Research and Practice in Technology Enhanced Learning
Vol. 3, No. 1 (2008) 65–93

KNOWLEDGE LABELS AND THEIR CORRELATES IN AN ASYNCHRONOUS TEXT-BASED COMPUTER-SUPPORTED COLLABORATIVE LEARNING ENVIRONMENT: WHO USES AND WHO BENEFITS?

LINA MARKAUSKAITE*, LOUISE M. SUTHERLAND† and SARAH K. HOWARD‡

Faculty of Education and Social Work (A35)
The University of Sydney, Sydney
NSW 2006, Australia
**l.markauskaite@edfac.usyd.edu.au*
†l.sutherland@edfac.usyd.edu.au
‡s.howard@edfac.usyd.edu.au

Learning is a complex process involving knowledge acquisition, transformation, and creation. This paper focuses on how students' beliefs about and use of learning scaffolds relate to their characteristics, and the specific context in which they are expected to use these labels. An asynchronous text-based online environment with built-in learning scaffolds (called "knowledge labels") was the context in this study. Hierarchical regression revealed a range of factors accounting for a significant amount of variance in the students' beliefs about the usefulness and usage of labels. Their beliefs about the usefulness of labels correlated with factors describing a deeper learning approach, more positive course learning experiences, and deeper engagement with online learning discourse. Answers about using labels were mainly related to greater participation in online learning and the students' deeper engagement in online learning discourse. This finding suggests a need for deep investigations into the complex interaction between students' personal characteristics and learning processes to understand the value of learning scaffolds.

Keywords: Learning scaffolds; online discussion forum; computer supported collaborative learning; reflection; preservice teachers; higher education.

1. Introduction

"Learning is a process — or, more accurately a number of processes — for the acquisition and development of knowledge, skills, attitudes and values" (Fisher, Higgins & Loveless, 2006, p. 11). It "flows from the need to make sense out of experience, reduce the unknown and uncertain dimensions of life and build the competencies required to adapt to change" (Morrison, 2001, p. 32). According to one perspective on understanding learning, a socio-cultural approach based on activity theory (Vygotsky, 1978), what is learnt, and the processes of learning are mediated by the cultural artifacts in a specific context (Kozulin & Presseisen, 1995; Hmelo-Silver, 2003). These cultural artifacts include symbolic tools, such as language, and material objects, such as computers.

In the context of higher education a number of knowledge-building processes required for learning have been identified. These include reading and discussion (Gilbert & Dabbagh, 2005), problem-oriented peer discussion (Weinbeger *et al.*, 2005), argumentation and reasoning (Cho & Jonassen, 2002), and articulation and reflection (Land & Zembal-Saul, 2003; Lin *et al.*, 1999). An essential question to enhance students' learning in higher education is how to support their effective engagement in these learning processes so that they are able to apply their learning to professional work beyond the university (Biggs, 2003; Symes & McIntyre, 2000).

Over the past two decades, there has been extensive experimentation and research developing learning environments which facilitate students' engagement in these learning processes. Past research has articulated progressive knowledge-building discourse such as offering scripts, prompts, constraints, and other forms of scaffolding which can have a positive impact on students' learning outcomes (c.f., Collins, 2006; Lin *et al.*, 1999; Quintana *et al.*, 2004; Scardamalia & Bereiter, 2006). Little is known, however, about the reasons for this success.

This paper begins to address this issue. A set of digital learning scaffolds referred to as knowledge labels, was implemented in an asynchronous text-based discussion forum. In this exploratory study, the impact of the students' perceptions and their use of these knowledge labels on their participation in the online learning experiences are examined. The context of the study was a compulsory course, which is part of their graduate teacher education program. The participants in this study were one cohort of preservice teachers. Questionnaire-based data combined with content analysis of these participants' online contributions was used to identify possible relationships among these preservice teachers' beliefs about the usefulness and their actual usage of knowledge labels, and a range of factors which might impact their engagement in the online learning experiences. Based on previous research, the factors considered in this study are the participants':

(1) Demographic and background characteristics;
(2) Approaches to study in the course;
(3) Beliefs about and satisfaction with the impact of the course on the development of their professional knowledge.

2. Learning in a Professional Education Program: Teacher Education

Learning is an active process (Engeström, 1999); it is both an individual and a collaborative activity (Greeno, 2006; Salomon & Perkins, 1998). In formal education settings, such as professional education courses, language and the associated discourse is central to learning. Language plays a mediating role in higher-order thinking, collaborative knowledge-building and conceptual change (McLoughlin & Oliver, 1998; Mercer, 2000; Ohlsson, 1995; Scardamalia & Bereiter, 1987), discussion (Goodyear & Zenios, 2007; Hammond, 2005), argumentation (Cho & Jonassen, 2002), and reflection (Hatton & Smith, 1995; Yukawa, 2006). While these and other discursive collaborative forms of learning are increasingly valued in higher education (Luppicini, 2007), high-quality discourse and interactions do not always occur naturally (Dillenbourg, 1999; Mercer, 2000). Specific supports are needed to assist students' learning.

Over the past two decades, there has been extensive experimentation and research toward developing learning environments to support these educationally valuable learning processes. This research has articulated progressive knowledge-building discourse such as offering scripts, prompts, constraints and other forms of scaffolding (c.f., Collins, 2006; Lin *et al.*, 1999; Quintana *et al.*, 2004; Scardamalia & Bereiter, 2006). The theoretical basis for the development of one example of scaffolding, knowledge labels, implemented in an online environment, is considered in this section.

In learning to become a teacher, students must develop a body of professional knowledge which Fisher *et al.* (2006) describe as "the interplay between the professional and the personal, the individual and the social, the objective and the subjective, the formal and the informal, the situated and generalized" (p. 2). This knowledge is developed in the two typical components of teacher education programs: formal course work and practicum experience in schools and classrooms. These contexts present and organize knowledge in different ways. Formal instruction typically focuses on theoretical knowledge expressed in academic discourse, while in the classroom teachers often express their personal/practical knowledge in common-sense terms (see also Connelly, Clandinin & He, 1997; Ebbutt, Robson & Worrall, 2000; Mewborn & Stanulis, 2000; Shulman, 1998). There is considerable overlap in the knowledge developed within these two different contexts, and both are essential for a well-rounded teacher's professional understanding and decision-making (Shulman, 1998; Wideen, Mayer-Smith & Moon, 1996). One of the challenges in teacher education is to assist students to integrate their knowledge and experiences from these two contexts. The processes of critical and analytical reflection are important for this integration (Schön, 1983; Shulman & Shulman, 2004). While reflection plays this crucial role, many preservice teachers find systematic reflection difficult (Gale & Jackson, 1997; Hatton & Smith, 1995).

