

Help-seeking in Interactive Learning Environments: Effectiveness of Help and Learner-related Factors in a Dyadic Setting

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Abstract: Offering help functions is a standard feature of computer-based interactive learning environments (ILE). 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. In this paper the issues of effectiveness of help and the impact of learner-related factors are addressed in an ILE for plant identification. We report first explorative data from a regular university course in plant identification. Students 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 in dyads, 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. The results are discussed with respect to their implications for future research on help-seeking in ILE.

Introduction

Help-seeking and Interactive Learning Environments

Help-seeking constitutes an essential component of self-regulated learning which is particularly important in computer-based interactive learning environments (ILE). The use of ILE has become widespread in all fields of educational practice (e.g., Dillon & Gabbard, 1998). One of the greatest assets of ILE 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, recent 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 (2000) reported that learners only spent very little time on actual help use. They especially ignored hints on how to solve mathematical problems and instead looked directly for answers. More abstract information such as definitions given in a glossary was also 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 there is very little empirical evidence on the interaction between help functions in ILE and learning processes (Aleven, Stahl, Schworm, Fischer, & Wallace, 2003). The lack of empirical findings calls for further research on the effectiveness of help-seeking in ILE. Yet to date most research on help-seeking is restricted to classroom learning settings (see Aleven et al., 2003). As there are considerable differences in the help-seeking process in traditional classroom settings and in ILE, concerning for example the amount and type of help available or the social presence of the source of help, a simple extrapolation of these findings would be inappropriate (Aleven et al., 2003). Thus, there is a need to establish research on help-seeking in ILE as a field in its own right. A major challenge for researchers should be in the identification of variables that have an influence on the effectiveness of help and encourage learners to actually use help. Extensive analyses of learner-related factors, system-related factors and their interplay are required to improve help-seeking in ILE. In this paper we report on an initial explorative 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.

The Learning Environment “Plant Identification Online”

We analyzed help-seeking behavior in the ILE “Plant Identification Online” (PIO; Stahl & Bromme, 2002; see <http://www.bestimmen-online.uni-muenster.de/>). 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 within these courses. 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 learning by rote is not possible. Therefore, plant identification is usually learned in a case-based manner employing so-called keys for identification. 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 constitute the basic element of a key and consist of a contrastive description of two sets of plant features. At each step learners have to decide whether one or the other set of features applies to the plant at hand. Having made their decision, they are guided to the next decision step until they arrive at the final taxon. Case-based learning with such keys has a long tradition in plant identification and is widely accepted as the best method for enabling students to identify a broad variety of plants on their own, even plants from taxonomic groups they are not familiar with. The design of PIO starts from this common practice. Therefore, it also incorporates a key, but differs from traditional book keys by making available various help functions, including about 80 000 instructional illustrations and different types of text-based help. From a theoretical perspective these help functions can be conceptualized as scaffolds since they allow students to deal with the complex problem of plant identification by giving hints and additional information (for an overview see Reiser, 2002). In this study, two types of help are examined: firstly, context-sensitive help materials that are tailored to the specific decision task at hand are offered at each decision step. In these help materials the relevant botanical concepts are explained by means of a combination of texts and high-quality line drawings, including tips for handling difficulties. Secondly, all basic botanical terms are explained in a glossary that is permanently available throughout the decision process. These glossary definitions provide more general explanations that are not context-sensitive. We assume that the appropriate use of these help functions has a strong effect on performance with PIO.

An important characteristic of courses in plant identification is that students traditionally learn how to identify plants in dyads. Learning in dyads is an organizational condition of the courses that is considered to be crucial for learning and performance in plant identification. We expect that help-seeking behavior and performance will be influenced by individuals’ learner-related factors within these dyads. Therefore, the effects of several learner-related factors described below are examined. Though the use of dyads as a necessary level of analysis hinders the examination of individual effects, it offers the opportunity to explore the interaction between students differing in their values on learner-related factors.

Research Issues

Effectiveness of Help

As explained above, there is little evidence on the effects of help-seeking behavior in ILEs. Therefore, we first of all wanted to know if our students would actually use the context-sensitive help and the glossary within the ILE, and whether the use of this kind of help would result in better performance.

