Online help-seeking in communities of practice: Modeling the acceptance of conceptual artifacts

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Abstract

Interactive online help systems are considered to be a fruitful supplement to traditional IT helpdesks, which are often overloaded. They often comprise user-generated FAQ collections playing the role of technology-based conceptual artifacts. Two main questions arise: how the conceptual artifacts should be used, and which factors influence their acceptance in a community of practice (CoP). Firstly, this paper offers a theoretical frame and a usage scenario for technology-based conceptual artifacts against the theoretical background of the academic help-seeking and CoP approach. Each of the two approaches is extensively covered by psychological and educational research literature, however their combination is not yet sufficiently investigated. Secondly, the paper proposes a research model explaining the acceptance of conceptual artifacts. The model includes users' expectations towards the artifact, perceived social influence and users' roles in the CoP as predictors of artifact use intention and actual usage. A correlational study conducted in an academic software users' CoP and involving structural equations modeling validates the model, suggesting thus a research line that is worth further pursuing. For educational practice, the study suggests three ways of supporting knowledge sharing in CoPs, i.e. use of technology-based conceptual artifacts, roles and division of labor, and purposeful communication in CoPs.

Highlights

• FAQ collections play the role of technology-based conceptual artifacts. • Artifact use and acceptance in communities of practice is insufficiently studied. • This study combines the community of practice and the help-seeking approach. • A conceptual model of artifact use and acceptance is empirically tested. • The findings suggest ways of fostering communities of practice at workplace.

Keywords

adult learning; architectures for educational technology system; cooperative/collaborative learning; learning communities; lifelong learning

1 Introduction

Observing the landscape of informal workplace learning in academic environments, a particular problem stands out. Since information technology (IT) has become ubiquitous, it is a common fact that users encounter problems in handling this technology at workplace. Consequently, they need specific knowledge and skills, and appropriate help in specific situations of technology use. As a response to the need for help, IT helpdesk services aim at sharing their knowledge with IT users, thus enabling them to manage their problems on their own. However, as helpdesk services are increasingly in demand, they often face overload (Leung & Lau, 2007), so that users may be dissatisfied (van Velsen, Steehouder & de Jong, 2007) and turn to informal support such as colleagues (Govindarajulu, 2002; Groth, 2004), which may be regarded as knowledge sharing within a community of practice (CoP; Lave & Wenger, 1991; Wenger, 1999).

A possible way to support knowledge sharing in CoPs is to design online help systems that integrate the knowledge of CoP members, playing thus the role of technology-based conceptual artifacts (Bereiter, 2002). This solution raises two main questions: how these artifacts should be used, and which factors influence their acceptance. Firstly, in the frame of the help-seeking approach (Mäkitalo-Siegel & Fischer, 2011; Mercier & Frederiksen, 2007; Puustinen & Rouet, 2009; Schworm & Heckner, 2010), roles and division of labor within a CoP (Engeström & Sannino, 2010; Wenger, 1999) as well as online help-seeking problems (Aleven, Stahl, Schworm, Fischer & Wallace, 2003) should be considered, which may result in effective usage scenarios of conceptual artifacts. Secondly, technology-based artifacts acceptance has been extensively investigated from the information systems perspective (Venkatesh, Morris, Davis & Davis, 2003), however mostly ignoring the social context of technology use, which may also have a noteworthy influence.

Against this background and corresponding to the two questions stated above, the first aim of this paper is to propose a theoretical frame and a scenario for the use of technology-based conceptual artifacts that integrate community members' knowledge. This involves the concepts of community of CoP, help-seeking, and acceptance of technology-based artifacts. The second aim of the paper is to propose and validate a conceptual model of the factors influencing artifact acceptance. The model includes online help-seeking problems, community members' expectancies toward the system, and the social environment, as predictors of artifact acceptance.

As a conclusion on theoretical level, the presented study combines two approaches, CoP and help-seeking, which have been investigated only separately in previous research. Since help-seeking is an important strategy of both formal and informal learning, bringing together findings on help-seeking and CoPs is an issue worth further examination. The combined approach may support a more specific design of online help systems, and contribute to refining the conceptual model of conceptual artifact acceptance. On practical level, the study suggests how help-seeking and knowledge sharing in online CoPs may be fostered by CoP members' use of technology-based cultural artifacts. For educational systems developers, this requires a system design that avoids specific online help-seeking problems. For educators, supporting workplace learning requires not only making conceptual artifacts available, but also adopting appropriate organization measures in the supported CoP, and sustaining purposeful communication.

After this introduction, the paper continues with a literature review outlining the two underlying theoretical approaches, CoP and help-seeking. The third chapter is dedicated to verifying the proposed models, therefore containing research questions and hypotheses, methodology and findings. Finally, we discuss the consequences of our findings for psychological research and educational practice, as well as the limitations of the study along with suggestions for future research.

2 Theoretical background

The following theoretical section focuses on CoP definition, conceptual artifacts, and help-seeking in general and in computer-based environments. It concludes by proposing a conceptual model of the acceptance of technology-based conceptual artifacts, and a usage scenario of online help-seeking environments.

2.1 Knowledge sharing and conceptual artifacts in communities of practice

Communities of practice (CoPs) are groups of people sharing goals, activities, and knowledge in the context of a given practice. Community members maintain contact over long periods of time and engage in common activities at various levels (Lave & Wenger, 1991; Wenger, 1999). Participation in CoPs can comprise face-to-face interaction, technology-mediated communication and interaction, or a combination of both (Johnson, 2001; Lee & Cole, 2003; Thompson & MacDonald, 2005), so that CoP participation does not necessarily require a common location for all CoP members. Depending on the individual degree of participation, CoP members can be described as "experts" (with intensive and central participation, advanced knowledge of the community practice), "intermediates", or "novices" (with peripheral participation, little knowledge; Handley, Sturdy, Fincham & Clark, 2006; Lave & Wenger, 1991). So called "visitors" may take part for a short time at the CoP periphery, then follow a learning trajectory that either leads to the CoP center, or leaves the CoP (Wenger, 1999). Due to the wide diversity of participation forms, the CoP borders often appear fuzzy, so that the observer can hardly discern between participation and non-participation, or estimate the precise number of CoP members. Several examples show that although CoPs can emerge within very large populations of hundreds and thousands of interested persons, such as in the case of the Linux developer community (Lee & Cole, 2003), or in the case of scientists participating in regular conferences (Kienle & Wessner, 2006), the group of members who actively sustain the community practice (experts and intermediates) is usually much smaller, e.g. few tens of persons (cf. Winston, Medlin & Romaniello, 2012).