3. Supporting Reflection Through Written Discourse and Learning Scaffolds

Asynchronous computer conferencing may assist preservice teachers' development of their capacity to engage in systematic reflection in two ways. First, the written, text-based, environment of asynchronous computer conferencing provides certain affordances and imposes constraints on students' learning processes. In this environment, students can learn more flexibly given the option of additional time, which supports their capacity to reflect (Davis & Brewer, 1997). Additionally, students' thinking is disciplined when they are forced to communicate complex ideas in writing (Garrison, Anderson & Archer, 2000). The persistent discourse maintained in an online discussion represents students' knowledge building processes (Goodyear & Zenios, 2007). This digital representation provides opportunities for reflection and further collaborative knowledge building. Second, scaffolding can be used to support students' articulation and reflection (Lin *et al.*, 1999; Quintana *et al.*, 2004). These scaffolds can take different levels of intrusion and can provide different kinds of support in a learning environment (Lin *et al.*, 1999; Quintana *et al.*, 2004). For example, Lin *et al.* (1999) suggest four scaffolding techniques to support reflective processes in e-learning environments: process displays, process prompts, process models, and online forums with add-on features for reflective social discourse.

A common scaffolding approach in asynchronous discussion forums is a structure called "process prompts". These prompts are usually implemented as textual pre-specified labels or tags. Based on the theory of constraints (Ean, 2005), these labels limit the types of content that can be posted in forums. Participants are required to structure postings and label contributions using the pre-specified tags (Cho & Jonassen, 2002). These labels on contributions act as scaffolds by providing an explicit framework for the production of an elaborated argument (Duffy, Dueber & Hawley, 1998). Thus, these process prompts may support students engagement in persistent and articulated discourse and reflection in an online environment (Barros & Verdejo, 1999; 2000; Lin *et al.*, 1999).

3.1. *Levels of working with knowledge*

Bereiter and Scardamalia's (1998) schemata of the levels of working with knowledge, and their concept of "knowledge embedded in practice" (Bereiter & Scardamalia, 1996), provides a mechanism for the construction of these process prompts.[1] This schema of working with knowledge includes seven levels (see Table 1). Bereiter and Scardamalia (1996) emphasize, the process rather than acquisition of content as the differential feature in this organizational hierarchy. Each level represents a progressive objectification and transformation of knowledge from concrete experiences and individual mental objects (Level 1 and 2) to socially shareable experiences and objects (Level 3 and 4) and, finally, to individually or collaboratively improvable conceptual artifacts (Level 5, 6, and 7). The last three levels represent abilities and dispositions to construct, apply, and improve knowledge. These include the construction and application of knowledge at both the: (a) personal knowledge (Level 5 and 6), and (b) community level.

[1] An important aspect of Bereiter's and Scardamalia's theory of knowledge-building is an explicit semantic and epistemic distinction between the terms "learning", which refers to the changes in *personal* mental states, and "knowledge-building", which refers to the construction of new *shared* conceptual ideas and theories (see Bereiter & Scardamalia, 1996; Scardamalia & Bereiter, 2003). It should be noted that, in this paper, the term "learning" is used in a broader sense than in Bereiter and Scardamalia's writings to include both changes in personal mental states and co-constructed shared conceptual knowledge, i.e. individual and collaborative aspects of learning and knowledge.

Table 1. Levels of working with knowledge, and description of knowledge labels and their weights.

Level of Approach to Knowledge[a]	Knowledge Label (weight)	Description
L1. Knowledge as individualized mental states. L2. Knowledge as itemizable mental content.	Explanation (1)	A statement about your understanding or your interpretation of the reading. This could be a summary of the main ideas in the article, written in your own words.
L3. Knowledge as representable and interpretable. L4. Knowledge as viewable from different perspectives.	Elaboration (2)	Additional evidence or insights beyond your explanation. The additional evidence could come from your reading of the research or policy document or it could be example(s) from your past or present experiences (e.g. school observations). It should be your own ideas.
L5. Knowledge as personally constructed artifacts. L6. Knowledge as improvable personal artifacts. L7. Knowledge as semi-autonomous artifacts.	Reflection/ Application (3)	Discussion as to how this idea(s) helps you in understanding more about teaching and/or learning and/or education in the Australian context. You might also discuss how you might use this idea(s) in your future work as a teacher.
	Request (0)	A question related to the discussion of the reading.
	Administration/ Maintenance (0)	Information not specifically related to the discussion of the reading. You might use this label for administrative matters.
	Social label (0)	It could be greetings, jokes, or off-task comments.
	No knowledge (0)	Any other information.
	Please choose (0)	Non-labeled paragraph (i.e., default option).

Note: [a]Based on, Bereiter, C. & Scardamalia, M. (1998). Beyond Bloom's taxonomy: Rethinking knowledge for the knowledge age. Developing higher-level approaches to knowledge. In A. Hargreaves, A. Lieberman, M. Fullan & D. Hopkins (Eds.), *International handbook of educational change* (pp. 675–692). Dordrecht: Kluwer Academic Publishers.

Based on this framework, process prompts — "knowledge labels" — were designed and implemented. These technological scaffolds were designed to support a range of learning processes, by specifically supporting progressively articulated discourse and reflection. The technological scaffolds included the following knowledge labels: "explanation", "elaboration", "reflection/application", "request", "administration/maintenance", "social label", and "no knowledge". The relationship between the knowledge label and the levels of working with knowledge in Bereiter's and Scardamalia's (1998) schemata is summarized in Table 1.

The wording of the tags in the study was adapted to suit both individual and collaborative progressive discourse. The first three tags articulated different levels of working with knowledge and emphasized generic aspects of knowledge generation (Bereiter & Scardamalia, 1998). This three-level representation was based on the research of Sloffer *et al.* (1999) which used the tags "exploration", "analysis" and "decision making". In this study these tags were labeled respectively, "explanation", "elaboration", and "reflection/application". Other tags were chosen to support interaction and unstructured social discourse amongst learners, as these types of communication are also important in distributed collaborative learning (Duffy *et al.*, 1998).

We also wish to consider the appropriateness of asynchronous discussion forums for learning and the extent to which technological scaffolds could support learning. First, as students must select the technological learning scaffolds, they provide passive rather than active support (Chan *et al.*, 1992; Scardamalia & Bereiter, 1993). Second, unlike scaffolds in synchronous interactions, such as teachers' support in a classroom, technological learning scaffolds are not responsive to learners' needs and abilities; neither are they flexible with respect to the learning context (Sloffer *et al.*, 1999). Finally little is known about how scaffolding in online forums relates to the learning process, students' performance (Pea, 2004), and individual student's characteristics. The purpose of this study is to enhance knowledge and understanding of the use of these types of scaffolds to support student learning by examining some of these factors.

3.2. *Factors affecting the use of scaffolds in online discussion forums: the analytical framework*

One of the models that considers the complex system of factors impacting on students' learning, taking into account their personal characteristics, is the *3P Model* (Biggs *et al.*, 2001). This model suggests possible relationships among a range of endogenous factors and exogenous factors which, within a specific context, may impacting the students' learning outcomes.

