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► **To cite this version:**

Rémi Venant, Philippe Vidal, Julien Broisin. A Help Management System to Support Peer Instruction in Remote Laboratories. 17th IEEE International Conference on Advanced Learning Technologies (ICALT 2017), Jul 2017, Timisoara, Romania. pp.430-432. hal-01913998

HAL Id: hal-01913998

<https://hal.science/hal-01913998>

Submitted on 6 Nov 2018

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DOI : <http://doi.org/10.1109/ICALT.2017.123>

To cite this version: Venant, Rémi and Vidal, Philippe and Broisin, Julien *A Help Management System to Support Peer Instruction in Remote Laboratories*. (2017) In: 17th IEEE International Conference on Advanced Learning Technologies (ICALT 2017), 3 July 2017 - 7 July 2017 (Timisoara, Romania).

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A Help Management System to Support Peer Instruction in Remote Laboratories

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Abstract— Help between peers, intended to positively influence learning, appears as a suitable activity for inquiry learning. While several studies reveal evidence that effective help-seeking and help-giving behaviors can improve learning, virtual and remote laboratories do not provide sufficient support to enable these social interactions. Based on a set of criteria defined from existing literature, we designed a management system and implemented it in Lab4CE, a remote laboratory environment for Computer Education. The first results of two experimentations reveal that learners do not tend to help each other spontaneously, while the presence of a teacher increases self-confidence on help given.

Keywords— virtual and remote laboratories; user interactions; help-seeking; help-giving; peer instruction.

I. INTRODUCTION

Virtual and Remote Laboratories, or VRL, promote inquiry-based learning [1] that relies on constructivism and considers social practices as part of the learning process. While help between peers is common in a physical lab and is considered as an important self-regulated skill [2, 3], students do not frequently use help features when help is provided by the system [3], and new design patterns to make students better help-seekers have to be found [4, 5]. Only few VRL support social forms of learning so far [6]. Therefore, we explore in this article how a remote lab can support the help processes, including both help-seeking and help-giving. Our proposition is threefold: (i) the specification of a set of criteria a VRL should meet according to the related literature; (ii) the design and implementation of a help management system for learners and teachers in Lab4CE, our remote lab for computer education; and (iii) the evaluation of this system through two experimentations conducted in real learning contexts.

II. STATE OF THE ART

Help in social contexts such as classrooms has been the topic of many studies in Social Sciences. Most of the research we reviewed focused on help-seeking, a marker of self-regulation skills [7] and metacognitive and domain knowledge. The process model of help-thinking, proposed initially by Nelson-Le Gall [2, 8] includes 5 steps: (i) to become aware of need for help, (ii) to decide to seek help,

(iii) to identify potential helper(s), (iv) to use strategies to elicit help, and (v) to evaluate a help-seeking episode.

To carry out each of these steps, learners may benefit from computer support. Providing self-awareness helps identifying one's difficulty [4]. While it exists several reasons for a learner to avoid to seek help (e.g.: the fear to be seen as incompetent) [9], providing social awareness about the overall help requests happening could avoid the learner having a representation of the group as focused on individual performance [10, 11]. Also, on-demand help seem to be more efficient than automatically provided by the system [3, 12]. To identify potential helper(s), the student needs first to decide whether to ask to the whole group or to someone in particular. Again, the system might provide information to achieve that step, such as social presence [13]. Finally, the environment should also support the evaluation step for learners, but also for the system itself, since it can be used for further processing such as peer recommendation.

We defined six criteria a remote lab should feature to support help episodes: (i) the ability to seek help on demand, (ii) the monitoring of help requests, (iii) the freedom to choose the helper(s), (iv) the capacity to identify a potential helper, (v) the provision of synchronous communication tools, and (vi) the lab replication (so that a peer can see what the other is doing).

