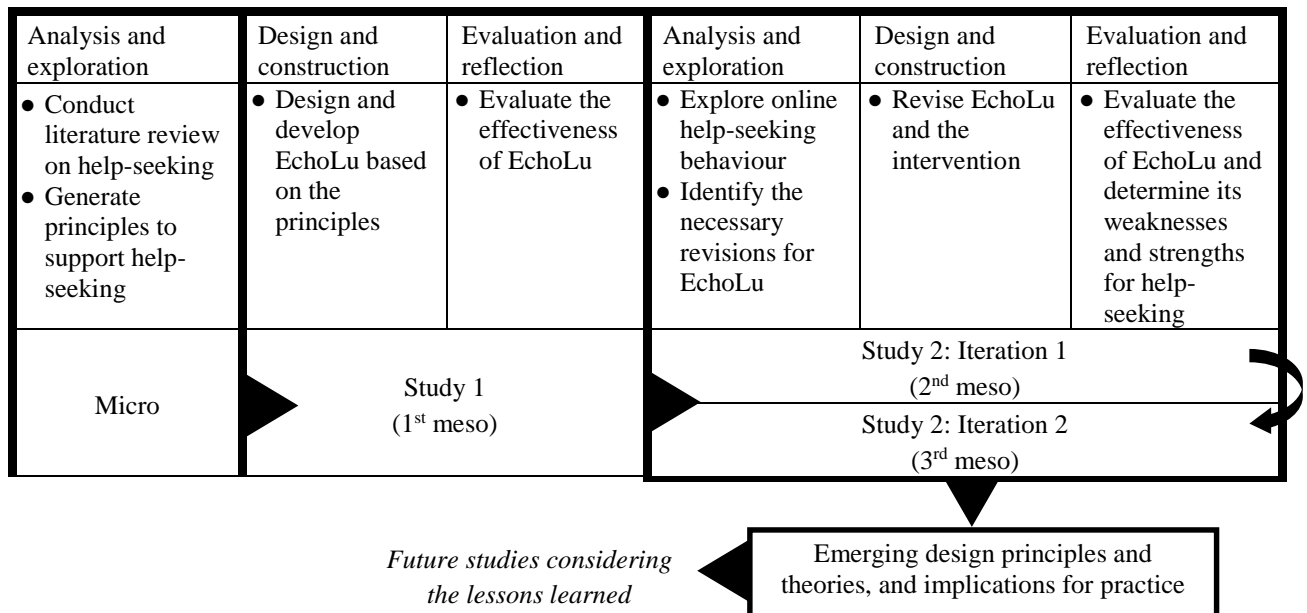


Figure 1. The research design adapted from the cyclic-model by McKenney and Reeves (2012)

Continuing with the second and third meso-cycles, EchoLu was further improved according to students' self-reported experiences of using it to seek help. Besides providing valuable information for improving EchoLu, these iterative cycles helped illustrate the complex nature of online help-seeking behaviour and revealed the processes that were not considered in earlier help-seeking models established through classroom interactions. Last, it is noteworthy that an active collaboration between the researcher and practitioner (i.e., the instructor) was established throughout the study. The instructor was the member of the research team throughout the study and played an active role, particularly in interpreting the results of each iteration and identifying the needed revisions to EchoLu before upcoming iterations. The instructor was also the leader of the instructional team consisting of five teaching assistants, and she brought their experiences to the table when discussing the revisions to EchoLu. The instructor was not involved in any tasks related to data analysis.

Principles for supporting help-seeking and the design of EchoLu

Overall, prior research suggests that help-seeking behaviours may be constrained by personal or social concerns rather than personal academic goals. In this section, four principles for supporting help-seeking are identified and the implications of each for the design of EchoLu are elaborated. The four principles

that support help-seeking are (1) address students' needs for privacy when seeking help, (2) increase students' awareness of instructor support for help-seeking, (3) promote observability of help-seeking activities by others, and (4) promote social support in the learning environment. The suggested principles particularly focus on encouraging help-seeking behaviour by removing or decreasing the barriers to help-seeking (i.e., threat to self-worth or being judged by others) for those who are more likely to avoid it. Figure 2 displays the four principles integrated into and embodied within the design of EchoLu.

Principles	Design of EchoLu
1 Address the privacy needs of students in help-seeking	Posting questions anonymously.
2 Increase students' awareness of teacher support for help-seeking	Notification system that informs students of teacher activities automatically.
3 Promote observability of peers' help-seeking activities	Posts visible to all class members, following others, subscribing to a specific activity (i.e., bookmarking), notification system.
4 Promote social support	Personal walls, public profiles, likes/comments.

Figure 2. The design principles for help-seeking and their implications on the design of EchoLu

Principle 1: Address the privacy needs of students when seeking help

Students may avoid asking for help because of their need to protect their self-worth against possible threats (e.g., looking dumb) (Karabenick & Knapp, 1991). An important factor in this avoidance behaviour is self-esteem, defined as "one's perceived sense of self-worth" (Schunk, 2012, p. 383). Self-esteem has been found to be related to the perceptions of threat for help-seeking, therefore playing a role in students' decision to seek help (Newman, 1990; Ryan et al., 1997; Ryan & Pintrich, 1997). Accordingly, studies reported that students with low self-esteem are likely to avoid help-seeking as a result of the threat to self-worth (Karabenick & Knapp, 1991; Newman & Goldin, 1990; Ryan et al., 1997). However, when privacy needs are addressed, students' perceptions of threat are likely to decrease, and they are more likely to seek help when they need it (Keefer & Karabenick, 1998; Puustinen et al., 2011). This principle suggests that students should be able to seek help with anonymous identities.

EchoLu embodies this principle by providing students with an option of posting on the wall with an anonymous identity (i.e., no photo or name). Because students also seek help by observing questions that are asked by peers (Nadler, 1998), all posts (i.e., anonymous or otherwise) are publicly available to all students. With this feature, a student can benefit from others' help-seeking activities without being actively involved in the activity, a behaviour called lurking (Dabbagh & Kitsantas, 2005).