Prior research has examined a complex range of factors. For example, Andersson's (2007) extensive review identified the following student-related characteristics as the most significant: (a) age; (b) gender; (c) academic confidence, such as previous academic qualifications; (d) technological confidence to use computers; (e) economic prerequisites for study, including access to computers; (f) new learning style confidence; (g) conflicting priorities, in terms of the time students devote to the course; and, (g) motivation, in terms of goal commitment, capacity and experience. If mapped to the *3P Model*, the first five characteristics represent students' endogenous factors that characterize their background and general approach to learning. The last three factors represent exogenous characteristics because they emerge from interactions among the students' endogenous variables and the learning context. In a specific context, these exogenous factors characterize the students' ongoing learning approaches, attitudes, and experiences.

Amongst previous studies in higher education (Chyung, 2007; Gay *et al.*, 2006; Linn, 2005; Goodyear *et al.*, 2004; Myers, Bennett & Lysaght, 2004; Muse, 2003; Schrum & Hong, 2002; Kimbrough, 1999; Hsi & Hoadley, 1997; McConnell, 1997; Hardy, Hodgson & McConnell, 1994) where similar sub-sets of factors have been shown to be significant, there are variations in which a combination of factors was examined. For example, Muse (2003) found that students tended to be more successful if they were older, a longer time away from college courses, learned in a more satisfactory study environment, and felt better prepared for web-based learning. Schrum and Hong (2002) identified seven significant dimensions, including regular access to appropriate tools, sufficient level of comfort using these tools, online learning preferences, study habits and skills in studying on their own, goals, purposes and associated motivation to study, lifestyle factors such as sufficient time, and personal traits and characteristics such as willingness and self-discipline.

Additional studies found that students' initial thoughts regarding the appropriateness of networked approaches to learning and their expectations of the usefulness of experiences in gaining new knowledge and skills were identified as important in a large scale study of undergraduates (Goodyear *et al.*, 2004). Significant differences between typical female interactions, compared with male student participation patterns, also have been observed in scaffolded online discussion forums (Jeong, 2006). While fewer studies have considered the impact of the participants' age, there are inconsistencies in their findings. Favorable results have been shown to occur for older students (Chyung, 2007), while Gay *et al.* (2006) showed more positive learning outcomes for younger students.

A range of variables measuring students' online learning performance has been investigated in the studies on computer-mediated communication. In the studies on scaffolded online learning these variables typically include: (a) students' participation in online learning, typically expressed by a number or volume of online contributions (Pifarre, 2007; Sloffer *et al.*, 1999), (b) students' engagement with online discourse, typically expressed by the various quality features of their online contributions (Choi, Land & Turgeon, 2005; Sloffer *et al.*, 1999), and (c) their externally assessed learning outcomes (Cho & Jonassen, 2002; Pifarre, 2007).

On this basis, an analytical framework for the study about students' beliefs and their use of the knowledge labels was developed (see Figure 1).

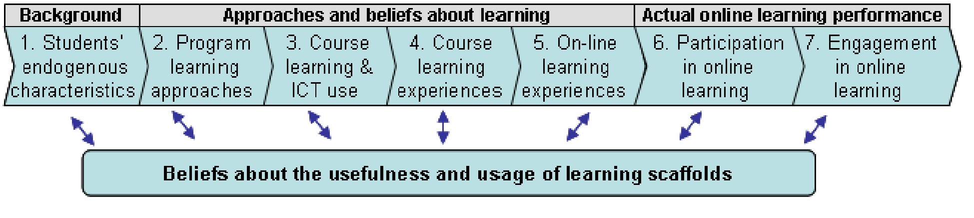


Figure 1. Analytical model of students' beliefs about the usefulness and usage of learning scaffolds.

Table 2. Summary of main variables investigated in the study.

Component [source]	Variable
Student endogenous characteristics [questionnaire]	GEN: Gender AGE: Age ACC: Access to ICT ILE: ICT-supported learning experience IUE: ICT use experience
Program learning approaches [R-SPQ-2F 20 item scale]	DLA: Deep learning approach SLA: Surface learning approach
Course learning and ICT use [questionnaire]	TSL: Study 1 work hrs per week TCN: Computer use for non-learning hrs per week TCL: Computer use for learning hrs per week
Course learning experiences [10 item scale]	IDL: Individual learning ITL: Interactive learning PBL: Problem-based learning
Online learning experiences [21 item scale]	MOL: Meaningfulness of the online learning DOR: Design and organization
Participation in online learning [online transcripts]	MES: Average total number of messages PAR: Average number of paragraphs LEN: Total number of words posted
Engagement in online learning [online transcripts]	ICE: Index of cognitive engagement ISCE: Index of socio-cognitive engagement ISE: Index of social engagement IR: Index of reflection

This framework includes seven groups of factors that were operationalized using 22 variables (see Table 2). The variables for the study were selected on the basis of previous research, by matching different aspects of the previously discussed factors to available data relevant in this learning context.[2]

4. Method

4.1. *Participants and the research context*

Participants were 270 first year graduates enrolled in the two-year teacher-training program (MTeach) at the University of Sydney. The research took place within a course, "Introduction to teaching and learning" (Study-1), during a 12-week period in the first semester. The course design was based on the concept "teacher as critically reflective practitioner" (Brookfield, 1995). The Study-1 unit aimed to support

[2]Some factors were not relevant in this specific learning context and thus were not analyzed. For example, students had very similar academic experience (i.e., as a minimum, they had completed a Bachelors degree); therefore, this parameter was not investigated. In addition, the course was not graded (i.e., "Pass" or "Fail" assessment) and, subsequently, the study did not use any measure of externally assessed learning outcomes.

various learning processes, including several compulsory components: lectures, face-to-face seminars, observation visits to schools, maintaining an individual learning journal, independently reading academic papers, and discussing prescribed readings in an online learning forum. An asynchronous online learning environment supported the last component, reinforcing the preservice teachers' integration of theoretical and practical components of their knowledge. Each week students read one or two academic papers, related to weekly unit topics (e.g. motivation, cognition, and teacher identity), and posted individual contributions (about 300 words) in an online discussion forum. In their posts students were asked to summarize three important points from the readings and to discuss these in light of their personal experiences and how the ideas related to their perceptions of their future work as a teacher.

The online environment was organized into two different discussion forums, "Reading Groups" and "Seminar Space". Students posted their initial contributions to their reading group, each containing approximately 5 students. The group's views were then synthesized, posted, and discussed with an experienced school-teacher and university academics in a larger seminar space (with approximately 25 students, one school teacher, and one academic). The students' individual posts to their reading group reflected personal responses to the reading, whereas posts to the seminar space reflected the group's engagement. The students' individual posts to their reading groups were analyzed in this research.

The online learning forum was developed using an open-source content management system, "Plone". Before posting messages to the online forums, participants were asked to structure messages into paragraphs and characterize each paragraph using one of seven pre-specified knowledge labels (Table 1). The purpose and meaning of each label and how to use them were explained in the course resource book and introduced during the first face-to-face lecture.

4.2. *Instruments and data*

Three main sources of data were used for the research: (a) a survey of the students' learning experience, completed at the end of the semester; (b) students' background information, collected in a survey at the beginning of the semester; and (c) the students' labeled contributions to their reading groups, which were automatically collected in Plone over the semester. A section of the background information survey collected data on the students' gender, age, previous experience of learning with ICT, and their self-rating of ICT expertise. The survey of the students' learning experience included the following main aspects: (a) their study approaches in the program; (b) their beliefs about the impact of the course "Introduction to teaching and learning" (Study-1) on their professional knowledge; (c) their online learning experiences in the course; (d) information regarding their use of ICT and independent study in the course. (See Appendix A for a more detailed description of the student learning experience survey.)