Participation in CoPs is assumed to lead to the accumulation of experience, stimulation of the social construction of knowledge, and the development of expertise (Bereiter, 2002; Engeström & Sannino, 2010; Fuller, Unwin, Felstead, Jewson & Kakavelakis, 2007; Lave & Wenger, 1991; Paavola, Lipponen & Hakkarainen, 2004). The socio-cognitive activity in CoPs relies on knowledge sharing and cognitive apprenticeship between experts and novices (Collins, 2006; Collins, Brown & Newman, 1989), where each CoP member can be at the same time expert and novice in respect to different activities. Lave and Wenger (1991, p. 92) emphasize that learning – based on participation and knowledge sharing – is the most pervasive phenomenon in CoPs, while explicit teaching can hardly be observed. An implicit curriculum may however be defined by ongoing practice. Wenger (1999, p. 63) claims that the key to learning processes in CoPs is the duality and interplay of participation and knowledge reification, where reification describes the transformation of knowledge into cultural artifacts that mediate between the subjects and objects of the community practice (as observed by the activity theory, Engeström & Sannino, 2010), thus sustaining the practice with its "ways of doing things". Further, Bereiter (2002, p. 75) describes conceptual artifacts as abstract artifacts serving purposes such as explaining and predicting the surrounding world. He emphasizes that conceptual artifacts can be improved by re-shaping them in concordance with negotiation of meaning and the knowledge constructed in the process of participation. As interactions that lead to development of conceptual artifacts, Zenios (2011) identifies epistemic activities such as describing, explaining, predicting, arguing, evaluating, explicating and defining, which occur during online collaborative learning and reshape emergent conceptual artifacts. Such an activity mirrors a cultural practice that is common in the Internet, of developing collections of FAQ (frequently asked questions). FAQs are examples of conceptual artifacts that reify experiences and knowledge of a community with a certain practice (Yang & Lai, 2011). Nistor (2010) claims that providing appropriate conceptual artifacts – such as FAQ collections – may be a means to foster knowledge sharing in CoPs.

2.2 Online help-seeking

Knowledge sharing in CoPs can take various forms; one of these is initiated by help-seeking, a resource-based learning strategy requiring interaction with persons expected to be more knowledgeable, or, in some cases, with computer-based learning environments such as online help systems (Mäkitalo-Siegel & Fischer, 2011; Puustinen & Rouet, 2009). Based on collaborative learning in pairs, Mercier and Frederiksen (2007) propose a help-seeking model in five steps: (1) Recognition of an impasse indicates that a relevant task cannot be successfully completed, which leads to the awareness of need for help. (2) Diagnosis of the origin of the impasse leads to a specification of a need for help. (3) Consequently a help goal is set. (4) The learner looks for appropriate help. Help is appropriate if it enables the learner to complete the task. This implies that the learner is able to comprehend help content. (5) Evaluating the received help completes the process.

For the purpose of this paper, we discuss the case in which help-seeking comprises interaction with the help system of a computer-based environment. In such a context, help-seeking and help-giving can be placed on a continuum according to two dimensions: (1) static vs. dynamic, (2) written by experts vs. written by users (Schworm & Heckner, 2010). Static help systems contain instructional explanations written by experts that, once developed, are no longer subject to change. Dynamic help systems are gradually developed both by experts and users, thus supporting Bereiter's (2002) definition of conceptual artifacts. Since Web 2.0, members of online CoPs can easily generate e-content themselves and thus participate in the knowledge construction process. They can write and edit articles, evaluate e-content of others by rating and tagging, and publish their personal experiences in wikis. A typical social web feature of wikis is that they support communication between blog authors and readers by enabling readers to comment contents and changes (Sim & Hew, 2010; Yang & Lai, 2011). These technology features may build a frame for epistemic activities contributing to the development of conceptual artifacts (Zenios, 2011).

Previous research hardly considers that help-seeking behavior may be initiated by goals and activities, which are part of a wider practice, and that the actors are integrated in a larger social context, as conceptualized by Lave and Wenger (1991). Both the overarching practice and the social context may decisively influence help-seeking behavior. Studies on situational aspects of help-seeking behavior have so far concentrated on the context of school and teaching (Karabenick & Newman, 2006), and little research has been done regarding help-seeking activities in CoPs and within the context of workplace learning.

Help-seeking in computer-based environments may entail several problems, which are necessary to understand and prevent by corresponding design of technology-based conceptual artifacts (Heckner, Schworm & Wolff, 2010).

- *Lengthy instructions*. The system's answer to a help query often includes lengthy step-by-step instructions. Consequently, output elaboration requires time and effort, and especially novices are frustrated by the irritating richness of details of the given help. As a solution, the formulation of help contents should follow the principle of minimalism (Carroll, 1990), so that users do not subjectively perceive the instructions as "too long, too redundant, and too labour-intensive to process" (Renkl, 2002, p. 536), which would distract them from their original task. Renkl further recommends "as much self-explanation as possible, as much instructional explanation as necessary" in order to stimulate and foster users' self-explanations. For a second step of help seeking, an extended explanation should be nevertheless available on demand (Renkl, 2002; Tidwell, 2006).

- *Split-source format*. As for the format of help output, many computer applications present help in a separate window, or even in an external application (e.g. a browser). The users have to keep in mind the concrete constellation of their problem (e.g. the relevant variables of the current task) or, even worse, they have to switch between several windows to map the aspects of the task to the information of the help output. This "split-source" format produces extraneous cognitive load that interferes with learning (Sweller, Merrienboer & Paas, 1998). As a recommendable alternative, the software being supported may integrate helpful visualizations (Bodemer, Ploetzner, Feuerlein & Spada, 2004), which may also be generated by users, or include users' contributions (Niesz, 2010; Schwamborn, Thillmann, Opfermann & Leutner, 2011).
- *Plain text format*. Plain text is a frequent format of current help systems, in spite of the extensive research available on the helpfulness of graphical representations and the usefulness of multiple representations for learning (Mayer, 2005; Schnotz & Bannert, 2003) and the usefulness of multiple representations for learning (Ainsworth, 2006). Screenshots are currently used to help the users find the relevant buttons or menu options. However, there are often more than just one or two screenshots necessary to visualize the workflow in question. Users have to scroll and memorize all foregoing steps. This again produces an irrelevant cognitive load, which interferes with the help content processing.
- *Lost in hyperspace*. The well-known phenomenon of being "lost in hyperspace" (Conklin, 1987) can also occur within help systems. Help systems often lack a clear navigation structure and after following the links of specific help pages getting back to the starting point is sometimes challenging.
- *Help goal formulation*. Users may encounter difficulties in setting an adequate help goal. The preciseness of the help request formulation is influenced by help seeker expertise. Nückles and colleagues (2007) show that successful help-seeking completion is influenced by users' competence to adequately formulate help requests. This is why help systems should lower the burden on users by accepting different synonymous formulations of help requests.