III. HELP SUPPORT IN LAB4CE

A. Lab4CE

Lab4CE, which stands for “Laboratory for Computer Education”, is a web-based environment to provide remote laboratories featuring advanced learning capabilities [14]. Lab4CE was designed to overcome the spatial limitations and security restrictions of physical labs. It provides each learner with a set of virtual machines, routers and switches required to complete a given practical activity, which are available from anywhere, at any time and without any limitation of use. The features offered to both students and teachers include real-time textual communication, on-demand collaboration (i.e., learners can work together on the same machine and see what peers are doing), learning analytics tools for self- and social awareness (i.e., learners can compare actions they are carrying out against those of their peers), and replay and deep analysis of working sessions. In order to assist users in help-seeking and help-

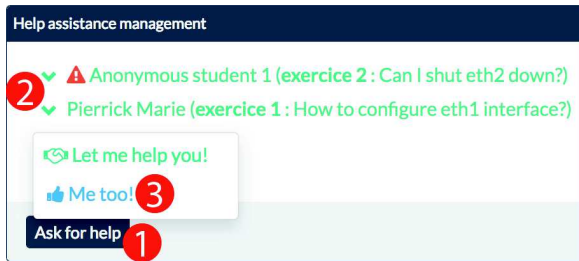


Figure 2. The Help Management System for Learners

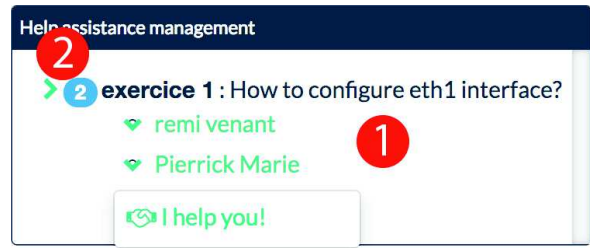


Figure 1. The Help Management System for Teachers

giving, we reused and adapted existing features to implement an innovative help management system.

B. Help Management system

During practical work sessions, the help management system allows sending help requests to others, monitoring current help requests, and taking actions on them. As illustrated by Figs. 1 and 2, views and features of the component are different according to the user role.

With the existing social comparison tool that allows learners to compare their performance, learners have a support to become aware of their need for help. In the help assistant management component, students can ask help (1 in Fig.1) by filling a simple form with the name of the exercise they are working on, a short description of their difficulty and the type of the request (i.e.: a *collective request* is sent to the whole class while an *individual request* is sent to a particular peer or teacher). They also have the opportunity to ask help anonymously, to engage learners that might avoid seeking help due to their class perception.

The component sorts the pending help requests according to the role of the user. For a student (2 in Fig. 1) the first requests are the individual ones (marked with a warning icon) then come the collective ones. In each subgroup, requests are sorted from the oldest to the latest. For a teacher (2 in Fig 2), requests are grouped by their exercise name and description to facilitate the detection of a difficulty that several learners are facing that would require a collective intervention. When a user takes in charge a request (“Let me help you!” in Figs 1 and 2), the request is removed from the management component. Also, a learner can seek for identical help by clicking on the “Me too!” option of a collective request, whereas both learner and teacher can decide to deny an individual request.

C. Regulation rules

In order to limit undesirable behaviors, 4 regulation rules were implanted. To avoid the temptation to rely on other, a learner can only ask help once at the time. To avoid split attention a learner can only be helped by one user at a time, while a learner who is helping a peer cannot be chosen for an individual request. Finally, to reduce the risk of giving up seeking help after too many requests without answer, pending collective requests or individual requests sent to

another students and that are not taken in charge after a certain period are automatically redirected to a connected teacher (if applicable).

D. Help episode and help evaluation

Once a user takes in charge a request, she is able to see what the other is doing in real-time on her resources. She can then help her through the instant messaging system. To reduce the risk of directive help, she cannot directly act on the machine of the learner she is helping.

Either the help-giver or the help-seeker can end the help episode at any time. When a help episode is over, the system notifies both users and asks them to quickly evaluate the help episode that occurred: the helper indicates whether she feels satisfied with the help she provided, while the help-seeker is asked whether she thinks the episode was helpful.