In total, 172 (64%) students voluntarily completed the learning experience survey. Of these, 161 provided valid personal identification numbers. For these students survey data was complemented with the information about their weekly posts (i.e., quantitative information about students' contributions to their online reading groups). 139 students completed the background survey at the beginning of the semester. This data was also combined with the learning experience survey.

5. Data Analysis and Procedure

Data analysis was accomplished in four steps. In the first step, students' background variables from the beginning of the semester (and gender for all non-anonymous students) were analyzed. Second, three scales, included in the students' experience survey, were examined using factor and scale reliability analysis. Determinants, Bartlett's Test of Sphericity, and KMO measures were used to assess the adequacy of the datasets for factor analysis. Then, Principal Axis Factoring, with varimax rotation and eigenvalues more than one, was employed for main factor extraction. Each subscale was developed from the extracted factors by including items loading at 0.4 or above. Cronbach's αs were calculated to check reliabilities. Average factor scores with equal item weights were then calculated and examined.

In the third step, parameters of students' participation and engagement in online learning, based on the analysis of students' online learning transcripts, were calculated and analyzed. The labels the participants attached to the paragraphs (Table 1) were assigned cognitive weights, ranging from 0 to 3. Weights were determined using Garrison *et al.*'s (2000) taxonomy of cognitive presence, reflecting the level of students' cognitive engagement with knowledge discourse (Markauskaite, Sutherland & Reimann, 2006; Markauskaite & Sutherland, 2008). For each student, three participation parameters (the total number of messages, the number of paragraphs, and the number of words posted by each participant), and four indicators characterizing students' engagement in online learning (Table 3) were calculated. The survey data, parameters of students' online learning, and background information were combined for the final analysis.

In the fourth step, the relationships between students' answers, for the two questions concerning the usefulness and the usage of the knowledge labels, and other parameters were examined. Hierarchical regression was used to examine significant relationships between these and the previously identified variables (see Figure 1).

5.1. *Reliability*

Reliability of participants' self-coding was assessed externally on a semi-random sample of 244 messages. After rater reliability was established, each paragraph was weighted by the number of words; Hosti's percent of agreement (cr) and Cohen's kappa (k) on a weighted sample were calculated. The results indicated that students' labeling in reading group forums was sufficiently reliable, $k = 0.731$, $cr = 81.1\%$ (Rourke *et al.*, 2001).

Table 3. Description of the main indexes of students' engagement in online learning.

Index	Description	Range
ICE: Index of Cognitive Engagement	An average cognitive level of the messages. Based on the length of the text (words) labeled with the cognitive tags (1–3); i.e., text with non-cognitive tags (0) is excluded.	1–3
ISCE: Index of Socio-Cognitive Engagement	An average cognitive level of the messages. Based on the length of the text (words) labeled with non-cognitive (0) and cognitive tags (1–3); i.e. all text in the message is included.	0–3
ISE: Index of Social Engagement	An average proportion of the text (words) labeled with non-cognitive tags (0) in the messages.	0–1
IR: Index of Reflection	An average proportion of the text (words) labeled with "Reflection" tag (3) in a message.	0–1

Note: From, Markauskaite, L. & Sutherland, M. L. (2008). Exploring individual and collaborative dimensions of knowledge construction in an online learning community of practice. *Informatics in Education*.

6. Results

Based on the framework for the analysis outlined, the results manifest how preservice teachers' beliefs about the usefulness of knowledge labels and their usage of these labels relate to the previously identified exogenous and endogenous factors.

6.1. *Preservice teachers' demographics characteristics*

Of the 270 students enrolled in the program, 184 (68%) were female and 86 (32%) were male. Of the 172 (64%) students who completed the survey, 114 (66%) were female, 50 (29%) were male, while 8 (5%) students' gender was unknown. The proportion of female and male students in the course and in the sample was the same, χ^2 (1, $N = 270$) $= 0.64$, $p = 0.57$ (two-tailed). From the data collected at the beginning of the semester, the age of participants ranged from 20 to 49 years with a mean 27.63 years, $SD = 6.94$, $n = 139$. The majority of students (91%) had easy access to a computer and the Internet in the place where they did most of their off-campus studies. More than half of the participants (59%) had previously taken one or more courses with an online learning component. More than half (51%) of the students rated their experience using Microsoft Windows or Apple Macintosh as "Experienced", 43% as "Competent", and 6% as "Beginners". None of the students said they have "No experience".

6.2. *Study approaches in the program*

Analysis showed the factors, Deep Approach and Surface Approach, accounted for 32% of the variance in participants study approaches in the program (see

Appendix B). The average score of Deep Learning Approach factor ($M = 2.07$, $SD = 0.74$) was significantly higher than the score of Surface Learning Approach factor ($M = 1.10$, $SD = 0.64$), $t(161) = 11.02$, $p < 0.001$, effect size $r = 0.66$. These results indicated preservice teachers tended to pragmatically approach learning in this program, i.e. they, on average, "Sometimes" (1) applied surface learning approaches, but about "Half the time" (2) used deep approaches. Students' Deep Learning Approach factor score negatively correlated with the Surface Learning Approach factor score, $r = -0.29$, $p < 0.001$. This result indicated that these two factors represent contrasting approaches to learning, though these approaches are not mutually incompatible.

6.3. *ICT use and Study-1 learning*

On average, students used a computer up to 10.20 ($SD = 8.10$) hours per week for non-learning activities, as well as up to 13.30 ($SD = 17.70$) additional hours per week for learning activities. Apart from formal face-to-face Study-1 sessions, students spent on average 5.26 ($SD = 3.54$) hours each week completing Study-1 related activities.

6.4. *Impact of the course on professional knowledge*

Three factors, Individual Learning activities, Interactive Learning activities, and Problem-based Learning activities, explained 51% of the variance of the course's impact on their professional knowledge (see Appendix C). The variable, weekly focus sessions, loaded below 0.4 on all factors and was therefore excluded from the analysis. The results show that the average ratings of perceived impact of learning activities in Study-1 were between "Some" (2) and "High" (3). The impact of Interactive Learning activities was rated the highest ($M = 2.68$, $SD = 0.72$), followed by Problem-Based activities ($M = 2.41$, $SD = 0.86$), and Individual Learning activities ($M = 2.09$, $SD = 0.77$). Differences between the average ratings across the three activity types were significant, $F(2, 158) = 39.34$, $p < 0.001$, effect size $\eta^2 = 0.20$.

