What Matters in Help-Seeking?
A Study of Help Effectiveness and Learner-Related Factors

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Abstract

Offering help functions is a standard feature of computer-based interactive learning environments (ILEs). Nevertheless, the effectiveness of learners’ use of help facilities has been subject to extensive debate. Recent research indicates an inefficient use or even ignorance of help functions. This article addresses the issues of effectiveness of help and the impact of learner-related factors in an ILE for plant identification. Students from three regular university courses in plant identification worked in a dyadic setting. The effects of two different types of help facilities (context-sensitive help and glossary function) on task performance in plant identification are analyzed. In addition, a broad set of potential learner-related factors is explored with respect to their effects on help-seeking, including prior knowledge, motivational orientation, interest, self-estimated competence, and epistemological beliefs. Results yield a positive effect of help-seeking on task performance. In addition, most learner-related factors affect help-seeking behavior and performance. Results are discussed with respect to their implications for future research on help-seeking in ILEs.

Keywords: help-seeking, interactive learning environment, learner-related factors
What Matters in Help-Seeking? A Study of Help Effectiveness and Learner-Related Factors

Help-seeking constitutes an essential component of self-regulated learning which is particularly important in computer-based interactive learning environments (ILEs). The use of ILEs has become widespread in all fields of educational practice (e.g., Dillon & Gabbard, 1998). One of the greatest assets of ILEs is seen in the supply of various help functions. This help may be in the form of specific hints, glossary functions or linked hypertext pages offering additional relevant information. Although it seems immediately plausible that such help functions have a great potential for learning, research casts doubts on the effectiveness of learners’ use of help facilities (e.g., Aleven & Koedinger, 2000; Mandl, Gräsel, & Fischer, 2000). Use of help functions seems to be rare and often ineffective. For example, Aleven and Koedinger reported that learners spent very little time on actual help use. They ignored hints on how to solve mathematical problems and looked instead directly for answers. More abstract information such as definitions given in a glossary was virtually ignored. Nevertheless, there is also first evidence that help facilities can foster learning if they are used effectively (Renkl, 2002; Wood & Wood, 1999).

All in all, little is known about the interaction of help functions in ILEs and learning processes. To date most research on help-seeking is restricted to classroom learning settings. Due to essential differences between the help-seeking process in traditional classroom settings and in ILEs a simple extrapolation of these findings would be inappropriate. Thus, there is a need to establish research on help-seeking in ILEs as a field in its own right (Aleven, Stahl, Schworm, Fischer, & Wallace, 2003). A major challenge for researchers should be in the identification of variables that have an influence on the effectiveness of help. Extensive analyses of learner-related factors, system-related factors and their interplay are required to improve help-seeking in
ILEs. This paper reports on a study on the effect of help on task performance in an ILE from the domain of botany. The aim was to find first hints as to the effects of different learner-related factors on help-seeking and performance with the ILE (see also Bartholomé, Stahl, & Bromme, 2004).

The Learning Environment “Plant Identification Online”

Help-seeking behavior in the ILE “Plant Identification Online“ (PIO; Stahl & Bromme, 2002; see http://www.bestimmen-online.uni-muenster.de) was analyzed in this research. Plant identification is a complex skill that is taught in compulsory university courses in biology and related fields. Students learn how to identify plants by determining living plant material. Due to the huge number of required botanical concepts (about 10,000 plant features in the common German flora) and the large degree of phenotypic variability within these concepts, plant identification is usually taught in a case-based manner employing so-called keys for identification (from now on referred to as “keys”). These keys take the form of complex structured decision trees that guide learners through a sequence of decision steps to the identification of the species. Decision steps consist of a contrastive description of two sets of plant features. At each step, learners have to decide which set of features applies to the plant under examination. Having decided, they are guided to the next step until they arrive at the final taxon (a taxonomic category or group, such as a phylum, order, family, genus, or species). Case-based learning with keys has a long tradition in plant identification and is widely accepted as a method for enabling students to identify a broad variety of plants on their own. Yet, traditional keys offer insufficient help functions (Bromme, Stahl, Bartholomé, & Pieschl, 2004). Therefore novice learners depend on extensive expert tutoring to deal with the complexity of the domain. In this traditional setting self-regulated learning processes are not supported. To overcome this
shortcoming, PIO also incorporates a key, but differs from book keys by making various help functions available, including about 80,000 instructional illustrations and different types of text-based help. In this study, two types of help are examined. First, context-sensitive help materials tailored to the specific decision task are offered at each decision step. In these help materials the relevant botanical concepts are explained by means of a combination of texts and line drawings, including tips for handling difficulties. Second, all basic botanical terms are defined in a glossary that is permanently available throughout the decision process. Glossary definitions provide more general explanations that are not context-sensitive.