2.3 Acceptance of technology-based artifacts in online help-seeking environments

From the online help-seeking problems described above, users' corresponding – and probably negative – expectancies related to performance vs. effort may emerge. These in turn may have an impact on CoP members' intention to use the help system, and on their actual use behavior. The use intention of a technology-based artifact and its use are currently addressed in the research literature as attitudinal and respectively behavioral technology acceptance. Venkatesh et al. (2003; also Venkatesh, Thong & Xu, 2012) explain technology acceptance under the influence of behavioral, normative and control beliefs, thus applying the theory of reasoned action (TRA) and its expanded version, the theory of planned behavior (TPB)(Ajzen & Fishbein, 2000). According to Venkatesh et al. and to their Unified Theory of Acceptance and Use of Technology (UTAUT), the use of technology-based artifacts is determined by use intention, which is further influenced by performance expectancy, effort expectancy, and social influence (fig. 1). Additionally, facilitating conditions have a direct effect on technology usage. The research done by Venkatesh and colleagues in the domain of Information System was extended by several other researchers in the domain of educational psychology (e.g. Pynoo, Tondeur, Braak, Duyck, Sijnave & Duyck, 2012). Chen, Chen and Kinshuk (2009) as well as Yang and Lai (2011) regard knowledge sharing in virtual CoPs as a particular case of technology use, and provide empirical evidence for the influence of the same acceptance predictors on knowledge sharing intention, and on corresponding behavior. However, the influences of members' roles in the CoP and division of labor are not taken into consideration. Further, Sykes, Venkatesh and Gossain (2009) propose a model of information system acceptance with peer support, and conclude that system use at workplace is better explained by community-related social network constructs than by individual variables. Further research is needed for a deeper understanding of the acceptance of technology-based artifacts in CoPs.

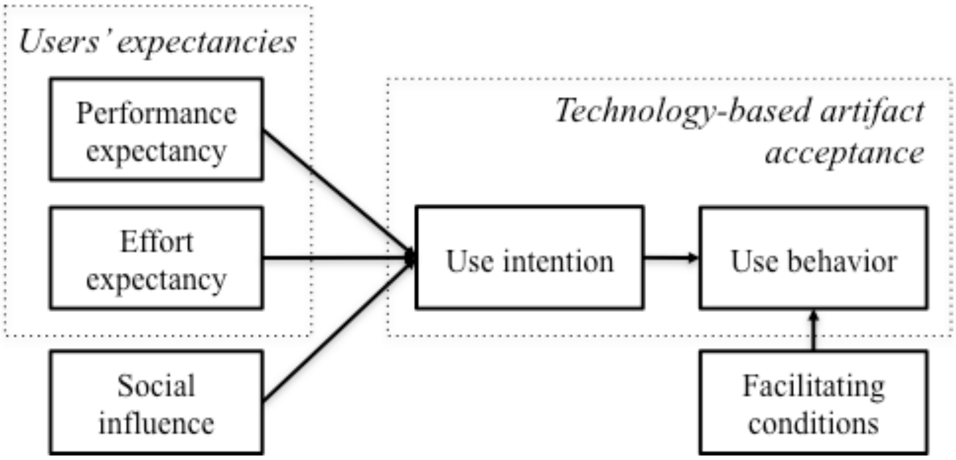

Fig. 1. Unified Theory of Acceptance and Use of Technology
(after Venkatesh et al., 2003, with authors' annotations)

Although TRA/TPB and UTAUT are essentially cognitive theories and contrast thus with the socio-constructivist orientation of situated cognition and CoP/help-seeking approach, the attitude concept stands out as a common point in all of them. Attitudes are most effective determinants of intentions in TRA/TPB and UTAUT, while they are constructed in individual's interactions with the social and material environment, as constructivist theories claim. Moreover, attitudes are closely linked with cultural values, interaction rules and identities in CoPs (Engeström & Sannino, 2010; Lave & Wenger, 1991). Also, performance and effort expectancies may determine learners' decision to seek help (Mercier & Frederiksen, 2007). For these reasons, UTAUT appears compatible with the CoP and help-seeking approach.

Applying now TRA/TPB and UTAUT in this context, the acceptance of technology-based artifacts is likely to be determined by CoP members' expectancies, which in turn may be influenced by occurring online help-seeking problems. CoP environment, e.g. CoP members' roles and expertise may have an impact on both their expectancies and their acceptance. These interdependencies outline a generic conceptual model shown in fig. 2. A more detailed conceptual model results by integrating detailed online help-seeking problems named above (Heckner et al., 2010) as well as the acceptance variables described by UTAUT (Venkatesh et al., 2003; 2012), and making a difference between receptive and active use of conceptual artifacts, i.e. reading explanations vs. actively contributing to their initial and further development. The detailed model is shown in fig. 3. Given the insufficient findings on the hypothesized relationships, this model requires empirical validation.