Principle 2: Increase students' awareness of instructor support for help-seeking

This principle suggests that instructors should be supportive of help-seeking and students' awareness of instructor support should be promoted. Several studies have reported a correlation between perceived instructor support for help-seeking and the resulting help-seeking activities (Karabenick & Sharma, 1994; Newman & Schwager, 1993). For example, Newman and Schwager (1993) found that students who perceive instructor support for help-seeking are more likely to seek help when they need it. In a study among 1,327 college students, Karabenick and Sharma (1994) reported that increased student perception of instructor support resulted in a higher number of questions asked in the classroom environment. This suggests that instructor support helps decrease students' feelings of help-seeking as a threat, and may enhance the belief among students that help-seeking is a useful learning strategy (Arbreton, 1998).

EchoLu promotes students' awareness of instructor support for help-seeking in several ways. First, students can follow the instructor and receive notifications whenever the instructor posts something new. Additionally, when the instructor answers the students' own questions, the students are notified automatically. Of course, instructor support is promoted most directly through the active participation. The more frequently the instructor posts answers to questions or provides positive feedback, the more students will be aware of the instructor support.

Principle 3: Promote observability of help-seeking activities

Students can learn how to use help-seeking strategies by observing the help-seeking behaviours of model students. A student with low self-efficacy may avoid seeking help and may not even know how to effectively seek it. Upon observing the help-seeking behaviour of a model student, a student can become aware that those who have similar misunderstandings and knowledge levels can confidently ask for help, receive positive feedback, and improve their learning (Karabenick, 1996; Nadler, 1998). Then, the student may try to seek help in a similar way to obtain similar outcomes.

EchoLu promotes the observability of help-seeking activities by making all posts (whether anonymous or otherwise) publicly available. This allows students to observe what others are seeking help for and what type of help is being sought. Next, EchoLu provides *follow* functionality. If a student follows a peer, then the student will be notified about the activities of that peer in the system. Also, EchoLu allows students to subscribe to and receive notification of updates on a help-seeking request initiated by a peer. These functions offer students a variety of ways to observe the help-seeking behaviours of peers within the system.

Principle 4. Promote social support in the learning environment

The literature on help-seeking highlights the importance of interpersonal relations and social interactions in students' decisions to seek help (Nelson-Le Gall & Resnick, 1998). Karabenick and Knapp (1988) noted that having higher numbers of friends positively influences help-seeking as students prefer not to seek help from strangers in academic settings. Similarly, Hertz-Lazarowitz (1995) found that help-seeking and help-giving behaviours are more likely to occur among students when peer interaction is promoted. Furthermore, Nelson-Le Gall and Resnick (1998) suggested that being a member of a learning community where help-seeking and help-giving are valued can help students develop a sense of belonging and foster active participation in help-seeking activities. Therefore, students may be more likely to seek help in environments that promote interaction with peers (Nelson-Le Gall, 1981) or increase students' sense of belongingness (Marchand & Skinner, 2007).

EchoLu provides many affordances for social interaction borrowed from popular social networking sites (e.g., Facebook, Twitter) such as posting, subscribing, commenting, *like*-ing activities, and personal space. Alternatively, students can subscribe to a particular question by bookmarking it in order to receive updates on that question. In EchoLu, all students are given a personal profile that allows them to share personal information with others. This personal space is also the public profile (or wall) of students visible to others, and others can post on those public walls. Moreover, students can ask questions, share resources, (add to) bookmark(s), and like (or thumbs up) peers' activities on the wall. Figure 3 illustrates the main interface of the first draft of EchoLu before any revisions.

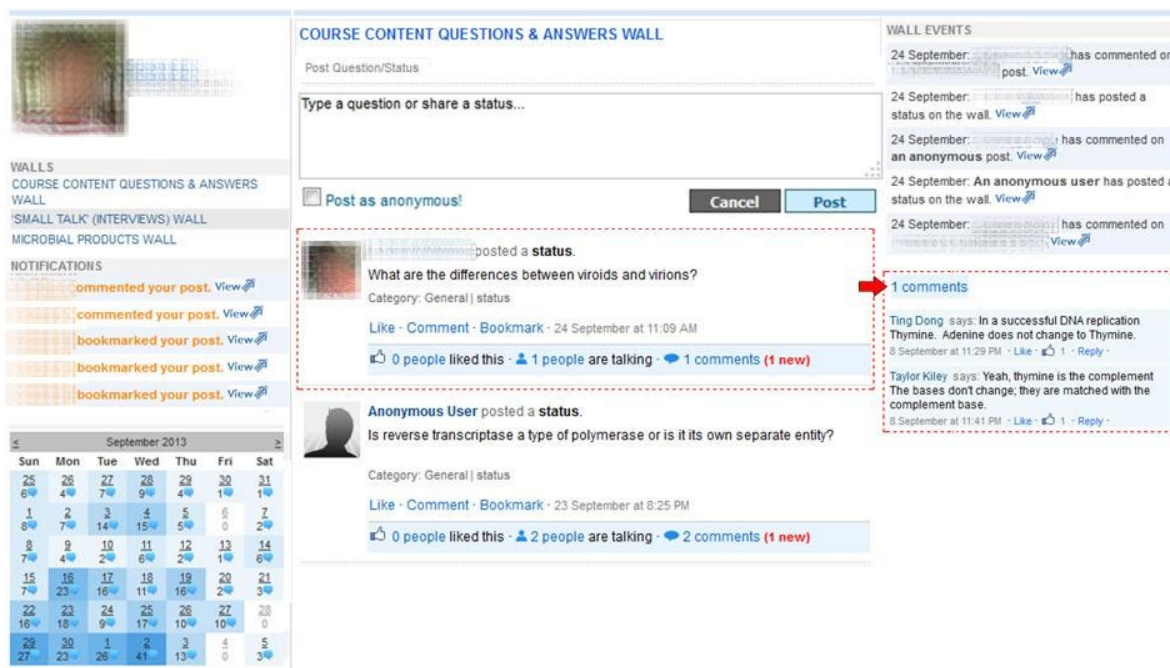


Figure 3. A sample screen shot from the first draft of EchoLu (used in Study 1)

Integrating EchoLu in a flipped science classroom: Two studies

The main goal of this EDR project was to explore the application of help-seeking principles in an online learning environment. Two separate studies were conducted in two consecutive school semesters in the flipped science course. Approval from the ethical committee of the university was obtained before the study started. The purpose of the first study was primarily to evaluate the usability and functionality of EchoLu and improve it before the second study. The purpose of the second study was to evaluate the performance of EchoLu as a help-seeking tool and to improve its effectiveness with two consecutive iterations in the same semester. These studies are summarised in Table 1 and described in detail below.