***INSERT FIGURE 1 ABOUT HERE***

Research Issues

The use of these help functions was examined in a real course setting. An important characteristic of courses in plant identification is that students traditionally learn in dyads. Therefore, all reported analyses in this paper refer to dyads rather than to individual learners. This procedure offers the opportunity to analyze the interactions between students having similar or differing values on their learner-related factors.

Help and Help-Seeking

As there is little evidence on the effects of help-seeking behavior in ILEs, the first question was if the students would actually use context-sensitive help and the glossary within PIO, and whether using help would result in better performance.

A second question was how different learner-related factors affect the use of PIO. Based on a comprehensive review of research (Aleven et al., 2003) the following variables were included as potential impact factors on help-seeking behavior:

Prior Knowledge. In several studies prior knowledge has been shown to substantially influence learning (e.g., Dochy & Alexander, 1995). Wood and Wood (1999) found significant
interactions between level of prior knowledge, performance, and frequency of help-seeking in an ILE. In their studies, learners with high prior knowledge exerted the most effective help-seeking behavior. They tended to seek help after making an error much more frequently than learners with low prior knowledge. One could conclude from Wood and Wood that learners who are high in prior knowledge made more accurate judgments about their need for help. Studies on help-seeking in computer-based and in traditional classroom settings (e.g., Puustinen, 1998) both agree that learners low in prior knowledge – those who need help the most – are least effective in making use of it.

Motivational Orientation. Results from traditional classroom settings suggest an important role for motivational orientation in help-seeking (e.g., Arbreton, 1998; Ryan & Pintrich, 1997). Most studies agree that motivational orientation towards gaining high competence (learning goal orientation, Arbreton; task orientation, Nicholls, 1984) is beneficial to learning. Arbreton also showed an effect on help-seeking strategies. Learning-orientated students in his study asked for instrumental help (e.g., hints) much more frequently, whereas performance-orientated students tended to ask for executive help (e.g., correct answers). Another factor likely to affect help-seeking is the tendency to try to avoid effort (work avoidance, Nicholls), which should be associated with reduced help-seeking behavior. This study examined the effects of task orientation and work avoidance on the use of instrumental help given in the form of context-sensitive help and the glossary. As far as could be determined, this is the first study that analyzes the effect of motivational orientation on help-seeking in an ILE (see Aleven et al., 2003).

Interest and Self-Estimated Competence. As a further variable, interest in a domain or topic has been shown to affect learning and comprehension (e.g., Boscolo & Mason, 2003; Schiefele, 1996). It was assumed that interest is also likely to affect students’ help-seeking in
ILEs. As Schiefele (1996) demonstrated, high interest is associated with deeper level understanding. It is expected that highly interested learners access more help in ILEs in order to gain a deeper understanding.

In addition, there is evidence that self-estimated competence affects learning processes (Schwarzer & Jerusalem, 1999). From research on self-efficacy (Bandura, 1982) it can be assumed that learners with high self-estimated competence invest more effort in performing tasks (in this case help-seeking activities). In contrast, the invested effort, i.e. help seeking, might decrease if a task is perceived to be easy (Salomon, 1984).

Epistemological Beliefs. Epistemological beliefs can be defined as beliefs about the nature of knowledge and knowing. A large body of research corroborates the influence of peoples’ epistemological beliefs on their learning processes and outcomes in classroom settings (e.g., Kardash & Howell, 2000; Schommer, 1993). There are also first hints as to the influence of epistemological beliefs on learning in ILEs (Jacobson & Spiro, 1995; Windschitl & Andre, 1998). Epistemological beliefs might also play a significant role in help-seeking. It seems reasonable to assume that if one believes, for example, that knowledge in a domain is simple and certain, this would lead to fewer and more superficial help requests than believing that knowledge is complex and uncertain.