Potential Factors Affecting Help-seeking

Moreover, we wanted to explore how different learner-related factors affect the use of PIO. Based on a comprehensive review of research (Aleven et al., 2003) we included the following variables 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 (1999) that learners 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, 1998; task orientation, Nicholls, 1984) is beneficial in learning. Arbreton (1998) could also prove an effect on help-seeking strategies. In his study learning or task orientated students asked for instrumental help such as 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, 1984), which should be associated with reduced help-seeking behavior. In our study we examined the effects of task orientation and work avoidance on the use of instrumental help given in the form of context-sensitive help materials and the use of the glossary. As far as we know, this is the first analysis of the effect of motivational orientation on help-seeking in an ILE (see Aleven et al., 2003).

Interest and Self-estimated Competence

As a further motivational variable, interest in a domain or topic has been shown to have an effect on learning and comprehension (e.g., Boscolo & Mason, 2003; Schiefele, 1996). We assume that interest is also likely to affect students' help-seeking in ILE. As Schiefele (1996) demonstrated, high interest is associated with deeper level understanding. It is expected that highly interested learners access more help in an ILE than learners with low interest, in order to gain a deeper understanding. In contrast to general motivational orientations, interest is measured on a domain-specific level. In addition, there is evidence that self-estimated competence affects learning processes (Schwarzer & Jerusalem, 1999). Therefore, we examined the effects of self-estimated competence on help-seeking.

Epistemological Beliefs

Epistemological beliefs can be defined as beliefs about the nature of knowledge and knowing. It is widely agreed that epistemological beliefs should be described as a multidimensional construct (e.g., Schommer, 1990). Nevertheless, the assumed number and type of these dimensions is still controversial. All researchers include beliefs about complexity and certainty of knowledge, but differ with regard to further dimensions. 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, 1990, 1993). Yet only a few works exist on the influence of epistemological beliefs on learning in ILE. Jacobson and Spiro (1995) for example found that learners with more sophisticated epistemological beliefs yielded better learning outcomes and were better able to apply their knowledge after using a hypertext system than students with simpler epistemological beliefs. We suppose that epistemological beliefs also play a significant role in help-seeking. It seems reasonable to assume that if one believes 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. As most instruments proposed for the measurement of epistemological beliefs fail to replicate their factor structure (e.g., Clarebout, Elen, Luyten, & Bamps, 2001) the new instrument CAEB was employed in this study. We suppose that the instability of previous questionnaires is at least in part due to confounding denotative and connotative aspects of beliefs (Stahl & Bromme, submitted). CAEB avoids this problem by explicitly focusing the connotative aspects of epistemological beliefs in a semantic differential. In this study we used the factors "texture of knowledge" and "variability of knowledge" from the CAEB.

Method

Participants

Thirty-two students of biology – 11 males, 20 females (one participant did not report her gender) – took part in this study. The age of participants ranged from 19 to 27 years with an average of 20.9. Students were enrolled in a regular plant identification course (2nd semester) at a German university. Students worked in 16 dyads.

Materials

Participants identified plants from the families *Cyperaceae*, *Juncaceae*, and *Poaceae* with the ILE "Plant Identification Online". Botanical prior knowledge was assessed via a questionnaire including multiple choice-items, feature listing items as well as graphical marking items. Motivational orientation was measured via the scales "task orientation" and "work avoidance" from the German version of the motivational orientation scales (MOS-D, Balke & Stiensmeier-Pelster, 1995; Nicholls, 1984). Interests and self-estimated competence in

the domain of plant identification were surveyed in the 17 item-IAPI-questionnaire (Interests and Attitudes in Plant Identification) consisting of two scales (“domain interest”; “self-estimated competence”). Epistemological beliefs were assessed on a domain-specific level using the semantic differential CAEB. The two dimensions “texture of knowledge” (e.g., structured-unstructured) and “variability of knowledge” (e.g., dynamic-static) consist of 11 adjective pairs. Indicators of help-seeking (context-sensitive help access, glossary access) as well as the proportion of wrong decisions (errors) as a measure of task performance were assessed via log-files. Students’ acceptance of PIO and its different features was surveyed in an additional questionnaire.

Procedure

The study took place in a regular course in plant identification. Students worked with PIO in dyads over a period of four course sessions. In each session they spent 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 two weeks before the first session. Acceptance data were collected after the last session.

Data analyses and Results

We defined $\alpha \geq .05$ as significant and $\alpha \geq .1$ as a tendency. It should be kept in mind that this is a first exploration of the effects of help-seeking and potential learner-related factors. For this purpose we report several ANOVAs without α -adjustments instead of MANOVAs, which will be considered in more advanced stages of research. As some students did not complete all questionnaire items we replaced missing values by the respective sample mean. This was to avoid a further reduction of sample size in the analyses.