Table 1
The context and participants of Study 1 and Study 2

	Study 1	Study 2
Context	Flipped microbiology class (Fall 2013)	Flipped microbiology class (Spring 2014)
Participants	387 students (154 male and 233 female)	356 students (139 male and 217 female)
Data collection	Email logs, and the notes from the face-to-face meeting with the instructor.	Online questionnaire composed of Likert-type items and open-ended questions
The role of instructor	Member of the research team	Member of the research team

Study 1: Towards a stable version of EchoLu

Study 1 was a pilot study conducted to collect feedback from 387 students (154 male; 233 female) about the technical aspects of EchoLu during the fall semester of 2013 and improve the EchoLu system accordingly. In the pilot study, EchoLu was integrated into the class as a learning tool where students were instructed to use it to ask questions and to share web resources and news outside the classroom. The instructor was involved when additional support was needed in answering the questions in EchoLu. Any form of student contribution such as asking a question, posting an answer, or sharing a web resource, was automatically credited towards the students’ final grade. Improving EchoLu during this pilot study was critical to continue research on the tool in that negative user experiences could be addressed and their potential to interfere with students’ help-seeking activities could be reduced.

Data collection and analysis

Data sources for this study were the researcher's email communication logs with the instructor, email transcripts of technical problems reported by students, and the notes from the face-to-face meeting with the instructor at the end of the semester. These materials were read through and the revisions before the next study were determined.

Findings and revisions

Students reported the need to simplify the EchoLu home page; specifically, they found the layout of the discussion page crowded and confusing. The EchoLu discussion page contained these six features: a list of recent question walls, personal notifications, the web form for making a post, a calendar showing daily posts, questions posted on the wall, and the list of recent student activities. To simplify the interface and improve its usability, recent student activities were no longer included on the discussion page. Notifications about recent posts were hidden until students chose to display them. Additionally, 14 issues in programming were corrected (e.g., broken links, duplicated posts, issues related to posting a web link or a video).

The instructor suggested two new features to improve access to questions and answers. The first was a tagging feature. When posting a question, students would define one or more relevant tags indicating the topic to which the question is related. Later, the popular tags could be grouped semantically and displayed on the discussion page, and students could filter questions by the selected tag. The second was a search function that allows participants to search through posts with a keyword of interest and find related posts more efficiently. The suggested features were based on the instructor's own difficulties with locating specific posts, as well as her observations on students' use of EchoLu during the semester.

The final issue was related to the instructor's role. The instructor observed that low instructor involvement contributed to low quality of content (i.e., trivial questions, repetitive questions, and insufficient answers) and low student participation. It was decided that the instructor, in collaboration with the teaching assistants, would reply to every single question posted by students to increase both the instructional value of EchoLu and students' perceptions of instructor support for help-seeking.

Study 2: EchoLu as a help-seeking tool

In the second study, the revised version of EchoLu was used in the Spring semester of the same course to facilitate help-seeking outside the classroom. Students were allowed to post questions related to the content of the course in EchoLu at any time. Students' contributions (i.e., questions or answers) were credited towards their final grades (5%).

This study included two iterations. The first iteration took place from the beginning of the semester to the middle of the semester (2 months); the second took place from the middle of the semester until the end (2 months). The goal of these iterations was to (a) determine the strengths and weaknesses in the design of EchoLu, (b) identify the affordances of EchoLu for help-seeking and student learning that were not foreseen initially, and (c) uncover the processes involved in students' online help-seeking activities. The first iteration also informed the design of the EchoLu; revisions were made prior to the second iteration. Data were collected at the end of each iteration.

Participants and data collection

The participants were 356 junior or senior college students (139 male and 217 female students). Participation in the questionnaires was voluntary. Both iterations employed a mixed methods design. The primary instrument was a researcher-generated online questionnaire that was administered at the end of each iteration. Students provided an identification number to track responses so comparisons could be made between the iterations. The questionnaire was evaluative in nature and contained two open-ended questions and four Likert-type items. The open-ended questions asked students to describe the most useful features as well as the limitations of EchoLu for help-seeking. The Likert-type items examined how effectively the design principles were embodied in EchoLu as interpreted by the students. The items were: EchoLu encourages me to seek help when I need it, because (a) it allows me to post anonymous questions; (b) it allows me to observe questions asked by peers; (c) it makes me aware of instructor support for help-seeking; and (d) it provides a supportive and social environment. Items were rated on 5-

point scale ranging from *strongly disagree* (1) to *strongly agree* (5). These items were developed by the researchers to obtain specific information that can help make design decisions in EchoLu. The questionnaire was administered once in the middle of the semester (at the end of the second month) – iteration 1, and once at the end of the semester (at the end of the fourth month) – iteration 2.

Analysis

The open-ended items were analysed first to assess the strengths and weaknesses of the affordances of EchoLu. Students' responses were coded as positive or negative experiences, then grouped by code type. Within each code type, responses were then grouped into major themes. Next, a Wilcoxon signed-rank test was conducted on the questionnaire items to identify any statistically significant changes in students' perceptions of the help-seeking affordances of EchoLu over time. The qualitative and quantitative results were then triangulated to better understand students' process of help-seeking using the online tool. Triangulation of data increases the credibility and validity of the results (Greene, 2007).