Method

Participants

Seventy-four students of biology and pharmacology from three regular courses in plant identification (2\textsuperscript{nd} semester) at three German universities took part in this study. Fifty-eight participants were female, 14 were male and 2 participants did not report their gender. Participants’ age ranged from 19 to 30 years with an average of 21.25 (SD = 1.87). Students worked in 37 dyads.
Materials

Participants identified living plants from common central-European plant families with PIO. Botanical prior knowledge was assessed via questionnaire. Motivational orientation was measured via the scales “task orientation” and “work avoidance” from the motivational orientation scales (MOS-D, Balke & Stiensmeier-Pelster, 1995; Nicholls, 1984). Interest and self-estimated competence in the domain of plant identification were surveyed in the 17 item-IAPI-questionnaire (Interests and Attitudes in Plant Identification). Epistemological beliefs were assessed on a domain-specific level using the semantic differential CAEB (Stahl & Bromme, submitted). CAEB consists of 14 adjective pairs measuring the dimensions “texture of knowledge” (ranging from beliefs that knowledge is structured and definite to beliefs that knowledge is unstructured and ambiguous), “variability of knowledge” (dynamic and flexible knowledge vs. static and inflexible knowledge) and “genesis of knowledge” (negotiated and constructed knowledge vs. detected and existing knowledge). Indicators of help-seeking (proportion of context-sensitive help access per decision step [context-sensitive help], proportion of glossary access per decision step [glossary]) as well as measures of task performance (proportion of correct decisions [correctness], proportion of decision steps on the wrong path [follow-up errors]) were assessed via log-files.

Procedure

The study took place in three regular courses in plant identification. Students worked with PIO in dyads over a period of four course sessions. In each session they spent about 1 – 2 hours identifying the supplied plants at their own pace. The first two sessions were to familiarize students with PIO. In sessions 3 and 4 help-seeking behavior was assessed via log-file analysis. Questionnaire data on the different learner-related factors were collected at the beginning of the course.
In this research, an $\alpha \leq .05$ was considered significant and an $\alpha \leq .10$ as marginally significant. As some students did not complete all questionnaire items missing values were replaced by the respective sample mean to avoid reduction of sample size.

With respect to the analysis of learner-related factors it should be noted that due to the early stage of research on help-seeking in ILEs the focus here was on exploring the impact of the various factors related to help-seeking in a naturalistic setting, not on studying the interrelations or interactions between these factors. Therefore, the impact of the learner-related factors in separate analyses was studied and a complete research design with a permutation of all possible combinations of factor values, which, moreover, would not have been feasible with the given sample in our real course setting was not used.

**Preparation of Questionnaire Data for Subsequent Analyses**

A sum score of correct item solutions in the prior knowledge test was calculated for each participant. The data from MOS-D, IAPI, and CAEB were factor analyzed. Factor analyses were run with a larger sample of biology students ($n = 650$). The two factors from the MOS-D, “task orientation” (6 items, Cronbach’s $\alpha = .64$) and “work avoidance” (5 items, Cronbach’s $\alpha = .82$), were confirmed with moderate to high internal consistencies. The factors accounted for 48.51% of the variance. The factor structure of IAPI could also be confirmed. The two factors “domain interest” (10 items) and “self-estimated competence” (7 items) explained 51.93% of the variance and yielded high inter-item consistencies (Cronbach’s $\alpha = 87.$ and .83). The factor analysis of CAEB yielded the three postulated factors with a total of 49.62% of the variance explained and acceptable to high internal consistencies (texture of knowledge: 7 items, Cronbach’s $\alpha = .83$; variability of knowledge: 5 items, Cronbach’s $\alpha = .67$; genesis of knowledge, 2 items,
Cronbach’s $\alpha = .28$). For the factors of MOS-D, IAPI, and CAEB factor sum scores were calculated.