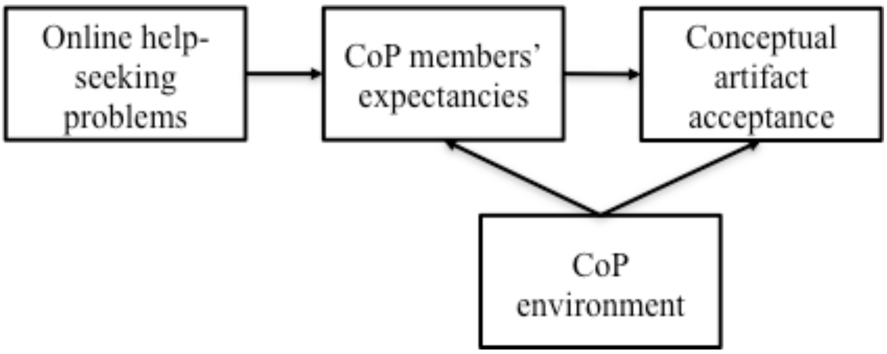

Fig. 2. Generic research model

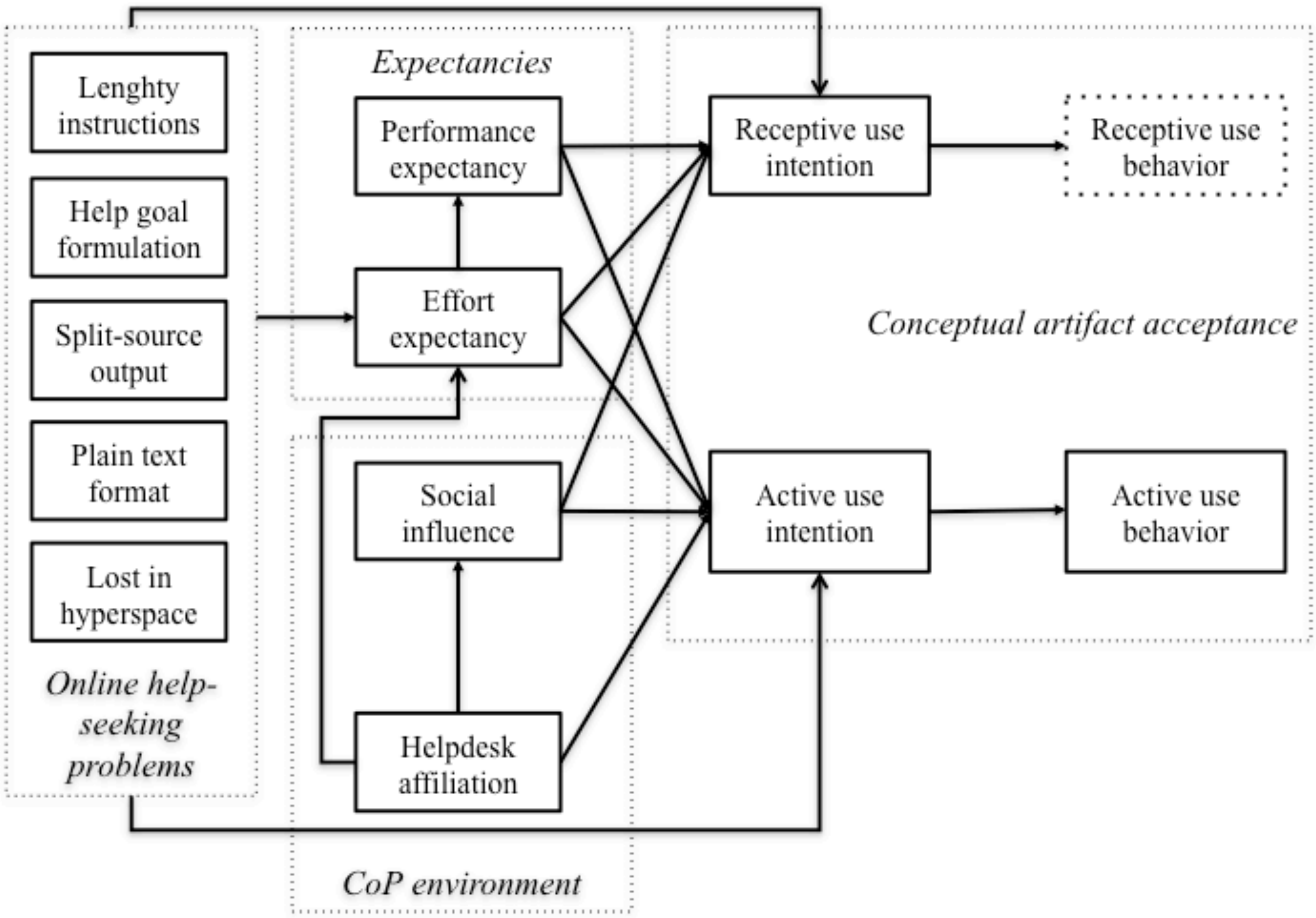

Fig. 3. Detailed research model

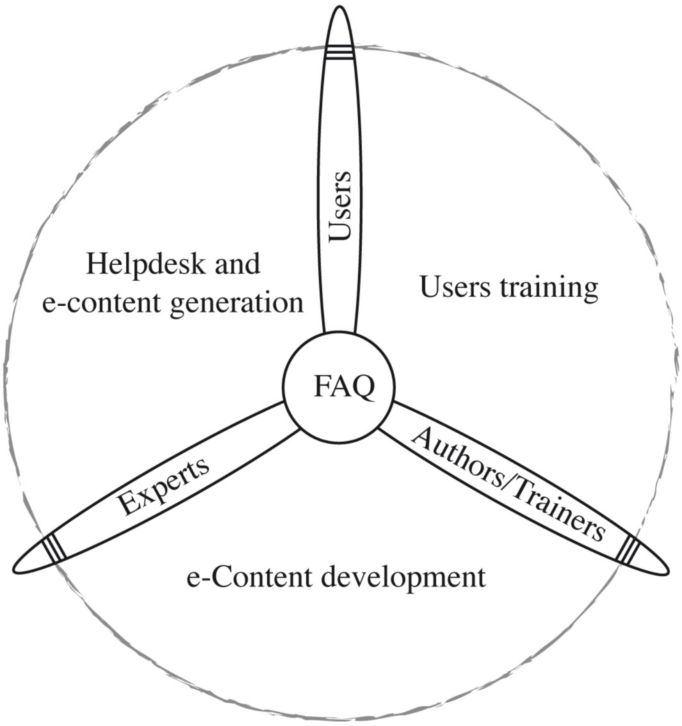

Fig. 4: “Propeller” model (Nistor et al., 2007)

2.4 A usage scenario for online help-seeking environments

As stated above, this paper’s first aim is to propose a theoretical frame for the use of conceptual artifacts that integrate CoP members’ knowledge. Previous information systems design based on user-generated content ignores specific CoP characteristics such as roles and division of labor. Nistor, Rubner & Mahr (2007) distinguish three different roles of CoP members and resulting activities, and propose the “propeller” model (fig. 4), based on the CoP concept with a focus on artifact production. The FAQ collection is regarded as a conceptual artifact (Bereiter, 2002) entailing reified knowledge negotiated in interaction between CoP members (Zenios, 2011). Participants are divided in three subgroups, i.e. users, experts and authors/trainers. Three activity zones emerge in interaction between them: (1) Helpdesk and content generation, where users ask experts questions about their problems, and receive and record explanations; (2) development of e-learning content, where authors/trainers put the expert explanation into a pedagogically meaningful form; (3) users’ training, where authors/trainers teach users how to handle with technology.

For the purpose of this study, the “propeller” model was applied in the context of a software users CoP. These were faculty (in “propeller” model addressed as “users”), working in the field of Psychology and Educational Sciences, where they used specific software tools. The implicit curriculum of the community practice included the following themes: internet/intranet access for faculty, software configurations and course presentation support on campus; use of collaboration software in intranet; use of web-based survey platform; statistics software installation, licensing and use; Mac OS versions of office and communication software, and their compatibility with Windows software; setting subdomain names for project web sites – and the list remains open, as the implicit curriculum of a CoP is determined by evolving practice (Lave & Wenger, 1991), which is potentially unlimited.

Software users could ask IT experts (in “propeller” model addressed as “experts”) for help with software handling problems. IT experts were either helpdesk staff or IT experienced faculty. Several IT helpdesk members (in “propeller” model addressed as “authors/trainers”) offered on a regular basis face-to-face and online IT training focused on frequent questions and problems of faculty, for which they developed course material and respectively e-content.