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 students of the computer-based course as well as participants of traditional courses ($n = 21$). The two factors from the MOS-D (Balke & Stiensmeier-Pelster, 1995), “task orientation” (6 items, Cronbach’s $\alpha = .61$) and “work avoidance” (5 items, Cronbach’s $\alpha = .80$), were confirmed with moderate to high internal consistencies. The factors accounted for 45.48% 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 51.43% of the variance and yielded high inter-item consistencies (Cronbach’s $\alpha = .89$ and $.83$). The factor analysis of CAEB yielded the assumed two factors with a total of 49.23% of the variance explained and moderate to high internal consistencies (texture of knowledge: 7 items, Cronbach’s $\alpha = .80$; variability of knowledge: 4 items, Cronbach’s $\alpha = .66$). For the factors of MOS-D, IAPI, and CAEB factor sum scores were calculated.

As we wanted to explore help-seeking in a real course setting we decided to use the unobtrusive method of log-file analysis instead of more qualitative data analyses which would have required a laboratory setting. The individual questionnaire data were adapted to the level of dyads for the subsequent data analyses. Therefore, for each of the variables, students were divided into two groups via median split: one group having low values on that variable and another group with high values. 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 impact 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

Acceptance

We begin by presenting students’ acceptance data concerning PIO. Acceptance of PIO as a new learning medium is assumed to be a pre-requisite for proficient help use. As these data are solely descriptive and not analyzed with respect to dyads’ help-seeking, they are reported on an individual level ($n = 23$). Students agreed that PIO was helpful in learning plant identification ($M = 4.52$; $SD = 0.51$; five-point-scale) as well as supportive in task performance ($M = 4.43$; $SD = 0.59$; five-point-scale). Moreover, PIO as a whole, as well as its components were evaluated on a 16-point German school grade scale (0 = “very poor” to 15 = “very good”) and

yielded “good” ratings (PIO overall: $M = 0.83$; $SD = 0.08$; context-sensitive help: $M = 1.10$; $SD = 0.14$; glossary: $M = 0.21$; $SD = 0.15$). Thus, the overall acceptance of PIO as a new learning medium in plant identification was high.

Help-seeking

As the following analyses deal directly with help-seeking, we refer to dyads ($n = 6$) from now on. Throughout the two logged courses students processed an average of 287.56 decision steps ($SD = 33.51$). On an average of 30.65% ($SD = 2.23$) of these decision steps context-sensitive help was accessed. The average percentage of glossary use per decision step was much lower ($M = 0.76\%$, $SD = 0.36$). As context-sensitive help directly refers to a specific decision step the relative frequencies of accessed context-sensitive help materials per decision step were used as an indicator of help-seeking. In contrast, glossary items could be accessed independently of specific decision steps. Therefore, the total number of glossary accesses was used as a variable.

Performance

In addition, the relative proportion of wrong decisions (errors) was defined as an indicator of performance in the plant identification process. The mean rate of errors was at 7.66% ($SD = 0.82$).

Help-seeking and Performance

The indicators of help-seeking (context-sensitive help access, glossary access) and task performance (error rate) were subjected to a correlation analysis. The correlations between help access and performance indicators yielded a substantial significant negative correlation with errors ($r = -0.55$, $p = 0.03$). Students accessing help materials at a high rate committed fewer errors. Thus, the use of context-sensitive help was effective in improving task performance. Glossary access was not significantly related to the error rate ($r = -0.04$, n.s.). These correlation data as well as the frequencies of access suggest completely different uses of glossary function and context-sensitive help.

Potential Impact Factors on Help-seeking and Performance

We examined the effects of dyads differing in their learner-related factors on the relative number of errors (as a measure for performance) and the relative number of context-sensitive help functions accessed (as a measure of help-seeking). The use of the glossary was only calculated in those cases in which the dyad types differed in their use to a reasonable extent.