To explore help-seeking in a real course setting the unobtrusive method of log-file analysis was used instead of more qualitative data analyses which would have required a laboratory setting. The individual questionnaire data were adapted to suit dyads for the subsequent data analyses. For each of the variables, students were divided into two groups via median split. Based on these median splits, dyads were assigned to one of three types: dyads with both participants having low values on a variable (low-value dyads), dyads with one participant having a high value and the other a low one (mixed dyads) and dyads with both participants having high values (high-value dyads). Group differences in help-seeking and performance between low-value, mixed, and high-value dyads on a specific variable provide information about the impact of that variable. Thus, in the analyses of the effects of learner-related factors on help-seeking and performance, dyad types were used as independent variables. Learner-related factors produced sufficient variance in the assignment of dyads to the three types to make these analyses viable.

Descriptive Data

**Help-Seeking.** All the following analyses are reported on at the dyads level ($n = 37$). Throughout the two logged courses students processed an average of 260.46 decision steps ($SD = 70.69$). On an average of 24.98% ($SD = 12.95$) of these decision steps context-sensitive help was accessed. The average percentage of glossary use per decision step was much lower ($M = 1.88\%, SD = 2.17$).

**Performance.** Two different indicators of performance were used: *correctness* and *follow-up errors*. If a student chooses the correct set of features at a decision step this decision is labeled as correct. When she or he has committed an error the participant leaves the correct path
of identification. From that point on the feature sets given at the following decision steps do not apply to the plant under examination. So whatever choices a participant makes on the wrong path lead to further errors until she detects her mistake, goes back to the first error and corrects it. This type of error is referred to as follow-up error. The proportion of correct decisions (correctness) was defined as a measure of students’ overall performance as it provides the best information about students’ efficiency in the identification process. The proportion of follow-up errors (follow-up errors) was defined as an efficiency measure of students’ error management. A low proportion of follow-up errors indicates that students spent little time on the wrong path and corrected errors quickly.

The mean of correctness was at 69.99% (SD = 9.81), the mean of follow-up errors was at 18.99% (SD = 8.46).

Help-Seeking and Performance

The indicators of help-seeking (context-sensitive help, glossary) and task performance (correctness, follow-up errors) were subjected to a correlation analysis. Context-sensitive help was significantly correlated with both correctness \((r = .53, p = .001)\) and follow-up errors \((r = -.40, p = .013)\). Students accessing help materials at a high rate made more correct decisions in their identification process and spent less time on the wrong path of identification. Thus, the use of context-sensitive help was effective in improving task performance. Glossary was not significantly related to the performance indicators \(correctness: r = -.24, \text{n.s.}; \text{follow-up errors: } r = .11, \text{n.s.}\). These correlation data as well as the frequencies of access suggest completely different uses of the glossary function and context-sensitive help.

Effects of Learner-Related Factors

The effects of dyads differing in their learner-related factors on correctness and follow-up errors and on context-sensitive help and glossary were examined. MANOVAs were calculated
for each learner-related factor using the dyad type (low, mixed, high) as independent variable and the performance and help-seeking measures as dependent variables. In a second step individual ANOVAs and post-hoc comparisons were calculated for each dependent variable. Table 1 gives an overview of the results of this section.

***INSERT TABLE 1 ABOUT HERE***

As noted above, separate analyses of the effects on help-seeking and performance were performed for each of the learner-related factors. Table 2 gives an overview of the correlations between the different learner-related factors. The relations between these factors were not in the focus of our study. They are only referred to in the following if they provide useful information in the discussion of effects on help-seeking and performance.