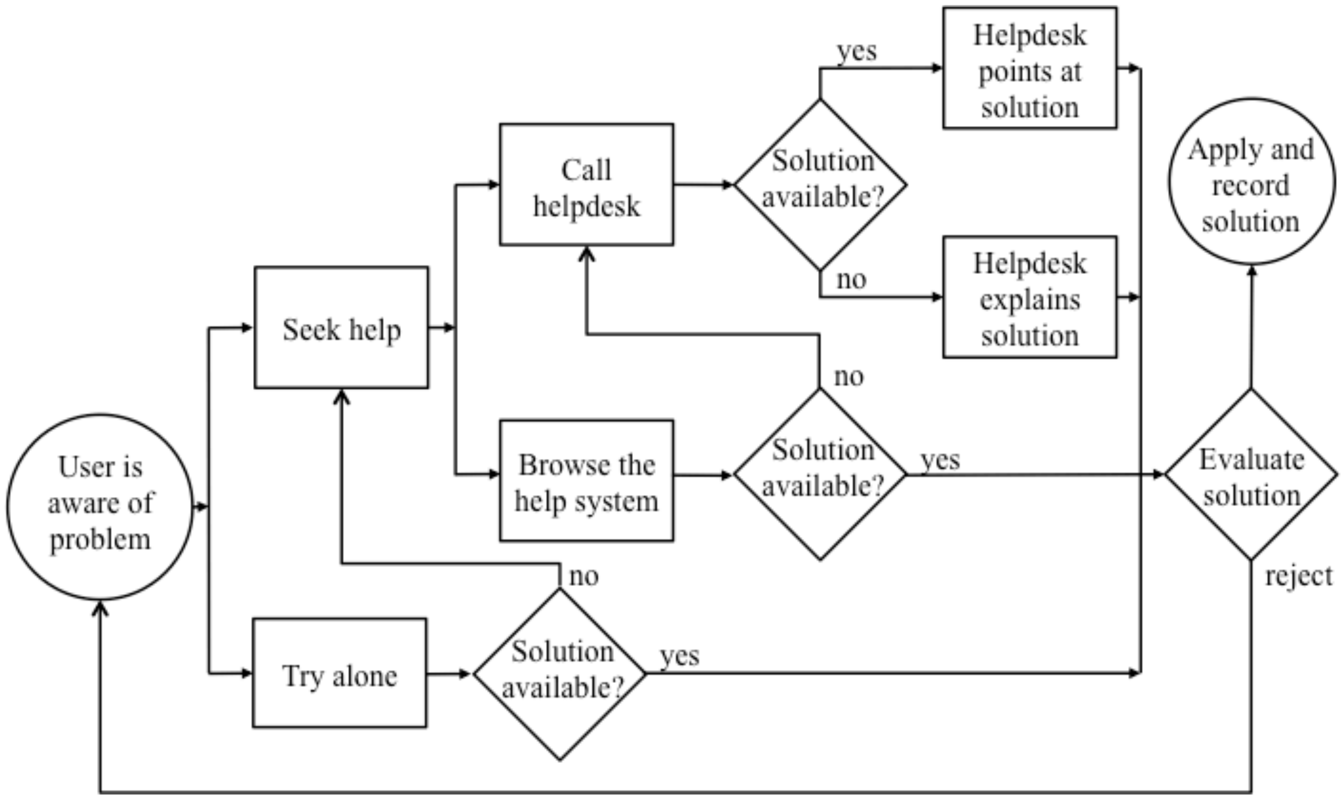

Fig. 5. Online help system usage scenario

To describe the use scenario of the conceptual artifact, its content items, i.e. frequent problems and questions, together with corresponding explanations and descriptions, were initiated by users’ questions, explained by experts, and finally transformed and into e-content and used in training sessions by authors/trainers. The FAQs could be used in two ways: seeking for information related to a problem and reading the FAQs (receptive use), and writing new descriptions of software usage or improving existing ones (active use). As shown in the diagram of the artifact use scenario (fig. 5), several ways lead from problem to solution, and to e-content generation. A CoP member who has encountered a problem and decides to seek help may browse the help system or call the helpdesk; a solution may be available in the help system or be provided by the helpdesk expert. In any case, the solution is first evaluated, and then applied. If the solution was not available in the help system, it may be recorded either by user or by helpdesk experts. Once recorded, a solution is reviewed and edited by content authors, so that the FAQ item is correct and self-explanatory. As a result, the developed FAQ collection gives suggestions about frequent problems, and thus about users’ need for technology training. After a needs analysis, e-content authors can edit FAQs into training material and conduct “propeller” training sessions in face-to-face meetings.

3 Verifying the proposed model

Besides artifact usage scenario, the second aim of this study is to propose and validate a conceptual model of the factors influencing artifact acceptance (fig. 2 and 3), thus investigating the dynamics of the involved variables, which may be useful in the educational practice of initiating and supporting vCoPs. In the following, the validation study concentrates on the initial phase of the help system's life cycle, i.e. the first six months, starting from scratch, and investigating the development of the first FAQ items.

3.1 Research questions and hypotheses

The attempted model validation comprises the following research questions (RQ).

RQ1: What are the values of the research model variables? Are there significant differences between IT helpdesk members and other CoP members in respect to these?

A functional help system is likely to display moderate values of all model variables, i.e. without floor or saturation effects. IT helpdesk member may perceive users expecting them to develop the FAQ collection, therefore social influence may be stronger for helpdesk staff. However, in the initial phase of the artifact development, helpdesk staff has no professional obligation in respect to the help system, hence no significant differences in their active use and active behavior are expected. Also, no significant influence of the helpdesk role is expected on receptive use, because helpdesk staff is supposed to have sufficient IT knowledge and skills, and little need for help.

RQ2: What is the influence of online help-seeking problems on CoP members' expectancies toward the technology-based conceptual artifact?

Problems with help system may directly influence both receptive and active use of the conceptual artifact. This influence should however be mediated by effort expectancy.

RQ3: What is the influence of CoP members' expectancies toward technology-based artifacts on the acceptance of technology-based artifact?

As suggested by UTAUT (Venkatesh et al., 2003; 2012), performance and effort expectancy should have an influence both on receptive and active use of the technology-based conceptual artifact. Further, attitudinal acceptance (receptive and active use intention) is expected to influence behavioral acceptance (receptive and active use behavior). TRA and TPB (Ajzen & Fishbein, 2000) strongly suggest a significant correlation between intention and behavior; however Bagozzi (2007) regards this correlation as overestimated, which may imply a weak or insignificant correlation. It has to be noted that in the initial phase of the help system development there is scarce material that can be receptively used, consequently the study concentrates on emerging, receptive and active use intention and its determinants.

RQ4: What is the influence of the CoP environment on members' expectancies toward technology-based artifacts?

UTAUT (Venkatesh et al., 2003) shows that use intentions are built under social influence. Additionally, according to the activity theory (Engeström & Sannino, 2010) social structure implies CoP members' different roles and perspectives, hence different effort expectancies under the influence of the CoP environment.

RQ5: What is the influence of the CoP environment on artifacts acceptance?

CoP members' different roles and perspectives further imply different use intentions under the influence of CoP environment.