6.5. *Online learning experiences*

Three factors, explaining 53% of the variance (see Appendix D), related to students' online learning experiences: Meaningfulness of Online Learning experience, Design and Organization, and Approach to Labels. On average, students identified "Neutral" (2) in all three aspects of their online learning experience. They were most positive about the Meaningfulness of Online Learning experience ($M = 2.16$, $SD = 0.73$) followed by the Design and Organization ($M = 2.02$, $SD = 0.92$), and Approach to Labels ($M = 1.85$, $SD = 0.91$). The differences across all three factors were significant, $F(2, 156) = 8.18$, $p < 0.001$, effect size $\eta^2 = 0.05$.

Table 4. Main parameters of students' participation and engagement in reading group discussions.

Parameter	n	M	SD
LEN: Average length of all messages	161	2995	1657
MES: Average number of messages posted	161	8.12	3.11
PAR: Average number of paragraphs posted	161	41.04	19.59
ISCE: Index of Social-Cognitive Engagement	161	1.82	0.37
ICE: Index of Cognitive Engagement	161	1.96	0.33
ISE: Index of Social Engagement	161	0.07	0.09
IR: Index of Reflection	161	0.34	0.18

Note: M = Mean, SD = Standard Deviation, n = number of students.

6.6. *Students' participation and engagement in online discussions*

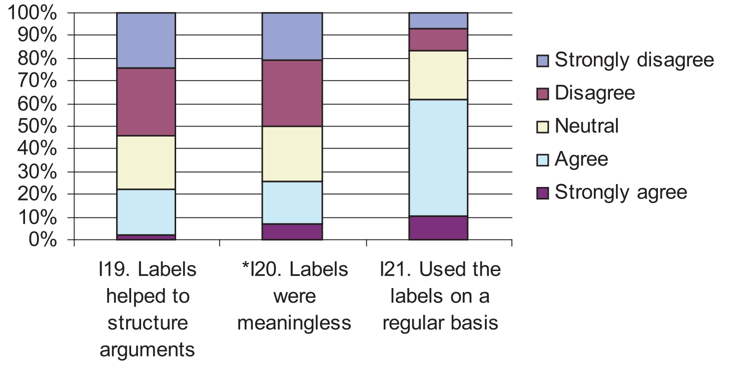
During the semester, each student posted 8.12 ($SD = 3.11$) messages on average and wrote 41.04 ($SD = 19.59$) paragraphs in the reading group discussion forums (see Table 4). The total average length of all students' contributions to the online discussion forums was 2,995 ($SD = 1,657$) words, indicating that students' messages were fairly long and comprehensive compared with the minimum course requirement of 300 words.

The average Indexes of Cognitive Engagement (ICE) and Reflection (IR) were 1.96 ($SD = 0.33$) and 0.34 ($SD = 0.18$), respectively. This indicates that, on average, students' texts labeled with cognitive tags were at the level of "Elaboration" and about one third of this text was labeled as "Reflection". The ICE was higher than ISCE ($M = 1.82$, $SD = 0.37$), indicating that students' messages contained some text labeled with non-cognitive tags. Nevertheless, the ISE was quite low ($M = 0.07$, $SD = 0.09$), indicating that, on average, only about 7% of the texts were labeled with non-cognitive tags.

6.7. *Students' beliefs about knowledge labels*

Three items (I19, I20 and I21) in the online learning experience scale and belonging to the factor Approach to Labels (see Appendix D) reflected students' beliefs about the usefulness (I19, I20) and their usage (I21) of learning labels in the online learning environment. These items were analyzed individually. In general, the students were negative about the labels. More than half of the students strongly disagreed or disagreed that the labels helped to structure their arguments (I19), and agreed or strongly agreed that they were meaningless (I20) (see Figure 2). Despite this trend, 62% agreed or strongly agreed that they used the labels on a regular basis (I21).

Answers to all three items significantly correlated. The relationship between students' answers about the usefulness (I19) and meaningfulness (reversed I20) of labels was strong, $r = 0.75$, $p < 0.001$. The two answers positively correlated with the students' agreement that they used labels on a regular basis (I21) $r = 0.35$ and $r = 0.31$, respectively, $p < 0.001$, but the relationships were not as strong. As students' answers regarding the usefulness and meaningfulness of labels were



Note. *Reversed scale. The ns for Items 19 through 21 were 158, 157 and 157, respectively.

Figure 2. Students' answers about the usefulness and meaningfulness of the labels, and their usage (see Appendix D for exact item wording).

strongly correlated, only one of these two items (usefulness) and students' answers about their usage of the labels were explored in detail.

6.8. *Students' beliefs about the usefulness of the labels*

There was no significant difference ($p > 0.05$) in beliefs about the usefulness of the labels between: (a) female and male students; (b) those who had easy access to a computer and internet off-campus and those who did not have such access; and, (c) those students who had used ICT for learning before the course and those who had not. Students' age and previous expertise with Microsoft Windows or Apple computer did not relate to their beliefs about the labels either, $p > 0.05$ (Table 5).

Students' beliefs about the usefulness of labels positively correlated with the Deep Learning Approach (DLA) factor ($r = 0.32$, $p < 0.001$), whereas it negatively and less strongly correlated with the Surface Learning Approach (SLA) factor ($r = -0.18$, $p < 0.05$) (Table 5). This relationship indicated that students with a deeper approach to the learning in this program tended to find labels more useful for structuring arguments; while students with a more surface approach to the learning tended to find labels less useful.

Students' beliefs about the usefulness also positively correlated with beliefs regarding course impact on their professional knowledge (IDL, ITL and PBL). The correlation was strongest with students' beliefs about the value of Individual Learning activities ($r = 0.49$, $p < 0.001$), followed by a correlation with beliefs about the Interactive Learning ($r = 0.32$, $p < 0.001$) and Problem-Based Learning activities ($r = 0.17$, $p < 0.05$). Students' beliefs regarding the usefulness of labels were associated with their online learning experiences of the course (MOL and DOR). The correlation with the beliefs about the Meaningfulness of the Online Learning was the strongest ($r = 0.44$, $p < 0.001$), followed by a correlation with students' beliefs on Design and Organization ($r = 0.32$, $p < 0.001$).

Table 5. Relationships between students' beliefs about the labels, their use, and other variables.