***INSERT TABLE 2 ABOUT HERE***

Prior Knowledge. Fifteen dyads with low prior knowledge, 13 dyads with high prior knowledge and 9 mixed dyads were examined. A MANOVA revealed a significant effect of prior knowledge ($F(8, 60) = 2.08, p = .05$). Subsequent ANOVAs showed significant differences between the three dyad types for context-sensitive help ($F(2, 34) = 5.27, p = .01$) and correctness ($F(2,34) = 5.06, p = .01$) as well as a marginally significant effect on follow-up errors ($F(2,34) = 2.64, p = .09$). Low knowledge dyads used help significantly more frequently than dyads with high prior knowledge (Tukey-HSD, mean diff. = .14, $p = .01$). Low knowledge dyads also had a significantly larger proportion of correct decisions (Tukey-HSD, mean diff. = .11, $p = .01$) and showed a tendency to make fewer follow-up errors than dyads with high prior knowledge (Tukey-HSD, mean diff. = -.07, $p = .08$). It can be concluded that low knowledge dyads searched for help most frequently and performed best. In order to find out whether the effects of prior knowledge on help-seeking and performance were independent or whether help-seeking mediated the impact of prior knowledge on performance, a partial correlation analysis
was carried out. Whereas the simple correlations between correctness and prior knowledge ($r_{xy} = -.47; p = .003$) and between correctness and context-sensitive help ($r_{xz} = .53; p = .001$) both are substantial in amount and highly significant, only the correlation between context-sensitive help and correctness remains significant when the other factor is partialized out ($r_{xz,y} = .40; p = .02; r_{xy,z} = -.29; p = .09$). Thus, it can be concluded that the effect of prior knowledge on performance was mediated by help-seeking.

Motivational Orientation (Work Avoidance and Task Orientation). Eleven dyads with low work avoidance, 12 dyads with high work avoidance and 14 mixed dyads were compared. A MANOVA with dyad type as independent variable and help-seeking and performance indicators as dependent variables yielded no significant effects ($F(8, 60) = 0.96, \text{n.s.}$). Eleven dyads with low task orientation, 12 dyads with high task orientation and 14 mixed dyads were compared. Again a MANOVA on the help-seeking and performance variables revealed no significant effects ($F(8, 60) = 1.18, \text{n.s.}$). In sum, motivational orientation had no effects on help-seeking and performance.

Interest and Self-Estimated Competence. Twelve dyads with low interest, 11 dyads with high interest and 14 mixed dyads were compared. A MANOVA revealed no significant effects on the help-seeking and performance indicators ($F(8, 60) = 1.31, \text{n.s.}$).

Ten dyads with low self-estimated competence, 10 dyads with high self-estimated competence and 17 mixed dyads were compared. A MANOVA showed a significant effect for self-estimated competence ($F(8, 60) = 2.17, p = .04$). ANOVAs revealed a significant difference for context-sensitive help ($F(2, 34) = 3.57, p = .04$) as well as a marginally significant difference for follow-up errors ($F(2, 34) = 2.61, p = .09$). Mixed dyads accessed context-sensitive help significantly more often than dyads low in self-estimated competence (Tukey-HSD, mean diff. = -0.12, $p = .03$). Mixed dyads also showed a tendency to commit less follow-up errors than
dyads with high self-estimated competence (Tukey-HSD, mean diff. = -0.07, \( p = .09 \)). A correlation analysis yielded no relation between self-estimated competence and prior knowledge (see table 2).

It can be concluded that interest had no effects whereas self-estimated competence had an impact on context-sensitive help use and the number of follow-up errors.

Epistemological Beliefs. Nine dyads who believed botanical knowledge to be certain and structured, 9 dyads believing that botanical knowledge is uncertain and unstructured and 19 mixed dyads (factor “texture of knowledge”) were compared. A MANOVA revealed a significant effect of texture of knowledge \( (F(8, 60) = 2.18, \ p = .04) \). Subsequent ANOVAs revealed significant differences for context-sensitive help \( (F(2, 34) = 5.47, \ p = .01) \). Dyads with beliefs that knowledge in plant identification is uncertain and unstructured accessed context-sensitive help more often than those who believed it to be more certain and structured (Tukey-HSD, mean diff. = -.18, \( p = .01 \)).

Eleven dyads that believed botanical knowledge to be dynamic and flexible, 12 dyads believing that botanical knowledge is static and inflexible and 14 mixed dyads (factor “variability of knowledge”) were compared. A MANOVA revealed no significant effects of variability of knowledge \( (F(8, 60) = 0.39, \text{n.s.}) \).

Twelve dyads who believed botanical knowledge to be constructed and negotiated, 12 dyads believing that knowledge already exists and just has to be discovered and 13 mixed dyads (factor “genesis of knowledge”) were compared. A MANOVA yielded a significant effect of genesis of knowledge \( (F(8, 60) = 2.63, \ p = .02) \). Subsequent ANOVAs revealed a significant difference for follow-up errors \( (F(2, 34) = 5.23, \ p = .01) \) as well as a marginally significant difference for correctness \( (F(2, 34) = 2.44, \ p = .10) \). Dyads who believed in pre-existing and discovered knowledge made significantly more follow-up errors (Tukey-HSD, mean diff. = -.09,
and showed a trend to have a smaller proportion of correct decisions than dyads believing that knowledge is constructed and negotiated (Tukey-HSD, mean diff. = .08, \( p = .10 \)).