3.2 Research methodology

A correlation study was conducted using one-shot transversal data collected from an IT users CoP that emerged at a faculty within the University of Munich, Germany. Since everybody used IT in various forms, the entire IT users population included 4500 students registered at the faculty, and 500 faculty members, predominantly female. However, only a relatively small part of this population could be regarded as an IT CoP. This study considers the IT CoP as consisting of persons with constant involvement in exchanging IT related knowledge, developing and using FAQ material. From the faculty members, 29 had long-term IT responsibility (so called IT manager); from these, 5 were members of the IT steering committee. Additionally, the faculty was provided with professional IT support from 12 temporary collaborators (most of which were students of Computer Science or related domains, with part-time jobs) and 3 permanent staff members. Thus, the studied CoP included a total of 44 active members corresponding to the definitions of "experts" and "intermediates", and some 50 to 150 persons with peripheral or intermittent, short time activity corresponding to the definitions of "novices" and "visitors".

The sample consisted of N = 66 IT CoP members with various degrees of participation, including 40 females and 26 males, aged from 19 to 48 (M = 26.35, SD = 5.88). From these, 33 were students, 15 student assistants, 15 faculty (3 of which played the role of IT managers in their work groups), 2 technical staff and 1 lecturer. Regarding their professions, 55 worked in non-technical fields (mostly in social sciences), 6 had technical professions (e.g. IT engineers), 5 had combined, i.e. both technical and non-technical professions; 43 had a highschool diploma, 19 a university diploma, and 4 a doctorate as highest degree. From the entire sample, 9 participants were affiliated to helpdesk.

According to this help system use scenario, in the first six months encompassed in this study, the participants developed 33 FAQs with a total length of 5599 words (in German language). From these, 26 FAQ entries consisted of plain text (16 well-formed contributions, 7 lists of bullet items, 3 texts with short paragraphs, i.e. 20-50 words), while 7 contained graphics, i.e. mostly screenshots. These FAQs were accessed by 69 users for 1909 times, and edited for 101 times. The IT helpdesk organized monthly hands-on training sessions of 90 min. each, based on the most frequent topics of the help system. More in-depth content analysis of the help system is provided in a follow-up report.

Measured independent variables were: problems of online help-seeking (lengthy instructions, help goal formulation, split-source output, plain text format, lost in hyperspace, help goal formulation), and helpdesk affiliation. Dependent variables were: performance expectancy, effort expectancy, social influence, receptive use intention, active use intention, active use behavior. Demographic data included participants' faculty position, i.e. individual helpdesk affiliation and IT manager responsibility. Participants' active use behavior was measured by counting their messages in the help system discussion forum. All other variables were collected by questionnaire survey. Acceptance variables (performance expectancy, effort expectancy, social influence, receptive use intention, active use intention, active use behavior) were measured using the UTAUT questionnaire (Venkatesh et al., 2003). The subscales describing problems of online help-seeking were formulated based on Heckner et al. (2010). The entire measure instrument is presented in tab. 1. The responders evaluated all questionnaire statements using a five point Likert scale from 1 = "I strongly disagree" to 5 = "I strongly agree".

Instrument validity was proven by factor analysis. Since all subscales had already been validated in previous studies, confirmatory factor analysis was chosen for validation in the new setting. The number of items and subscales was reduced by factor rotation. Orthogonal factor rotation (in its simplest form, varimax; see tab. 2) was chosen because of easier interpretation of its results, i.e. the factor loadings represent correlations between latent variables and their indicators (Brown, 2006, p. 31). First, some of the original items were eliminated due to low factor loadings. Further, performance and effort expectancy were synthesized to a single subscale (performance/effort expectancy, PEE). According to Brown (2006), high primary loading (here over .6) and low cross-loading (here mostly under .10, left aside in tab. 2 in order to simplify the presentation) attest satisfactory convergent and respectively discriminant validity of the measure instrument. Subsequently, the internal consistency of subscales was verified by calculating Cronbach's α (tab. 1), which was excellent for PEE ($\alpha > .9$), good ($\alpha > .8$) for receptive and active use intention, and questionable ($.6 < \alpha < .7$) for the online help-seeking problems subscales. However, due to favorable results of the confirmatory factor analysis, and considering the clear meaning and conceptual relevance of the constructs, the online help-seeking problems subscales were accepted, too, for use in the study.

Tab. 1. Questionnaire items and subscales, and corresponding Cronbach's alpha values

Subscales and items	Cronbach's alpha
Lengthy instructions (LI) LI2: Reading the instructions takes too much time. LI3: Understanding the instructions takes too much time.	.66
Split-source format (SSF) SSF1: Switching between application and help system is disturbing. SSF2: I use to forget the instructions while I switch back from the help system to the application. SSF3: I use to forget my question while I am searching for an answer in the help system.	.68
Plain text format (PTF) PTF1: The instructions contain too much plain text. PTF2: The instructions consist of an ideal mix of text and pictures.	.64
Lost in hyperspace (LIH) HGF1: It is no problem for me to find adequate instructions for my problem in the help system. HGF2: It is difficult for me to find the right keywords in order to find the instructions I need. LIH2: I can always find my way through the help system.	.65
Performance/effort expectancy (PEE) PE4: I would find the contents of the help system useful in my job. PE5: Using the contents of the help system enables me to accomplish tasks more quickly. PE6: Using the contents of the help system increases my productivity. EE5: My interaction with the help system would be clear and understandable. EE6: It would be easy for me to become skilful at using the help system. EE7: I would find the help system easy to use. EE8: Learning to operate the help system is easy for me.	.91
Receptive use intention (RUI) RUI1: I intend to use the help system for information search in the next months. RUI2: I predict I would use the help system for information search in the next months. RUI3: I plan to use the help system for information search in the next months.	.84
Active use intention (AUI) AUI1: I intend to contribute to the further development of the help system in the next s. AUI2: I predict I would contribute to the further development of the help system in the next months. AUI3: I plan to contribute to the further development of the help system in the next months.	.82

Tab. 2. Principal component analysis with varimax rotation

	PE	SSF	PTF	LIH	PEE	SI1	SI2	AUI	RUI
Lengthy instructions (LI)									
LI 1	,797								
LI 2	,750								
Split-source format (SSF)									
SSF 1		,686							
SSF 2		,820							
SSF 3		,652							
Plain text format (PTF)									
PTF 1			,664						
PTF 2			,829						
Lost in hyperspace (LIH)									
HGF 1				,838					
HGF 2				,634					
LIH 2				,643					
Performance/effort expectancy (PE)									
PE 4					,733				
PE 5					,749				
PE 6					,705				
EE 5					,861				
EE 6					,830				
EE 7					,819				
EE 8					,788				
Social influence (SI)									
SI 1						,877			
SI 2						,913			
SI 3							,842		
SI 4							,809		
Receptive use intention (RUI)									
RUI 1								,865	
RUI 2								,673	
RUI 3								,829	
Active use intention (AUI)									
AUI 1									,865
AUI 2									,834
AUI 3									,716

After help system development, the questionnaire was published online and all CoP members were invited to use the system, and afterwards to answer the research questionnaire. To log in to both help system and online questionnaire, participants used a nickname that appeared in the discussion forums too, which allowed pairing questionnaire data and contributions in discussion forums, while at the same time preserving anonymous participation. Data was collected in the first six months after help system implementation. Data analysis was performed using IBM SPSS Statistics and AMOS version 19.