Iteration 1: Useful features, limitations, and affordances of EchoLu

The analysis of the open-ended items ($n = 297$) revealed three components that students found most useful. First, students ($n = 44$) noted the utility of searching through the posts and comments using a specific keyword. Second, students ($n = 38$) mentioned the usefulness of the tagging feature that allows them to filter questions and responses by a specific tag of interest. The other popular feature highlighted by students ($n = 38$) was the feature that allows them to post questions anonymously.

Students ($n = 142$) also pinpointed several limitations with the design of EchoLu. First, the overall page design (or the user interface) was confusing and difficult to use ($n = 47$). Similarly, students ($n = 27$) also reported navigational difficulties. In particular, students noted that it was difficult to keep track of questions that had been read, and that the way the answers were displayed was confusing. Third, students ($n = 25$) indicated that a better categorisation was needed to be able to locate the relevant questions effectively and to filter out irrelevant questions. Some students ($n = 16$) similarly noted that the search feature needed improvement. Last, students ($n = 19$) reported that the system runs slowly, contains some bugs, and crashes occasionally when many students connect to the website at the same time.

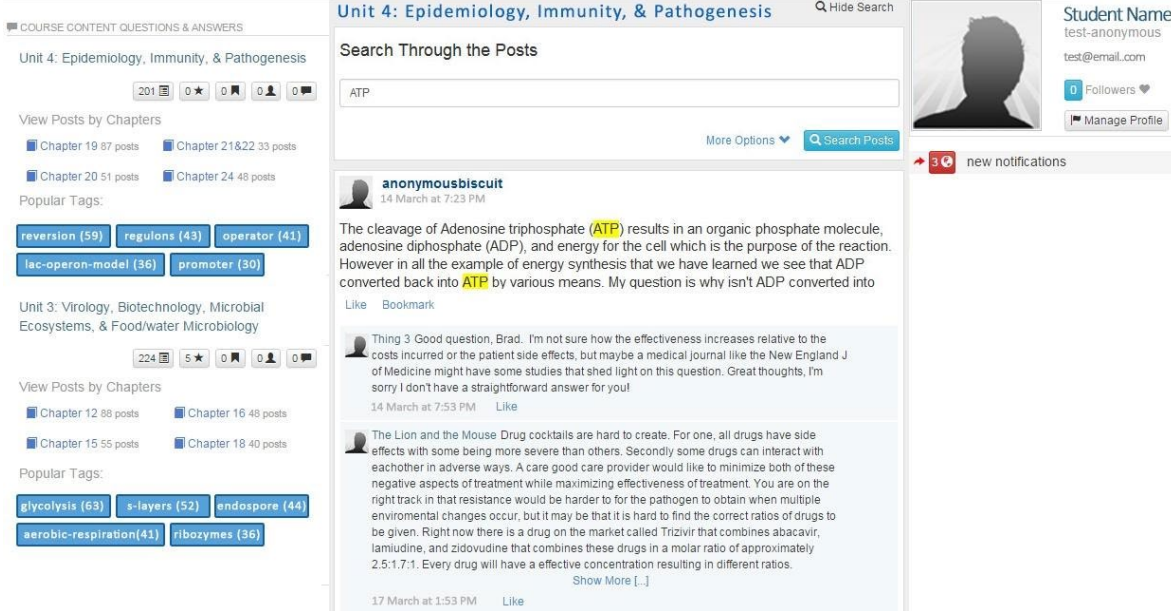
Student feedback also addressed specific help-seeking principles underlying the affordances of EchoLu. First, students ($n = 49$) found it beneficial to observe and examine the questions posted by peers. In particular, these students noted that observing peers' concerns was helpful for the identification of weaknesses in their conceptual understanding that would not otherwise have been brought to their attention. Related with this finding, some students ($n = 18$) noted that they were able to receive indirect help from EchoLu by solely reading the questions and answers of other students and instructors. Second, students ($n = 35$) considered the availability of EchoLu for asking questions 24 hours a day, 7 days a week beneficial in supporting their learning outside the classroom. Third, students ($n = 35$) reported that getting answers to their questions using the whole class as a source of help was beneficial to their learning. Similarly, some students ($n = 29$) noted that it was beneficial to get help from or observe the verification of peers' answers from the instructors and teaching assistants.

The results of the first iteration suggest that the design of EchoLu was successful in several ways. Other than the anonymous post feature, other popular features of EchoLu were the ones that allowed students to access the relevant information in the system effectively (e.g., categorisation by tags, and search). Students also highlighted the benefits of a system where they could ask questions anytime and anywhere and receive support from the whole class or instructor – something that is not possible in a classroom setting. These findings support other studies that have reported students' desire for features that facilitate easy access to relevant information in web-based collaborative learning environments (Wang & Yang, 2012).

Revisions after Iteration 1

Revisions after the first iteration were decided in collaboration with the instructor. This provided the researcher with critical information about the interpretation of the results of the first iteration and the areas of EchoLu that needed improvement to better address student needs. First, the user interface was simplified by reducing the homepage elements to the three most popular (see Figure 4) – categorisation of

questions (on the left-hand side), the questions and answers (in the middle), and the user profile and the notifications (on the right-hand side). Other elements (such as calendar and events feed) were removed from the page. In addition, navigation was improved by adding a separate menu that allowed students to easily access their own questions, questions to which they provided answers, and questions that they had bookmarked. The homepage was modified to include a pagination feature that allows students to move through all questions more smoothly. These specific changes in the interface and the navigation of the system were primarily pinpointed by the instructor based on her own experience of using EchoLu. Additionally, AJAX (Asynchronous JavaScript and XML; see [http://en.wikipedia.org/wiki/Ajax_\(programming\)](http://en.wikipedia.org/wiki/Ajax_(programming))) technology was used to prevent unnecessary page refreshes that previously caused students to lose track of the questions they had already read. To further enhance the clarity of the interface, a professional styling framework, Bootstrap (<http://getbootstrap.com/>), was applied.