Variable[a]	The usefulness of the labels (I19)				The usage of the labels on a regular basis (I21)			
	r	*SD/D* *M* (*SD*)	*N* *M* (*SD*)	*A/SA* *M* (*SD*)	*r*	*SD/D* *M* (*SD*)	*N* *M* (*SD*)	*A/SA* *M* (*SD*)
1. AGE: Age in years	0.10	27.18 (6.65)	26.80 (6.67)	29.38 (7.49)	−0.06	28.86 (8.95)	26.33 (5.27)	27.67 (6.77)
1. EXP: Experience with Windows or Apple Macintosh	−0.01	2.42 (0.64)	2.52 (0.65)	2.38 (0.56)	0.10	2.43 (0.60)	2.26 (0.71)	2.50 (0.60)
2. DLA: Deep learning approach	0.32***	1.87 (0.75)	2.26 (0.58)	2.36 (0.78)***	−0.06	2.22 (0.75)	2.06 (0.68)	2.03 (0.78)
2. SLA: Surface learning approach	−0.18*	1.16 (0.67)	1.10 (0.60)	0.93 (0.66)	−0.23***	1.36 (0.69)	1.32 (0.73)	0.95 (0.58)**
2. TSL: Study 1 work hrs per week	0.30***	4.17 (2.73)	6.46 (4.05)	6.46 (3.91)***	0.13	4.36 (3.65)	5.34 (3.87)	5.43 (3.37)
3. TCN: Computer use for non-learning hrs per week	−0.05	10.90 (8.45)	9.05 (9.30)	9.70 (6.15)	−0.04	10.2 (7.55)	11.40 (10.95)	9.85 (7.35)
3. TCL: Computer use for learning hrs per week	0.22**	12.00 (6.65)	13.09 (9.65)	16.6 (8.50)*	0.08	11.60 (7.60)	14.85 (10.05)	13.55 (7.15)
4. IDL: Individual learning	0.49***	1.76 (0.73)	2.28 (0.62)	2.63 (0.63)***	0.15	1.87 (0.75)	2.00 (0.90)	2.15 (0.73)
4. ITL: Interactive learning	0.32***	2.46 (0.69)	2.80 (0.68)	3.06 (0.65)***	0.02	2.74 (0.70)	2.45 (0.58)	2.72 (0.75)
4. PBL: Problem-based learning	0.17*	2.28 (0.93)	2.51 (0.76)	2.61 (0.78)	−0.01	2.38 (0.92)	2.43 (0.88)	2.40 (0.86)
5. MOL: Meaningfulness of the online learning	0.44***	1.89 (0.69)	2.40 (0.63)	2.55 (0.68)***	0.09	2.11 (0.81)	1.91 (0.73)	2.24 (0.69)
5. DOR: Design and organization	0.32***	1.77 (0.88)	2.15 (0.86)	2.50 (0.89)***	0.08	1.92 (0.98)	1.78 (0.93)	2.12 (0.89)

Table 5. (*Continued*)

Variable[a]	The usefulness of the labels (I19)				The usage of the labels on a regular basis (I21)			
	r	SD/D M (SD)	N M (SD)	A/SA M (SD)	r	SD/D M (SD)	N M (SD)	A/SA M (SD)
6. MES: Average total number of messages	0.06	8.17 (2.63)	7.88 (3.15)	8.44 (4.37)	0.11	8.15 (2.49)	7.00 (2.90)	8.58 (3.38)
6. PAR: Average Number of Paragraphs	0.09	40 (18)	43 (21)	41 (20)	0.28***	35 (11)	33 (16)	45 (20)***
6. LEN: Total number of Words posted	0.11	2961 (1234)	2945 (1559)	3185 (2580)	0.21*	2667 (1153)	2459 (1172)	3269 (1878)*
7. ICE: Index of cognitive engagement	0.20*	1.91 (0.35)	1.97 (0.27)	2.07 (0.31)	0.43***	1.65 (0.32)	1.94 (0.37)	2.06 (0.26)***
7. ISCE: Index of socio-cognitive engagement	0.26***	1.75 (0.41)	1.87 (0.26)	1.95 (0.31)**	0.46***	1.46 (0.44)	1.80 (0.40)	1.93 (0.25)***
7. ISE: Index of social engagement	−0.25***	0.09 (0.10)	0.05 (0.04)	0.06 (0.05)*	−0.32***	0.13 (0.15)	0.08 (0.07)	0.06 (0.06)***
7. IR: Index of reflection	0.19*	0.31 (0.18)	0.34 (0.18)	0.40 (0.18)*	0.28***	0.22 (0.15)	0.33 (0.21)	0.37 (0.17)***
n	158	86	37	35	157	26	34	97

Note: SD/D = Strongly Disagree or Disagree, N = Neutral, A/SA = Agree or Strongly Agree, r = Pearson's correlation, M = Mean, SD = Standard Deviation, n = number of students.
[a]Numbers before variables correspond to the component numbers in Figure 1.
$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.

The parameters of students' participation in the online learning (i.e., number of contributions, number of the paragraphs, and total number of words) did not correlate significantly with beliefs relating to the usefulness of labels. In contrast, all parameters of students' engagement with knowledge discourse (ICE, ISCE, ISE and IR) correlated significantly, $p < 0.05$. This relationship was positive with all indexes characterizing the level of students' cognitive engagement (ICE, ISCE, and IR) and negative with the index characterizing students' social engagement (ISE). This finding indicates that students participated in the online discussions and wrote similar length contributions regardless of their beliefs concerning the usefulness of labels. Nevertheless, students who found the labels more useful tended to apply higher cognitive level tags to their contributions. Students who did not perceive labels as useful more often labeled their texts with non-cognitive tags or used the default option.

Variables that were significantly related with the students' beliefs about the usefulness of the labels were grouped into the components shown in Figure 1 and their joint relationship with the students' beliefs was explored with hierarchical regression. Table 6 shows the results' summary. Of the original seven components listed in Table 5, two components (Components 1 and 6) were not included in the regression because they did not show a significant relationship to Item 19. Thirteen variables, belonging to five different components, were entered into the regression in five steps. At the first step, regression explained 9% of variance in the students' beliefs about the usefulness of labels and was statistically significant ($p < 0.01$). The variables entered in the next four steps explained a further 4%–12% of variance. All increments were statistically significant ($p < 0.01$). The final regression explained 34% of the variance. The regression coefficients of the following five components were positive and significant: (a) deep learning approach; (b) time spent weekly for Study-1 work; (c) individual learning experience of the course; (d) beliefs about the meaningfulness of the online learning, and (e) social and cognitive engagement.

Table 6. Summary of hierarchical regression analysis for variables related to students' beliefs about the usefulness of the labels and their usage.

The usefulness of the labels (I19)					
Step	Comp	Var	B	SE B	β
1	2	DLA	0.27	0.12	0.17*
2	3	TSL	0.04	0.02	0.13*
3	4	IDL	0.32	0.13	0.23*
4	5	MOL	0.32	0.13	0.21*
5	7	ISCE	0.66	0.22	0.22**

Note: *Comp* = Component (see Figure 1), *Var* = Variable, $n = 140$, $R^2 = 0.34$ for full Model: $R^2 = 0.09$ for Step 1, $\Delta R^2 = 0.06$ for Step 2, $\Delta R^2 = 0.12$ for Step 3, $\Delta R^2 = 0.03$ for Step 4 and $\Delta R^2 = 0.04$ for Step 5 (ps < 0.01). Only variables with significant regression coefficients are shown.
*$p < 0.05$, **$p < 0.01$.

The usage of the labels on a regular basis (I21)					
Step	Comp	Var	B	SE B	β
1	2	SLA	−0.04	0.01	−0.22**
2	6	PAR	0.01	0.00	0.23***
3	7	ISCE	1.22	0.20	0.43**

Note: *Comp* = Component (see Figure 1), *Var* = Variable. $n = 144$, $R^2 = 0.33$ for full Model: $R^2 = 0.07$ for Step 1, $\Delta R^2 = 0.20$ for Step 2 and $\Delta R^2 = 0.05$ for Step 3 (ps < 0.01). Only variables with significant regression coefficients are shown.
**$p < 0.01$, ***$p < 0.001$.