It can be concluded that beliefs concerning the texture of knowledge influenced students’ help-seeking behavior whereas beliefs about the genesis of knowledge had an impact on performance. Beliefs concerning the variability of knowledge had no effects.

Discussion

This research gives insights into the issues of effectiveness of help-seeking and potential impact factors. In the following, our results on these two issues will be discussed. Our results offer promising implications for theoretical debate and future research on help-seeking.

Effectiveness of Help

First of all, help-seeking was effective. The commonly observed phenomenon of marginal help use or even ignorance of help did not emerge in this study, at least with respect to context-sensitive help. The average amount of context-sensitive help use per decision step was substantial and seems to be appropriate for novice learners. Additionally, help-seeking had a significant positive effect on performance. Extensive context-sensitive help-seeking was associated with a high proportion of correct decisions. Thus, context-sensitive help supports successful decision-making processes in plant identification.

In line with prior research, the glossary was rarely used or even ignored and not related to performance. The patterns of use of context-sensitive help and glossary function were completely different. This may be due to the fact that context-sensitive help materials are tailored to the specific demands at a decision step whereas the glossary contains more general information, which may not be seen as particularly useful in actual task performance. With respect to the design of help functions, the different patterns of use call for tailoring help to task
requirements. If learners experience the usefulness of help in task completion immediately, they may be more likely to use it.

However, while adapting help to learners’ needs might possibly help to cure avoidance, there is also a risk of misuse. If help is perfectly suited to task requirements learners may be successful in performance, but may be hindered in deep processing and learning. Conflicting effects of help on performance and learning are documented in the literature (see Aleven et al., 2003). Context-sensitive help functions are especially susceptible to so-called “gaming the system”-behavior directed at better performance with the ILE by systematically taking advantage of the properties and regularities of help functions in order to complete the task instead of thoroughly processing the material (Baker, Corbett, Koedinger, & Wagner, 2004). Yet, in our specific setting conflicting effects on learning and performance were difficult to assess because there is no clear-cut distinction between learning and performance in plant identification: since improving performance in identification with a key actually is the main learning objective. This study focussed on performance measures and did not assess learning. One possible way to separate the effects on learning from performance in follow-up studies might be by examining the impact of help-seeking on future performance with a key offering reduced or no help functions. By this, transfer effects of help-seeking could be analyzed.

A major problem is the avoidance of more abstract help, which is assumed to foster learning if used appropriately. From an instructional design perspective, a possible approach of increasing the use of abstract help would require better coordination of information given on a context-specific and on an abstract level. Reducing information on the context-sensitive level while extending abstract information could result in a higher interdependency of help functions on both levels and in turn in a satisfactory trade-off between learning and performance. Future research should more systematically examine which factors influence the effect of help on
performance and learning. From such research, design guidelines for help functions could be derived in order to tailor help to performance or learning respectively.

**Learner-Related Factors and Help-Seeking**

A major issue of our study was to acquire first insights into the effects of several learner-related factors on help-seeking and performance discussed in the literature. A differentiated pattern of results was found.

*Prior Knowledge.* The prominent role of prior knowledge in help-seeking and performance could be confirmed by the results. However, the direction of the prior knowledge effect found is surprising and contradicts the well-known phenomenon that learners low in knowledge are least effective in help use (e.g., Wood & Wood, 1999). This study found that dyads consisting of two students with rather low prior knowledge used context-sensitive help more often and also performed better than dyads with higher prior knowledge. Moreover, partial correlation analysis showed that the negative relation between prior knowledge and performance was mediated by the extensive help use in the low knowledge dyads. This indicates that low knowledge learners not only used help more often, but used it more effectively than learners with high knowledge.