The screenshot displays the EchoLu interface for 'Unit 4: Epidemiology, Immunity, & Pathogenesis'. On the left, there is a sidebar with 'COURSE CONTENT QUESTIONS & ANSWERS' and navigation options for chapters and popular tags. The main content area features a search bar with the keyword 'ATP' and a list of posts. The first post, by 'anonymousbiscuit', discusses the cleavage of Adenosine triphosphate (ATP) and highlights the keyword 'ATP' in yellow. The second post, by 'Thing 3', discusses the effectiveness of drugs. The third post, by 'The Lion and the Mouse', discusses drug cocktails. On the right, there is a user profile for 'test-anonymous' and a notification for 'new notifications'.

Figure 4. The revised version of EchoLu with the new page layout, and new or improved features (used in Study 2, Iteration 2)

Furthermore, the search function was improved. First, the keyword search was extended to query questions as well as answers associated with questions and the name of the students who asked the question. These changes were specifically requested by the instructor. Second, the keyword that was searched was highlighted with a yellow background in the results view (questions or answers) in order to increase the prominence of the results for students, which was suggested by the researcher and agreed upon by the instructor. Last, in addition to the keyword field, start and end date fields were added to allow students to search through the questions asked within a specific timeframe. This improvement was suggested by the instructor to allow students to be able to retrieve the questions asked in a specific time period.

Other important changes involved improving the categorisation of questions for effective information access. The instructor played a primary role in determining the categories, which included: by phase of the course – one period for each examination, by book chapter, and by popular tags. It is also noteworthy that a default list of tags was created by the instructor for each chapter instead of allowing students to create their own tags. This was prompted by the instructor who observed that allowing students to create their own tags led to redundancy that created student confusion and produced an incomplete representation of posts related to a topic. The instructor also recommended that every student has a unique anonymous name to be used throughout the semester to improve the visibility of student contributions.

This change in the anonymous feature was implemented for the second iteration. The revised version of EchoLu is illustrated in Figure 4. All revisions performed throughout study are summarised in Table 2.

Table 2
Summary of changes implemented in Study 1 and 2

For Study 2, Iteration 1 (i.e., after Study 1 /Pilot)	For Study 2, Iteration 2 (i.e., after Study 2, Iteration 1)
Simplify layout/navigation <ul style="list-style-type: none"> - Remove one element (i.e., recent activities) - Hide notifications until expanded by student 	<ul style="list-style-type: none"> ● Simplify layout/navigation <ul style="list-style-type: none"> - Display the three most popular elements - Add separate menu to improve access to questions they have posted, followed, or bookmarked - Paginate posts
Add function to search through posted questions	<ul style="list-style-type: none"> ● Refine search function <ul style="list-style-type: none"> - Allow searching of answers as well as questions - Allow searching by timeframe
Add a feature for students to tag questions as they post them	<ul style="list-style-type: none"> ● Limit scope of tags to instructor-generated tags ● Categorise questions and answers by relevant indicators (e.g. phase of course, book chapter, popular tags) ● Allow pseudonymity (i.e., posting under a false and unique name) ● Improve technology functionality (e.g., AJAX to prevent page refreshes; Bootstrap to style page elements)

Iteration 2: Useful features, limitations, and affordances of EchoLu

Analysis of the open-ended answers ($n = 284$) indicated that the number of positive responses increased overall since the first iteration. One hundred students in this iteration highlighted the usefulness of categorisation in finding relevant information compared to 38 students in the first iteration. Additionally, there was an increase in the number of students ($n = 53$) who reported that the anonymous post and comment feature was useful.

There was a decrease in student reports regarding the limitations of EchoLu ($n = 140$). The reported issues related to interface and the navigation of EchoLu decreased whereas there was an increase in the number of students who reported that the system runs slow and crashes ($n = 43$). This was probably due to the fact that recent revisions introduced new errors into the system and that limited testing was performed to correct these errors because of time and labor force constraints. Furthermore, students ($n = 284$) noted similar benefits associated with the affordances of EchoLu. The useful features and limitations of EchoLu reported by students in the first and the second iterations are summarised in Table 3.

Table 3
The comparison of results in iteration 1 and iteration 2

	Iteration 1	Iteration 2
Useful features		
Categorisation by:		
Tags	38	72
Chapters	0	22
Examination	0	6
Search	44	37
Anonymous posting	38	53
Well-organised interface	0	11
TOTAL	140	201
Limitations		
Confusing interface	47	32
Navigation difficulty	27	12

Better categorisation needed	25	16
Search feature improvement needed	16	14
The system runs slowly	19	43
TOTAL	134	117

Affordances

The ability to observe peers to determine one's own weaknesses	49	53
Receive indirect help by reading questions and answers	18	20
Ask questions 24 hours a day, 7 days a week	35	31
The opportunity to use the whole class as a source of support	35	34
The possibility of receiving direct help from instructors	39	28
TOTAL	176	166

The majority of the results in this iteration confirmed the results of the first iteration; however, there were also additional findings. First, there was an increase in the number of students reporting efficiency in finding relevant information through categorisation of questions and the search feature. Compared to 82 students in the first iteration, a total number of 137 students in the second iteration highlighted the usefulness of question categorisations. The enhancement in the anonymous feature (i.e., unique anonymous names; anonymous comments) also appears to have increased its usefulness in the second iteration (from 38 to 53). The decrease in the number of incidents regarding the limitations of EchoLu suggests that the revisions made prior to iteration 2 were effective in a number of ways.

Changes in students' perceptions over time: Study 2

The Likert-type items were analysed to detect the change in students' perceptions over time regarding the principles that informed the design of EchoLu. A total of 303 responses (out of 356) were included in the analysis; 53 were discarded because the participants did not submit questionnaire data for both iterations. Questionnaire responses from iteration 1 and 2 were matched by student identification numbers (i.e., 9-digit numbers), and after the matching, student numbers were removed for confidentiality. Also, the instructor was not involved in the data analysis. The questionnaire was found to be highly reliable in both iterations ($\alpha_1 = .872$ and $\alpha_2 = .878$).