6.9. *Students' beliefs about their usage of the labels*

Students' answers about their usage of labels on a regular basis were not related to background variables, average time that students spent weekly using a computer for learning and non-learning activities, or doing Study-1 work ($p > 0.05$). Further, students' beliefs about the impact of Study-1 on their professional knowledge (IDL, ITL and PBL) and their online learning experience (MOL and DOR) were also unrelated. Nevertheless, students' answers about the use of labels were related to their learning approaches in the program (DLA and SLA). The correlation with the Deep Learning Approach (DLA) factor score was very small and insignificant ($p > 0.05$). This suggests that students with higher and lower scores on the Deep Learning Approach factor used labels similarly. (In a larger population no correlation would be expected). There was a negative correlation between reporting of their use of knowledge labels and a Surface Learning Approach (SLA) to learning ($r = -0.23$, $p < 0.001$). This suggests that students with higher scores on the Surface Learning Approach factor tended not to use the labels or used them less mindfully.

Students' answers about their usage of the labels did not relate to the average number of their contributions in the reading group forums. However, students, who said that they used labels regularly wrote on average, significantly more paragraphs and words, $r = 0.28$, $p < 0.001$ and $r = 0.21$, $p < 0.05$, respectively. As Table 5 shows, students with positive beliefs wrote 10 more paragraphs on average during the semester than peers with negative and neutral beliefs.

Students' answers about their usage of the labels were positively correlated with indexes characterizing cognitive engagement (ICE, ISCE, and IR) and negatively with the index of social engagement (ISE), $p < 0.001$. This indicates that students' answers regarding the usefulness and their usage of these labels were associated with cognitive and social engagement in a similar way. The associations of engagement indexes with students' answers about the *usage* of labels were stronger than the associations with answers about the *usefulness*.

In total, seven variables belonging to three different components significantly correlated with students' answers about their usage of labels. These variables were entered into the hierarchical regression in three steps. The regression obtained at the first step explained 7% of the variance in the students' answers and was statistically significant ($p < 0.01$). The variables entered into the equation in the next two steps explained a further 20% and 5% of variance. Both increments were statistically significant ($p < 0.01$). The final regression explained 33% of the variance and the regression coefficients of the following three variables were significant: (a) surface learning approach; (b) number of paragraphs written; and, (c) social and cognitive engagement. The regression coefficient of the first variable was negative, whereas the other two were positive.

7. Discussion

Large-scale and long-term research studies examining the factors impacting students' learning and engagement within online environments are still rare in higher education (Goodyear *et al.*, 2004; Luppicini, 2007). Few studies have examined the extent that technological scaffolds, such as knowledge labels, can be used to effectively support a range of learning processes simultaneously, and, in particular, students' engagement in individual and collaborative reflection in online environments (Lin *et al.*, 1999; Quintana *et al.*, 2004).

This study addressed these questions by examining how students' beliefs regarding the usefulness and their regular usage of knowledge labels related to the complex set of interrelated factors characterizing them as learners, the learning processes, and the outputs. The research used correlation and regression analyses to examine how students' beliefs regarding labels related to (a) their' endogenous characteristics prior to the engagement, (b) their study approaches and beliefs related to various aspects of learning, and (c) their online performance.

The study revealed that students' beliefs regarding the usefulness of knowledge labels and their perceptions about their own usage of labels on a regular basis in their learning were interrelated. Students who found labels more useful tended to affirm that they used labels more regularly and vice versa. Nevertheless, detailed investigation showed clear differences between students' beliefs regarding usefulness and their systematic usage of labels.

Students' endogenous factors, such as gender, age, general ICT experience, and prior experience in online learning were not related significantly with their beliefs about the usefulness and their usage of labels. This finding differs from previous generic studies on students' networked learning experiences which often found older, more experienced, and male students were more positive regarding online learning experiences (Gay *et al.*, 2006; Goodyear *et al.*, 2004; Muse, 2003; Schrum & Hong, 2002). This discrepancy suggests that further investigation is needed.

This study has also shown that students' beliefs regarding the usefulness and systematic usage of labels were differently associated with their learning approaches and beliefs about the learning process and online contributions. Students' approach to learning is one factor, which clearly demonstrates the difference between students' beliefs about the usefulness and regular usage of the labels in their own learning. A deep learning approach, as measured by the R-SPQ-2F inventory (Biggs *et al.*, 2001), was positively associated with students' beliefs about the usefulness, of labels but was not significantly correlated with students' beliefs regarding the regular usage of labels. Yet, a surface learning approach negatively correlated with the students' beliefs regarding both usefulness and regular usage of the labels. These results suggest that there was a positive link between students' deep learning approach and their positive beliefs about the usefulness of labels. In contrast, a deep approach to learning did not relate to the regular usage of these labels. This suggests that some students accepted and used labels for structuring their messages regularly, even if they did not hold an explicit deep learning approach. However, a surface learning approach was negatively related to students' beliefs about the regular usage of labels, suggesting that those students who hold a stronger surface learning approach tended to use labels irregularly or labeled less mindfully. These results were in line with the findings in other broader studies on students' study styles and online learning experiences, indicating that students with a deeper learning approach typically have better online learning experiences (Goodyear *et al.*, 2004).

Students' learning approaches, including time spent for learning and perceptions of positive learning experiences in the Study-1 course, were not related to the systematic usage of the labels, but they were related to students' positive beliefs about the usefulness of labels. The correlations with the students' beliefs about the individual Study-1 learning activities and the meaningfulness of the online learning were much stronger in this relationship compared with other aspects of students' learning experience in this course (e.g., lectures, seminars, and case study analysis). This finding suggests that only conscious use and appreciation of the scaffolds enhanced students' learning experiences, whereas mechanical systematic use of the scaffolds did not contribute to students' learning experiences.

In contrast, the parameters of students' participation in the online learning were not related with their beliefs about usefulness. However, several parameters were related to the students' beliefs regarding the regular usage of the labels. Notably, students' answers about the usage of the labels did not relate to the number of posted messages, indicating that all students made an almost equal (close to a required minimum) number of contributions. Nevertheless, these answers were related to the number of paragraphs and words that the students wrote and posted over the semester. This indicates that those students who reported using labels more regularly generally wrote longer and more elaborated messages. One likely reason for this is that those students who were more mindful about knowledge labels, and used them regularly also exerted more deliberative effort in structuring and elaborating their discourses.

Further support for this proposition comes from examination of students' engagement indexes. All parameters of students' engagement with the knowledge discourse correlated with both students' beliefs about the usefulness and the regular usage of labels. The correlations with the latter variable were stronger than with the former. This suggests that the labels were acting as scaffolds assisting students who used the labels to elaborate on ideas in the weekly readings. Overall, the results suggest that positive opinion and regular usage of labels were positively associated with the students' deeper engagement with learning. This result is consistent with results from other studies reporting a positive impact of scaffolds on students' engagement when learning in collaborative online learning environments (Cho & Jonassen, 2002; Sloffer *et al.*, 1999).