IV. EARLY RESULTS

We conducted two experiments to evaluate the help management system we designed. As learners did not take their final assessment at the time of writing yet, early statistical results reflecting usage of the system are exposed.

A. Experimentation protocols

Both experiments were carried out at the University of Toulouse (France), in a computer-engineering course on two different populations. The course introduces computer and network administration in an inquiry-based learning context. During classroom sessions, learners worked in dyads, so help processes were observed between dyads. In the first experiment (Exp1), 28 dyads of second-year students practiced for three sessions of 90 minutes each. Also, no teachers were available on Lab4CE, and learners were completely free to use (or not) the help management system. At the time of the experiment, the system was not offering the possibility for learners to detail the exercise name and description of the problem when sending a help request.

In the second experiment (Exp2), a teacher was connected on the Lab4CE system, and 12 dyads of students had 4 sessions of 90 minutes to achieve the practical tasks. The teacher informed students that the use of the help management system could bring them up to 2 bonus points for their final grading (for a maximum grade of 20). However, he did not specify any thresholds on the number

of expected interactions. In this experiment, all features of the help management system were available.

B. Results and Discussion

Results of both experiments are given in Table 1. To compare both experiments, we computed all indicators (except rates) as a value per working session. A first observation is the nearly zero usage of help in Exp1. As noticed by [12], it appears that learners do not often use help by themselves. Of course, the motivation introduced in Exp2 seriously boosted the use of the help management system. %HG on HR denotes the percent of help requests that received an answer. %LearnerHG on Total HG represents the proportion of answers provided by learners; since no teachers were involved in Exp1, this latter indicator is 100%. While in Exp2 the percent of help-giving is twice higher than in Exp1, 41% of help was provided by the teacher. On the other hand, %LearnerHG on HR expresses the percent of help given by learners only on all help requests; we observe similar results for this indicator. We can thus notice that motivating learners encourages the help-seeking process, but additional efforts are required to foster the help-giving process. We can also notice that evaluations of help episodes between learners increased from Exp1 to Exp2 as well. %Good Evaluation Learner HR is the percent of help episodes evaluated positively by help-seekers, whereas %Good Evaluation Learner HG represents the percent of help episodes evaluated positively by help-givers. In Exp1, both indicators values are under 50%, while in Exp2 they are above this threshold (i.e., 69% and 60% respectively). These significant increases, especially those related to help-givers self-evaluation, could be explained by the presence of the teacher that may provide more confidence to learners to give help. This hypothesis seems to be confirmed by the feedback we received from the teacher, who explained that many students asked him to confirm their explanations they were giving to others.

Table 1. Experiments Results

Indicator	Exp1	Exp2
Mean HR per session	13.00	35.25
Mean HR per session per dyad	0.47	2.94
Mean HG per session	4.33	23.25
Mean learner HG per session per dyad	0.15	1.15
% HG on HR	33%	66%
% LearnerHG on total HG	100%	59%
% LearnerHG on HR	33%	39%
% Good Evaluation HR	46%	69%
% Good Evaluation Learner HG	23%	60%

V. CONCLUSION

In inquiry learning settings, help-related processes are key factors of engagement that remote and virtual labs should support. Starting from a reference model designed by literature, we defined a set of criteria remote labs should support to instrument help-seeking and help-giving

behaviors, and integrated a help management system in Lab4CE, our remote laboratory for Computer Education.

Two experimentations show that learners do not often help each other when they are free to do so. When students are stimulated, they use the help management system to seek for help, but also to offer help to peers. Finally, evaluation of help received or given between learners tends to increase when a teacher is present on the platform.

While we still have to assess impact of help on learning, we target several mid and long term perspectives. So far, we intend to integrate intelligent features into the help management system. As several studies showed that different learner-related factors have an impact on help-seeking, we plan to integrate a learner profile to provide peer recommendation to invite specific learners to take in charge requests matching with their profile. Eventually, we highlighted a lack in formal definition and specification of the help-giving process, both in Social and Computer Sciences, even if it might add comprehension about motivational factors of a helper.

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