Because an ordinal scale was used in the Likert items, a non-parametric statistical test called Wilcoxon signed-rank test was used to identify the significant changes in students' perceptions. As shown in Table 4, the results of the analysis indicate that the overall mean score of students' perceptions at the end of the second iteration is statistically significantly higher than that obtained at the end of the first iteration ($M_1 = 3.52$, $M_2 = 3.68$, $Z = -3.250$, $p = .001$). That is, after the revisions, the embodiment of design principles in EchoLu was more effective as interpreted by the students. When the questionnaire items were examined individually, a statistically significant increase was identified for each item: (a) posting anonymously ($M_1 = 3.44$, $M_2 = 3.61$, $Z = -3.250$, $p < .001$), (b) observing others' questions ($M_1 = 3.72$, $M_2 = 3.84$, $Z = -2.220$, $p < .026$), (c) promoting instructor support ($M_1 = 3.59$, $M_2 = 3.76$, $Z = -3.119$, $p < .002$), and (d) providing a supportive and social environment ($M_1 = 3.35$, $M_2 = 3.52$, $Z = -3.010$, $p < .003$). These results indicate that there was a positive influence in students' collective experience of EchoLu after the revisions to EchoLu. The effect sizes of the change in individual items were a small effect size according to Cohen's d (Cohen, 1988).

Table 4

The change in students' perceptions over time and the Wilcoxon test results

	M_1 (Iteration 1)	M_2 (Iteration 2)	Z score (Wilcoxon test)	p	d (Effect size)
Overall average	3.44	3.61	3.250	.001	
Q1	3.44	3.61	-3.250	.001	.13
Q2	3.72	3.84	-2.220	.026	.09
Q3	3.59	3.76	-3.119	.002	.13
Q4	3.35	3.52	-3.010	.003	.12

Discussion of Studies 1 and 2

According to iteration 1 results, although students favoured the use of tags in categorising the questions and the search feature for finding relevant information in the system, their feedback still indicated their desire for better information access tools in the system. This was because students did not use EchoLu only for asking questions; they utilised EchoLu as a learning repository. Students were able to (a) re-examine their understanding of a specific concept by reading numerous questions brought up by peers about that concept, and (b) locate existing answers to a question that was similar to theirs instead of spending time asking a question and waiting for an answer. This behaviour of reading the existing questions and answers has been reported as a beneficial learning strategy in online discussion research (Beaudoin, 2002; Mazuro & Rao, 2011).

The majority of the results in the second iteration confirmed the results of the first iteration; however, there were also additional findings. The improvements with categorisation and the change in the implementation of the tag feature (i.e., providing students with a list of tags to choose from instead of creating new ones) led to an increase in the number of students reporting efficiency in finding relevant information in the system. These findings further strengthen the argument that students might use the existing pool of questions and answers to receive indirect assistance (such as finding relevant questions with a valid answer) in collaborative help-seeking environments besides pursuing help by directly posting their own questions. Additionally, in the second iteration, the enhancement in the anonymous feature also appears to have increased its usefulness in the second iteration. This is not unexpected. In a study examining the anonymity options in an online community, Kilner and Hoadley (2005) found that community members are more likely to prefer *pseudonymity* (i.e., a unique username not linked to real identity of the user) instead of complete anonymity because of their need for building and maintaining an identity and reputation. It may be that students who seek help may prefer their contributions to remain confidential while also being recognised in some way.

Furthermore, the results of the Wilcoxon test suggest that revisions made to EchoLu between iterations 1 and 2 positively affected students' collective experience of EchoLu. These revisions were linked mainly to two affordances of EchoLu: observing others' questions and answers (e.g., improving user interface, question categorisation, and search) and posting anonymously within the system. There were no revisions that directly relate to the remaining two affordances, instructor support and supportive and social environment. However, enabling students to monitor others' questions and answers, including responses from the instructor, may have indirectly promoted student awareness of instructor support and may have indirectly led to a more supportive social environment. One's perception of learning within an online environment is influenced by the manner in which instructors and peers interact within the system (Wei, Chen, & Kinshuk, 2012). First, in the revised version of EchoLu, instructors contributed to the learning environment by providing an answer to students' questions, confirming student answers, summarising the discussion, or sharing additional resources. These activities of the instructors are a form of teaching presence, which is an important factor in students' perception of a learning environment (Anderson, Rourke, Garrison, & Archer, 2001). The increased presence of instructor responses likely contributed to the improved student perceptions of EchoLu for promoting instructor support. Second, the increase in students' perceptions of EchoLu as a supportive and social environment can be explained by social presence, defined as "the ability of learners to project themselves socially and affectively into a community of inquiry" (Rourke, Anderson, Garrison, & Archer, 1999, p. 50). Students' favourable comments about the information-seeking capacity of the revised EchoLu suggest that students were better able to find specific questions and answers that interested them. This may have led to greater awareness of the contribution of peers within the environment. In addition, the improvements in user interface and navigation might have a positive influence on social presence. Well-designed user interfaces promote interactions among students in collaborative learning environments, and therefore enhance social presence (Wei et al., 2012). These improvements to the design of EchoLu may have contributed to a stronger sense of social presence and, in turn, students' perceptions of the learning environment.

Informing theory and design

EchoLu was developed around four principles for supporting student help-seeking: (1) address students' needs for privacy when seeking help, (2) increase students' awareness of instructor support for help-

seeking, (3) promote observability of help-seeking activities by others, and (4) promote social support in the learning environment. These principles, however, were generated from face-to-face classroom interactions – the present project explored the application of these principles in an online learning environment. The results of this study provide insight into the theories that informed the design of EchoLu and the design principles themselves.