This surprising finding may be explained in terms of the specific characteristics of the key in PIO and of the task “plant identification”. The successful use of keys for identification depends on learners’ knowledge of the concepts involved, especially the knowledge of acceptable variability within concepts. Due to the large number of required concepts and the difficult distinction between instantiations of different concepts, novice learners are unable to successfully use keys without additional help. In contrast to other ILEs examined, the discrepancy between the high task requirements and low prior knowledge may make novice learners aware of their need for help immediately. Therefore, the superiority of high knowledge
learners, which is often explained in terms of a better ability to assess the need for help, may not have occurred in our study. In fact higher prior knowledge may have hindered successful identification. Having some – fragmentary – knowledge of the terms used in the key may have prevented learners with higher prior knowledge from using help (illusion of knowing, e.g., Kintsch, 1998). Obviously using help is indispensable at this stage of knowledge acquisition and learners with the least knowledge profited because they used help most often.

These findings call for a broadening of the theoretical conceptualization of the role of prior knowledge in help-seeking. There is no effect of prior knowledge per se. Rather the effects of prior knowledge seem to depend on the characteristics of the specific task and of the ILE used and on the level and range of knowledge within the study sample.

**Motivational Orientations.** Though motivational orientations play a major role in the debate on effective help use our data did not confirm this supposed impact. Our results yielded no effect of students’ orientation towards work avoidance and task orientation on help-seeking and performance. At least with respect to the factor task orientation the results can be explained in terms of a ceiling effect. All participants had considerably high values in task orientation, which may be due to the social desirability of high task orientation. Another explanation that holds for both motivational orientation scales is that they may be too global to account for differences in domain-specific motivational orientations. In addition it should be noted that our current data are restricted to quantitative log-files. Nothing is known about concrete interactions in dyads that may have produced these results. Thus, future research on motivational orientations in help-seeking and performance should include process data like think-alouds, so as to get a finer-grained insight into the effect of task orientation on performance.

**Interest and Self-Estimated Competence.** Interest in the domain had no effect on help-seeking. A possible explanation for this result may be due to the real course setting and the
relevance of the subject matter for the exams. These course conditions may have reduced the influence of interest compared to more artificial study settings in which intrinsic motivation and interest in the domain might play a more prominent role.

In contrast, students’ self-estimated competence affected both, help-seeking and performance. Mixed dyads consisting of students differing in self-estimated competence accessed context-sensitive help most often and made the least follow-up errors.

This inverse u-shaped relation between self-estimated competence and help-seeking and performance may be explained by the mechanism proposed by Salomon (1984). On the one hand a higher self-estimated competence is expected to result in a higher investment of mental effort in task completion, which may explain the increased help access of mixed dyads compared to dyads with low self-estimated competence. On the other hand high self-estimated competence can be detrimental to performance if the task is erroneously perceived as easy. Dyads high in self-estimated competence may have been overconfident in their identification process, which in turn may have led to insufficient error management and more follow-up errors. In mixed dyads this effect may be cancelled out because the dyad member with low self-estimated competence feels less confident in her decision-making and is thus more aware of difficulties and errors. Following this line of thinking the perceived difficulty of the task might be an important moderator in the interplay between self-estimated competence and help-seeking and performance. A didactic implication – though speculative – may be grouping students with mixed self-estimated competence together in courses.

Finally, it should be noted that there was no relation between self-estimated competence and prior knowledge in this study. Discrepancies between subjective self-estimations and objective knowledge data are a common phenomenon (e.g., Raju, Lonial, & Mangold, 1995). Yet, the lack of a relationship between prior knowledge and self-estimated competence suggests
that both factors have a distinct impact on help-seeking and performance. Whereas the knowledge questionnaire employed focuses on declarative knowledge of basic concepts in plant identification, the self-estimations are measured on a more procedural level concerning plant identification as a skill as well as its learnability. With respect to these different focuses the missing relationship between the two factors seems to be comprehensible.