3.3 Findings

RQ1: Model variables' values and differences between subgroups. The occurrence of online help-seeking problems had medium values. Helpdesk members differed from other participants only in their perceptions of the split-source format. As for acceptance values, performance and effort expectancies were generally high, and perceived social influence low. Helpdesk members perceived significantly higher social influence than the rest of the sample. Receptive and active use intention was low to medium. Helpdesk members had a slightly higher intention to actively use the help system. Active use behavior ranged from 0 to 10 comments in discussion forums, in most of the cases between 0 and 3. The total number of comments was 80. The research model variables are described in tab. 3.

Tab. 3. Mean values (M) and standard deviation (SD) of the evaluation variables, and differences between subgroups

	Entire sample (N = 66)		Helpdesk members (*n* = 9)		Others (*n* = 57)		Differences (two tailed T test)		
	M	SD	M	SD	M	SD	T	df	*p*
Lengthy instructions	3.53	0.98	3.28	1.23	3.57	0.95	0.68	9.56	0.51
Split-source format	3.34	0.93	3.93	0.66	3.25	0.94	-2.66	13.72	0.02*
Plain text format	3.56	0.91	3.50	1.03	3.57	0.90	0.19	10.02	0.85
Lost in hyperspace	3.73	0.82	4.04	0.59	3.68	0.84	-1.57	13.81	0.14
Performance/effort expectancy	4.17	0.74	4.29	0.52	4.15	0.77	-0.66	14.21	0.52
Social influence	2.85	0.76	3.42	0.74	2.76	0.74	-2.47	10.66	0.03*
Receptive use intention	2.71	1.11	3.00	0.94	2.67	1.13	-0.96	11.97	0.36
Active use intention	2.26	1.03	3.04	1.24	2.13	0.95	-2.09	9.54	0.07
Active use behavior (i.e. number of comments)	1.21	1.77	0.89	1.27	1.26	1.84	0.77	13.95	0.46

The research model was tested using structural equation modeling. In the original form (fig. 3), its goodness of fit was low, so that several modifications had to be considered. The final model with high goodness of fit is provided in fig. 6, along with its path coefficients and explained variance of the dependent variables. In this form, the model could explain 31% of the variance of receptive use intention, 21% of the variance of active use intention, and 11% of the variance of active use behavior. The corresponding fit indices, compared with reference levels are provided in tab. 4.

RQ2: Influence of online help-seeking problems on CoP members expectancies. As hypothesized, participants' perceived online help-seeking problems had a direct effect on PEE. However, the only problem type with a significant influence was "lost in hyperspace".

RQ3: Influence of CoP members' expectancies on artifact acceptance. PEE had an influence both on receptive and active conceptual artifact use, however only its influence on receptive use intention was significant. The influence of active use intention on active use behavior could not reach statistical significance.

RQ4: Influence of CoP environment on members' expectancies. The influence of CoP environment manifested itself through perceived social influence towards active artifact use, and through participants' responsibility as IT managers. However, none of them had a significant influence on PEE.

RQ5: Influence of CoP environment on artifact acceptance. Both perceived social influence and IT manager responsibility had significant effects on active use intention. Furthermore, IT manager responsibility had a significant influence on active use behavior.

Tab. 4. Fit indices of the research model
(RMSEA = root mean square error of approximation; CFI = comparative fit index)

Fit index	Level of acceptable fit	Level of good fit	Fit of the research model
χ^2/df	$0 \leq \chi^2/\text{df} \leq 3$	$0 \leq \chi^2/\text{df} \leq 2$	.97
p	$.01 < p \leq 1.00$	$.05 < p \leq 1.00$	.50
RMSEA	$.05 < \text{RMSEA} \leq .08$	$.00 \leq \text{RMSEA} \leq .05$	.00
CFI	$.95 \leq \text{CFI} \leq .97$	$.97 \leq \text{CFI} \leq 1.00$	1.00

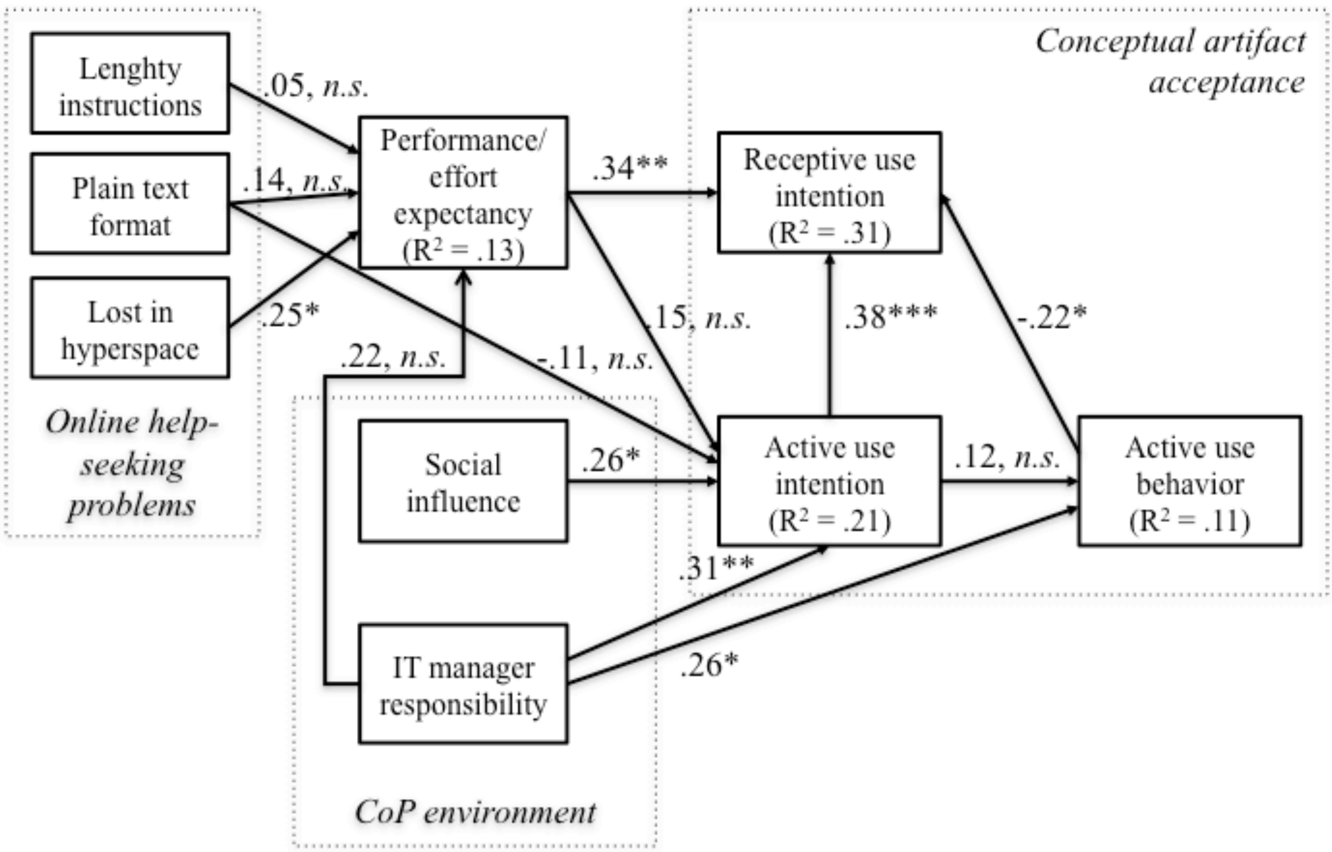

Fig. 6. Path analysis of the research model with path coefficients and explained variance (R2) (*p < .05, **p < .01, ***p < .001)