Revisiting help-seeking in the context of web-based collaborative learning environments

Student feedback provided insight into the decision-making processes associated with seeking help in a web-based collaborative learning environment. In particular, students in this study repeatedly noted the need to include and improve upon information-seeking functions within EchoLu – that is, the ability to search and locate both questions and answers within the system without posting a question of their own. Figure 5 displays a model of online help-seeking that is proposed from the results of the current study and supported by related literature. The model is unique in that it considers information-seeking an integral part of help-seeking. Information-seeking has been discussed in help-seeking research (Cheng et al., 2013; Puustinen & Rouet, 2009; Tsai, 2011); however, it was recognised as a distinct help-seeking strategy that students employ to seek the relevant information on the web, whereas in the proposed model, information-seeking is suggested as a component of help-seeking in collaborative learning environments. Students’ self-regulated learning skills are likely to play an important role in the proposed model since students with self-regulation skills may more effectively use information-seeking techniques for academic help-seeking (Cheng et al., 2013).

In the model, a student begins by determining whether he or she has a specific question to ask. The student may then follow one of two different routes. In the first route, the student has a specific question and may seek an answer to that question by either directly asking for help (i.e., posting their questions anonymously or using their real names) or searching through the existing pool of questions and answers to locate a similar question with a valid answer.

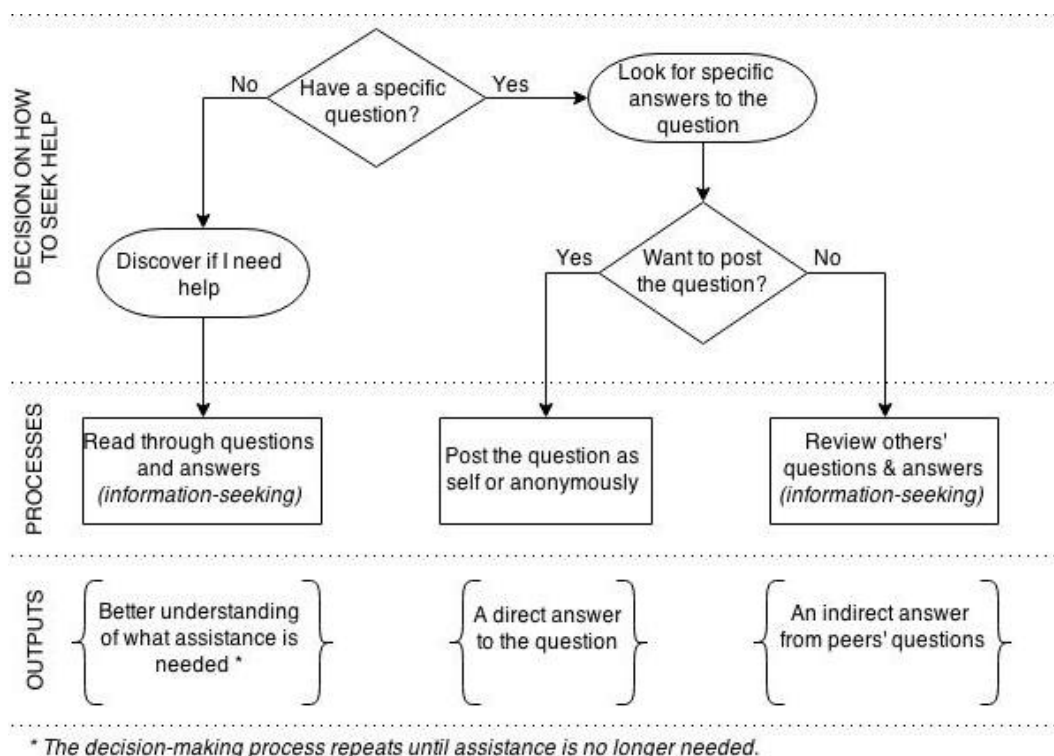


Figure 5. The decision-making processes for help- and information-seeking in a web-based collaborative learning environment

If the student prefers to get the needed assistance by directly posting their questions, then the help-seeking processes identified by Nelson-Le Gall (1981) will take place starting with the identification of potential

helper(s) (in our study, the class members using EchoLu), the employment of strategies to elicit help (in our study, posting the question to the discussion page), and the reactions to the help-seeking attempt, which is the evaluation of the provided answers and the decision whether further help is needed. However, the student may prefer to engage in information-seeking instead of asking for help directly. When this is the case, a student may find an answer to a question within the existing pool of questions and answers (i.e., seeking the needed information). Previous research has reported students' use of existing questions in a discussion forum to find an answer to their own questions (Chang, 2002). In students' efforts to find the relevant questions and/or answers, the affordances of the media for effective access to information is likely to play an important role (Wang & Yang, 2012). If a similar (or the same) question is located, then students will need to determine whether the answers to the question found are satisfying or not, and decide if further assistance is needed (Nelson-Le Gall, 1981).

Another help-seeking behaviour suggested by the results of this study is *question identification*. Students in EchoLu noted that they used existing questions and answers to determine if they were actually in need of academic help and what help they needed. This indicated the second possible route in the proposed help-seeking model. Others have similarly found that students may prefer to review their current understanding through scanning the existing pool of questions and answers, and as a result, improve their learning (Beaudoin, 2002; Cheng, Pare, Collimore, & Joordens, 2011; Mazuro & Rao, 2011). Once students locate the questions that signal problems in their own understanding, they can then determine if an existing answer to their question targets the problems in their conceptual understanding, or if further help is needed (Nelson-Le Gall, 1981). If students decide that further academic help is needed, then they can follow the first route, which supports direct or indirect help-seeking, and post a new question.

In summary, help-seeking in online collaborative learning environments may involve additional processes that are different from the previous help-seeking models based on face-to-face research. These new processes involve the search for useful information that can either answer students' existing questions, or help students review their current understanding of a concept. Therefore, collaborative online tools used for help-seeking should embody features to facilitate students' information-seeking activities. As described in the next section, the present study proposes a new help-seeking principle that underlines the importance of information-seeking when students seek help in web-based collaborative learning environments.