**Epistemological Beliefs.** Results confirm that epistemological beliefs play a prominent role in help-seeking and task performance. The effects showed a reasonable pattern indicating that more sophisticated beliefs in knowledge being unstructured and constructed rather than structured and pre-existing resulted in a higher amount of help-seeking and better performance. The believed texture of knowledge had a major impact on the access of context-sensitive help. Believing that botanical knowledge is unstructured and uncertain (low values on “texture of knowledge”) led to increased context-sensitive help-seeking. This effect may be explained in terms of a better meta-cognitive monitoring throughout the identification process by dyads believing in higher complexity of domain knowledge. Those students who believe that they are performing a task in an unstructured domain may have a better awareness of potential difficulties and may consequently experience the need for help more often than students who believe that botany is a simple, well-structured domain. A similar explanation applies to the effect that students believing in botanic knowledge being constructed and negotiated rather than pre-existing and simply discovered (“genesis of knowledge”) perform better. Sophisticated beliefs in knowledge being negotiated may be associated with a more reflective application of this knowledge. Again the supposed mechanism by which epistemological beliefs in a specific kind of knowledge generation might influence performance is increased meta-cognitive monitoring activity. Persons with sophisticated beliefs may monitor their identification more closely, become aware of contradictory information on the wrong path earlier than less reflective learners.
and thus spend only little time on the wrong path until the initial error is corrected. It should be noted that beliefs about the genesis of knowledge did not influence the proportion of correct decisions, but it did affect follow-up errors. These are indicators of error management, which can be considered as a component of meta-cognitive monitoring. The analysis of the specific interplay between epistemological beliefs and meta-cognitive processes is a promising field for future research.

Concluding Remarks

Given the growing use of computers in education and the fact that virtually all computer systems in educational practice offer help functions, the bottom line that help per se is not effective dramatically stresses the need for extensive research on help-seeking in ILEs. This paper presents an example of effective help-seeking in an ILE and proposes some promising variables for further research. In more advanced stages of research, finer-grained analyses employing complementary data sources such as log-files, verbal protocols and observational data as well as larger sample sizes and complete experimental designs are required to shed light on the interplay of the different learner-related factors in help-seeking. Especially the quantitative process data should be augmented with qualitative analyses. In addition, it should be stressed that our research has didactical implications for grouping learners in cooperative settings based on their learner-related factors. A promising field for further research would be the analysis of learner-related factors in individual help-seeking processes in ILEs.
Acknowledgements

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References


Table 1.

*Effects on help-seeking and performance*

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Context-sens. Help</th>
<th>Glossary</th>
<th>Correctness</th>
<th>Follow-up Error</th>
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<td>Prior Knowledge</td>
<td>low &gt; high**</td>
<td>n.s.</td>
<td>low &gt; high**</td>
<td>low &lt; high*</td>
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<td>Work Avoidance</td>
<td>MANOVA n.s.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Task Orientation</td>
<td>MANOVA n.s.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest</td>
<td>MANOVA n.s.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-estim. Competence</td>
<td>mixed &gt; low*</td>
<td>n.s.</td>
<td>n.s.</td>
<td>mixed &lt; high*</td>
</tr>
<tr>
<td>Texture of Knowl.</td>
<td>low &gt; high</td>
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<td>n.s.</td>
<td>n.s.</td>
</tr>
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<td>Variability of Knowl.</td>
<td>MANOVA n.s.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Genesis of Knowl.</td>
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<td>n.s.</td>
<td>high &gt; low*</td>
<td>high &lt; low**</td>
</tr>
</tbody>
</table>

*p ≤ .10;  † p ≤ .05;  ‡ p ≤ .01

1 The direction of effects is indicated by “<” and “>”. Significance levels refer to group differences in post-hoc Tukey tests. “Low” refers to dyads with both students having low values on the independent variable, “mixed” refers to dyads with one person having a high and the other person having a low value, “high” refers to dyads with both persons having a high value on that variable.

2 High values on this variable indicate that students believe botanical knowledge to be constructed rather than pre-existing.
Table 2.

*Correlations between the learner-related factors (dyad level)*

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<td>-.09</td>
<td>-</td>
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<tr>
<td>Interest</td>
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<td>.31</td>
<td>-.13</td>
<td>-</td>
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<tr>
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<td>-.43**</td>
<td>.30</td>
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</tbody>
</table>

* p ≤ .05; ** p ≤ .01

¹ High values on this variable indicate that students believe botanical knowledge to be constructed rather than pre-existing.
Figure Captions

Figure 1. Screenshot of a decision step in P1O and the two help functions (context-sensitive help and glossary)
Figure 1