4 Conclusions

Starting from the problem of overloaded IT helpdesks (Govindarajulu, 2002; Leung & Lau, 2007; van Velsen, Steehouder & de Jong, 2007), the presented study proposed an alternative way of fostering IT knowledge and skills at workplace through informal learning, i.e. knowledge sharing in CoPs mediated by the use of technology-based conceptual artifacts (Bereiter, 2002; Engeström & Sannino, 2010; Wenger, 1999; Zenios, 2011). While the CoP approach describes the social context of learning from a macroscopic perspective, initiating specific learning activities requires zooming in to a microscopic perspective, which was provided by the help-seeking approach (Heckner et al., 2010; Mercier & Frederiksen, 2007; Puustinen & Rouet, 2009). In the frame of situated cognition, the help-seeking approach offers a more structured view of the learning process, so that the two approaches complement each other. In this context, the application of a cognitive theory such as TPB (Ajzen & Fishbein, 2000; Venkatesh et al., 2003; 2012) may appear unusual. Nevertheless, the presented findings suggest some degree of compatibility between perspectives.

The usage scenario formulated on this basis has proved to be functional. A first run of the system produced a moderate amount of comments and, most relevant, a significant part of the users showed positive attitudes towards the system. The hypothesized conceptual model (fig. 2) could be empirically confirmed. Online help-seeking problems, especially "lost in hyperspace" (Nückles et al., 2007) had an effect on CoP participants' expectancies towards the technology-based conceptual artifact. This means that a well-designed help system, which causes little or no problems, is indeed regarded as helpful. Positive expectations further sustain artifact acceptance. Also, the CoP environment in the particular form of perceived social influence and CoP members' roles and responsibilities influence both members' expectancies and their artifact acceptance.

Remarkably from organizational point of view, the local IT manager responsibility had a stronger impact on active use intention than helpdesk affiliation, probably because the help system development was at the moment of the survey not yet an official helpdesk task. Finally, active use behavior was somewhat influenced by active use intention, and again, more strongly by IT manager responsibility. This finding supports the claimed compatibility between TRA/TPB/UTAUT (Ajzen and Fishbein, 2000; Venkatesh et al., 2003; 2012) and the CoP/help-seeking approach (Puustinen & Rouet, 2009; Wenger, 1999), and strongly suggests that the CoP context may be an important influence factor of artifact acceptance.

Surprisingly, active use behavior had a negative influence on receptive use intention, suggesting that active and receptive use occurs separately, i.e. skilled IT users may tend to active artifact use as help givers, while novices may limit their activities to receptive use as help seekers. The opposite influences of active use intention and active use behavior on receptive use intention may be explained by a weak correlation between active use intention and the corresponding behavior, as observed by Bagozzi (2007, p. 245).

The explained variance of receptive and active use intention is relatively low, reminding of the fact that there are further predictors of system use besides online help-seeking problems and technology acceptance. Both the weak correlation between intention and behavior, and the relatively low percent of explained variance of behavior indicate the point where the compatibility between TRA/TPB/UTAUT, help-seeking and situated/distributed cognition may be overstretched. Future studies should refine the conceptual model proposed here, and its theoretical frame.

As a conclusion for educational practice, knowledge sharing and help-seeking in online CoPs may be fostered by CoP members' use of technology-based conceptual artifacts (Bereiter, 2002), where artifact usage implies negotiation of meaning (Wenger, 1999) and epistemic activities (Zenios, 2011) connected with the community practice. For educational systems developers, this requires a system design comprising comprehensive and transparent navigation, which allows users to remember and pursue their help-seeking goals and prevents them from getting "lost in hyperspace". This is how the help system's perceived usefulness can be increased, thus also enhancing CoP members' intention to use it. At the same time, the system should take into account social structures, roles and division of labor, so that participants with different backgrounds and roles may easily contribute their questions and answers to the help system, and negotiate shared "ways of doing things" in the CoP (Wenger, 1999). This may in turn provide more transparence to members' navigation through the help system, and through the community practice as well.

For educators, the task of supporting workplace learning requires not only making help systems available, but also adopting appropriate organization measures and sustaining purposeful communication in the supported CoP. Regarding organization, the helpdesk staff can effectively stimulate and practice active use of technology-based conceptual artifacts. However, this should be declared as an explicit helpdesk task, and a significant part of its activity. A similar, positive effect on knowledge sharing may be obtained by assessing IT support tasks to skilled CoP members outside the helpdesk. Help-seeking and help-giving between colleagues may be as stimulating and helpful as helpdesk support. As for communication, the influence of the social environment can be a significant factor of active use and knowledge sharing in the help system. In order to be successful, a new help system has to be efficiently made known to the community. This can be reached for example by e-mail communication, informing the community about functionality and advantages, and especially by inviting skilled CoP members to contribute their knowledge to the conceptual artifact.

Although the presented study suggests some valuable interventions for further help system development, and, more generally, for the practice of technology-enhanced learning, it has nevertheless a few limitations. Some of these are due to the early development stage of the help system. Since no contents were available at the beginning of the study, receptive use behavior related to the help system could hardly be measured, so the evaluation focused on active use, i.e. content development. Both the number of users and the quantity of developed content were relatively low, suggesting that the critical mass was not yet reached. Regarding methodology, transversal data could be gathered with low effort, however this may oversimplify the studied phenomena, and especially CoP processes such as the reification of knowledge. Future studies should also consider longitudinal data, i.e. the evolution of CoP participation and artifact use. The subjective data collected in this study should also be corroborated with more detailed content analysis data illustrating participants' use of the help system and the accompanying learning process. Further, the questionnaire items related to online help-seeking problems are not yet sufficiently validated, as the questionable internal consistency of subscales indicates. Even if the constructs have a clear meaning and conceptual relevance, and the confirmatory factor analysis suggests good convergent and discriminant validity, future studies should improve the research instrument. Finally, the study sample was small. In the near future, help system usage is expected to increase, thus offering larger samples of users and enabling in-depth research of the CoP and help-seeking phenomena, also in later phases of the CoP life cycle.

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