An emergent principle: Support students' information-seeking performances

When computer-supported collaborative learning tools are used to facilitate help-seeking among class members, a large accumulation of information occurs after a period of time. In the current study, this accumulation of information exposed students' interest in seeking help by pulling the needed piece of information out of the large pool of questions and answers. This *information-seeking* behaviour served as an alternative to formulating and posting their own questions. Thus, the results of this study suggest a new principle of help-seeking that emerged from the iterative development of research on EchoLu: Online help-seeking environments should embody specific access tools that improve the information-seeking performance of students.

There exist many theories on information-seeking behaviour such as information search process theory (Kuhlthau, 1990), principle of least effort theory (Zipf, 1949), information foraging theory (Pirolli & Card, 1999). Among these theories, the principles of least effort theory seems to be the best candidate to explain the information-seeking behaviour within the help-seeking context since this theory has been commonly used to explain the information-seeking behaviour of Internet users, including particular users in related fields such as library and information science (Chrzastowski, 1995; Griffiths & Brophy, 2005). According to the principles of least effort theory, individuals have a desire to find information quickly and easily, and therefore they are likely to pick the search technique that is the most advantageous (Zipf, 1949). Individuals who search for information on the Internet employ some of the strategies of the principles of least effort theory (Jansen, Spink, Bateman, & Saracevic, 1998). This search behaviour was observed when students sought help in EchoLu. The first iteration indicated students' need for further information-seeking tools (e.g., a better question categorisation system), and the second iteration showed higher perceptions of the usefulness of these tools (e.g., categorisation by tags, chapters, and exams; improved search function) when seeking help.

Student information-seeking behaviours may also have served as a way to preserve one's privacy (principle 1). If students had difficulty understanding a concept they could search through the existing questions and answers by specific keyword or filter questions by a topic, concept (tag), or chapter of interest. This is likely to have improved their perception of privacy because they could pull information from the system without the risk of exposing their own lack of knowledge. With the affordances of current technology, designers of online tools for learning should consider ways to store each user's contributions and make those contributions easily accessible to others in the future.

Informing other help-seeking principles

This study informs the other principles of help-seeking as well. The designers initially conceived that allowing an option for anonymous posting would provide sufficient privacy for students. However, exercising this form of privacy proved a detriment to the principle of promoting social support – others in the online environment were unable to determine who was posting, and with what frequency. By allowing students to engage in pseudonymity, they could more easily see who was contributing to the discussion while preserving their own privacy. Designers of online discussion tools should consider developing functionality that allows unique but private usernames to be used. The introduction of this functionality in EchoLu corresponded with more favorable perceptions toward posting anonymous questions.

A primary focus of the revisions from iteration 1 to iteration 2 focused on improving student access to the questions and answers posted in the system (e.g., the question categorisation in multiple levels – tags, chapters, and exams, and the search feature). The improved access is likely to have directly facilitated the observability of help-seeking activities by others, and indirectly promoted students' perceptions of instructor support and their perceptions of EchoLu as a social and supportive learning environment. The Wilcoxon test indicated significant improvements in students' perceptions of both. Open-ended responses similarly showed an increase in positive comments and a decrease negative feedback. These results suggest that designers on help-seeking features in online learning environments would benefit from refining the functionality associated with improving student access to and awareness of the contributions of others within the system.

The analysis in this study was performed primarily to improve the design of EchoLu as well as to inform the theory without much of concern on the generalisability of the results. Therefore, other researchers and practitioners should not expect to apply these help-seeking principles without considering their own contexts.

Limitations and future research

There were several limitations pertaining to the data collection. First, student contributions to EchoLu were graded, which might have influenced students' use of EchoLu and their perceptions. Therefore, the results might be biased to a certain degree. Second, the survey items were positively worded, which might have led to acquiescence bias in the results (Winkler, Kanouse, & Ware, 1982). Moreover, the quantitative questionnaire items contained only four specific items that evaluate EchoLu in terms of the proposed help-seeking principles. This might have not only limited the student perspective on the affordances of EchoLu but also raised validity issues.

However, the purpose of the study was not to generalise to the population but to improve and refine the embodiment of theoretical design principles in an applied context. With that in mind, the study offers insight into key design choices that supported help-seeking. The small effect sizes associated with the Wilcoxon test suggested that changes from iteration 1 to iteration 2 were present but required more detailed analysis to identify them. Triangulating survey data with open-ended responses revealed a high level of consistency across data types and exposed students' interest in information-seeking as an additional form of help-seeking. Other designers may use this study to make informed decisions about the features integrated in EchoLu and their application in similar contexts.

Future research might examine student performance scores in relation to changes in student perceptions of using EchoLu. In this way, the influence of EchoLu on students' academic performances can be investigated. Future research could investigate the influence of pseudonymity and some trending information-seeking features such as hashtags. With such features implemented, the social networking emerging in EchoLu may be interesting to examine in flipped classrooms. The social networking in a flipped classroom where students have limited face-to-face opportunities to interact with peers might be influential in help-seeking. The interactions among students could be explored using social network analysis paired with data tracking in the form of student activity logs. This may provide a distinct perspective towards understanding the online help-seeking strategies of students. Moreover, future research could also examine instructors' roles and experiences in students' online help-seeking activities. Last, considering the importance of self-regulation in information-seeking (Cheng et al., 2013; Lee & Tsai, 2011), future research could examine self-regulation in relation to online help-seeking.

Conclusion

The present study explored college students' help-seeking behaviour in a web-based collaborative learning environment. Framed as an EDR, three iterations took place in this exploration. Through iterative cycles of research, the help-seeking tool (EchoLu) was continuously improved, and the nature of online help-seeking behaviour was examined. The results of this study informed the help-seeking principles upon which the EchoLu tool was built, and led to the generation of a new theory explaining online help-seeking behaviour, and a new design principle for supporting help-seeking.

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