Prior Knowledge

We compared 5 dyads with low prior knowledge, 5 dyads with high prior knowledge and 6 mixed dyads. An ANOVA revealed significant differences between the three groups concerning their help-seeking ($F(2,16) = 3.3$, $p = 0.02$) and their relative number of errors ($F(2,16) = 4.9$, $p = 0.03$). The mixed dyads made significantly fewer errors than those dyads with low prior knowledge (Tukey-HSD, mean diff. -0.03 , $p = 0.03$) and showed a tendency to make fewer errors than those dyads with high prior knowledge (Tukey-HSD, mean diff. -0.02 , $p = 0.07$). The mixed dyads also searched more often for help. This was significant compared to those dyads with high prior knowledge (Tukey-HSD, mean diff. -0.06 , $p = 0.02$). It can be concluded that the mixed dyads searched most frequently for help and made the least number of errors.

Motivational Orientation (Work Avoidance and Task Orientation)

We compared 6 dyads with low work avoidance, 4 dyads with high work avoidance and 6 mixed dyads. ANOVAs revealed no significant differences for help-seeking ($F(2,16) = 0.7$, n.s.) or number of errors ($F(2,16) = 0.9$, n.s.). We compared 3 dyads with low task orientation, 3 dyads with high task orientation and 10 mixed dyads. ANOVAs revealed no significant differences for help-seeking ($F(2,16) = 0.5$, n.s.), but a trend for number of errors ($F(2,16) = 3.2$, $p = 0.07$). Dyads with high task orientation made more errors than dyads with low task orientation (Tukey-HSD, mean diff. -0.03 , $p = 0.06$). Therefore, we found the counter-intuitive result that dyads with high task orientation showed low performance.

Interest and Self-estimated Competence

We compared 4 dyads with low interest, 4 dyads with high interest and 8 mixed dyads. ANOVAs revealed no significant differences for help-seeking ($F(2,16) = 0.3$, n.s.) or number of errors ($F(2,16) = 0.2$, n.s.). We compared 5 dyads with low self-estimated competence, 5 dyads with high self-estimated competence and 6 mixed dyads. For these groups we found differences in glossary use and included this factor in our analysis. ANOVAs revealed no significant differences for help-seeking ($F(2,16) = 0.3$, n.s.) or number of errors

($F(2,16)=0.9$, n.s.), but a tendency for use of the glossary ($F(2,16)=0.2$, $p=0.5$). Those dyads with high self-estimated competence used the glossary the most and showed a tendency to use the glossary more often than dyads with low self-estimated competence (Tukey-HSD, mean diff. $=0.8$, $p=0.4$). It can be concluded that the use of the glossary was affected by self-estimated competence.

Epistemological Beliefs

We compared 5 dyads who believed botanical knowledge to be certain and structured, 5 dyads believing that botanical knowledge is more uncertain and unstructured and 6 mixed dyads (factor “texture of knowledge”). ANOVAs revealed no significant differences for help-seeking ($F(2,16)=0.4$, n.s.), but a tendency for number of errors ($F(2,16)=0.4$, $p=0.3$). Dyads with beliefs that knowledge in plant identification is certain and structured made more errors than those that believed it to be more uncertain and unstructured (Tukey-HSD, mean diff. $=0.02$, $p=0.3$). We compared 6 dyads who believed botanical knowledge to be dynamic and flexible, 6 dyads believing that botanical knowledge is more static and inflexible and 4 mixed dyads (factor “variability of knowledge”). For this comparison we found differences in glossary use and included this factor in our analysis. ANOVAs revealed no significant differences for help-seeking ($F(2,16)=0.5$, n.s.) or number of errors ($F(2,16)=0.3$, n.s.), but a tendency for use of the glossary ($F(2,16)=0.6$, $p=0.6$). Dyads believing that knowledge in plant identification is dynamic and flexible used the glossary more often than mixed dyads (Tukey-HSD, mean diff. $=0.7$, $p=0.1$) or dyads with belief in static and inflexible knowledge (Tukey-HSD, mean diff. $=0.5$, $p=0.09$). It can be concluded that use of the glossary and the number of errors were affected by epistemological beliefs about the texture and variability of knowledge.

Discussion

This research gives exploratory insights into the issues of effectiveness of help-seeking and potential impact factors. In the following, the results of our study on these two issues will be discussed. Due to the small sample size, the discussion of results necessarily remains somewhat speculative. Nevertheless, there are promising implications for theoretical debate and future research on help-seeking.

Effectiveness of Help

First of all, it is important to stress that PIO in general as well as the two help functions were accepted by the participants. This is a major pre-requisite to introducing a new learning medium into a traditional domain like plant identification. In addition, 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 appropriate for novice learners. Additionally, help-seeking had a significant effect on performance. Extensive help-seeking was associated with a low error rate. Thus, context-sensitive help supports successful decision-making processes. In contrast, the glossary function was rarely used or even ignored and was 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 fitting 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 hindered in deep processing and learning. On the other hand, glossary functions, which supply more general information, may be expected to foster deeper understanding if they are used appropriately. Conflicting effects of help on performance and learning are documented in the literature (see Aleven et al., 2003). A major problem is the avoidance of more abstract help that is assumed to foster learning. Future research on help-seeking should examine more systematically 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.

Impact Factors and Help-seeking

A major issue of our study was to acquire first insights into the effects of several learner-related factors that are discussed in the literature on help-seeking and performance. Despite the small sample size we found effects for most of the analyzed factors.

Prior Knowledge

The prominent role of prior knowledge in help-seeking and performance could be confirmed by the results. However, there is no simple increase in help-seeking and performance as prior knowledge increases. The mixed dyads consisting of one student with high and one with low prior knowledge performed better and did more help-seeking than the low-knowledge and the high-knowledge dyads. This effect may seem surprising at first and is not consistent with prior research. Yet there is a possible explanation for it: low-knowledge dyads may not become aware of difficulties in the plant identification process due to their low knowledge. For this reason they may not be able to accurately judge their need for help, which would result in reduced help-seeking and a high error rate. In contrast, high-knowledge dyads may be overconfident with respect to their decisions in the identification process. Thus, they might underestimate their need for help and produce a higher error rate. These negative effects may in turn be cancelled out in mixed dyads. The overconfidence of the student with high knowledge may be reduced when explaining his decision to a student with lower knowledge in a mixed dyad. In this case, both students would benefit from the mixed-dyad composition. From a didactic perspective it can be concluded from this result that learners should be grouped in mixed-knowledge dyads in order to gain best help-seeking and performance effects.

Motivational Orientations

The results yielded no effect of students' orientation towards work avoidance on help-seeking and performance. Nevertheless, this may be due to the small sample sizes. With respect to task orientation results indicate that dyads with a high orientation towards learning and gaining competence performed worse than dyads low in task orientation. This result contradicts the expectations derived from the literature and is hard to interpret. As the current data are restricted to quantitative log-files nothing is known about interactions in dyads that may have produced this result. 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 and performance. This result is noteworthy as the lecturers holding traditional courses report that there is a large group of students with low interest in the domain who are reluctant to participate actively in courses. Obviously reduced interest did not lead to less help-seeking or worse performance. Thus, the implementation of PIO in regular courses is potentially capable of compensating for differences in interest. In addition, self-estimated competence affected the use of the glossary function. Dyads whose members judged their competence in plant identification to be high accessed the glossary more often. Maybe self-estimated competence is a promising factor in the use of abstract help functions in general. It should therefore be more systematically analyzed with respect to the use of glossaries and related help functions. It is especially interesting that *objective* knowledge had no effect on glossary use. Therefore, the common phenomenon of differences between subjective self-estimations and objective data was also observed in our study.

Epistemological Beliefs

The results confirm that epistemological beliefs play a significant role in help-seeking and task performance. The effects showed a reasonable pattern indicating that more sophisticated beliefs in knowledge being unstructured and flexible resulted in a higher amount of help-seeking and better performance. Believing that botanical knowledge is unstructured and uncertain (low values on "texture of knowledge") led to a lower rate of errors. This effect may be explained in terms of 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 make fewer errors. A similar explanation applies to the effect that students believing in high flexibility of knowledge (high values on "variability of knowledge") use the glossary more frequently. If students believe that the task domain is not stable and liable to change over time they may be encouraged to consult the glossary for additional information. Moreover, it is remarkable that epistemological beliefs are associated with glossary use, but not with context-sensitive help access. Maybe the use of more abstract help functions in general is highly dependent on specific person variables such as sophisticated epistemological beliefs or self-estimated competence.

Conclusion

Given the growing use of computers in education there is a need for extensive research on help-seeking in ILE. This paper presents an example of effective help-seeking in ILE and proposes some promising variables for further research. In more advanced stages of research finer-grained analyses employing complementing data sources such as log-files, verbal protocols and observational data as well as larger sample sizes 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. Currently we are collecting data from five university courses in plant identification to validate our explorative findings with a larger sample size.

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