8. Conclusions, Limitations, and Recommendations for Further Research

Students face a complex and challenging task in learning to become a teacher. They need to engage with theoretical and practical knowledge to integrate axiomatic systems of two different epistemic cultures. Further, they need to create their own professional understanding through active engagement with different kinds of knowledge and ways of knowing. Findings from this study suggest that asynchronous text-based computer conferencing and build-in technological scaffolds could provide preservice teachers with the affordances and constraints that help them to regulate their thinking, develop a persistent discourse, and, through articulation and reflection, construct their high-level professional understanding. Preservice teachers, however, are active interpreters of their own learning processes and learning environments. Variations in their conceptions of these affordances and constraints can affect their learning processes and outcomes. This study has primarily focused on detecting and understanding such variations in these students' conceptions. It has examined how their beliefs about the usefulness and usage of learning scaffolds in a specific course were related to a range of student-related factors typically impacting preservice teachers' learning experiences in online environments.

The results show that the preservice teachers' interpretations of labels were undoubtedly related to the learning process and outcomes. More positive beliefs about the usefulness and regular usage of these technological constrains were clearly associated with these students reporting deeper engagement with learning. There were also clear differences in the association of the students' beliefs about the usefulness and regular usage of the labels with other factors explored in this study. Results show that students who found labels more useful tended also to be deeper and more engaged learners. These students placed a higher value on their individual learning and their online learning experiences and tended to engage more deeply with knowledge discourse. Meanwhile, students who used labels systematically were neither deeper learners nor more positive about their learning experiences. Further studies investigating not only beliefs about the usefulness and usage of the labels but also students' interpretations of the labels and other factors associated with their use are needed.

Nevertheless, the study has shown students' beliefs about their usage of the labels were positively related to students' performance, including quantitative and qualitative measures of their participation and engagement. This suggests that students were likely to benefit from using labels, even if they did not acknowledge this benefit explicitly. It is likely that imposed technological constraints forced students who were mindful about the labels to be more conscious about the structure and meaning of their contributions and, consequently, to produce more elaborated discourses. This finding, however, should be treated with a note of caution: the measures of engagement were based on students' self-labeling and could be compounded by students' survey answers about the labels. Studies using external coding of online learning transcripts are needed to validate this result.

Overall, the findings indicate that labels support preservice teachers' engagement in reflective learning discourse. The results, however, do not indicate whether these improvements in the process of reflective inquiry sustain outside the learning environment in spontaneously structured situations, especially for those learners who use scaffolds without acknowledging their benefits. In addition, the large number of variables associated with students' beliefs about labels and the substantial amount of unexplained variance in the regression analysis reveal complexities associated with understanding the value of learning scaffolds for individual learners. Further studies are necessary to address these questions.

From the learning design perspective, the aim of this study was to provide students and teachers with an environment that could be used in a large course and could support different ways of learning and knowing, including individual and collaborative, reflective, and discursive forms. As discussed earlier, asynchronous computer conferencing has advantages as well as limitations. By enhancing a discussion forum with a basic set of labels to provide generic structure for elaboration of coherent discourse, we attempted to help scaffold students' progressive learning and improve efficiency of this medium. This study did not investigate whether students' beliefs were affected by a specific set of labels or whether and how students' beliefs changed in a different scaffolded learning environment. Additional research is needed to investigate these aspects.

References

Andersson, A. (2007). *Beyond student and technology: Seven pieces to complete the e-learning jigsaw puzzle in developing countries.* Paper presented at the 30th Information systems research seminar in Scandinavia, IRIS 2007, Tampere, Finland.

Barros, B., & Verdejo, M. F. (1999). *An Approach to Analyse Collaboration When Shared Structured Workspaces are Used for Carrying Out Group Learning Processes.* Paper presented at the 9th international conference AIED'99, Lemans.

Barros, B., & Verdejo, M. F. (2000). Analysing student interaction processes in order to improve collaboration. The DEGREE approach. *International Journal of Artificial Intelligence in Education*, *11*, 221–241.

Bereiter, C., & Scardamalia, M. (1996). Rethinking learning. In D. R. Olson & N. Torrance (Eds.), *Handbook of education and human development: New models of learning, teaching and schooling* (pp. 485–513). Cambridge, M.A.: Basil Blackwell.

Bereiter, C., & Scardamalia, M. (1998). Beyond bloom's taxonomy: Rethinking knowledge for the knowledge age. Developing higher-level approaches to knowledge. In A. Hargreaves, A. Lieberman, M. Fullan & D. Hopkins (Eds.), *International handbook of educational change* (pp. 675–692). Dordrecht: Kluwer Academic Publishers.

Biggs, J. (2003). *Teaching for quality learning at university* (2nd ed.). Buckingham: Open University Press.

Biggs, J., Kember, D., & Leung, D. Y. P. (2001). The revised two-factor study process questionnaire: R-SPQ-2F. *British Journal of Educational Psychology*, *71*(1), 133–149.

Brookfield, S. D. (1995). *Becoming a critically reflective teacher.* San Francisco: Jossey-Bass.

Chan, C. K. K., Burtis, P. J., Scardamalia, M., & Bereiter, C. (1992). Constructive activity in learning from text. *American Journal of Educational Research*, *29*(1), 97–118.

Cho, K.-L., & Jonassen, D. H. (2002). The effects of argumentation scaffolds on argumentation and problem solving. *Educational Technology, Research and Development*, *50*(3), 5–22.

Choi, I., Land, S., & Turgeon, A. (2005). Scaffolding peer-questioning strategies to facilitate metacognition during online small group discussion. *Instructional Science*, *33*(5–6), 483–511.

Chyung, S. Y. (2007). Invisible motivation of online adult learners during contract learning. *The Journal of Educators Online*, *4*(1), 1–22.

Collins, A. (2006). Cognitive apprenticeship. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 47–60). Cambridge: Cambridge University Press.

Connelly, F. M., Clandinin, D. J., & He, M. F. (1997). Teachers' personal practical knowledge on the professional knowledge landscape. *Teaching and Teacher Education*, *13*(7), 665–674.

Davis, B. H., & Brewer, J. P. (1997). *Electronic Discourse: Linguistic Individuals in Virtual Space*. Albany: State University of New York Press.

Dawson, K. (2006). Teacher inquiry: A vehicle to merge prospective teachers' experience and reflection during curriculum-based, technology-enhanced field experiences. *Journal of Research on Technology in Education*, *38*(3), 265–292.

Dillenbourg, P. (1999). What do you mean by collaborative learning? In P. Dillenbourg (Ed.), *Collaborative-learning: Cognitive and computational approaches* (pp. 1–15). Oxford: Pergamon.

Duffy, T. M., Dueber, B., & Hawley, C. L. (1998). *Critical thinking in a distributed environment: A pedagogical base for the design of conferencing systems.* Bloomington, IN: Indiana University.

Ean, K. C. (2005). *Thinking smart: Applying the theory of constraints in developing thinking skills.* Selangor: Pelanduk Pubns.

Ebbutt, D., Robson, R., & Worrall, N. (2000). Educational research partnership: Differences and tensions at the interface between the professional cultures of practitioners in schools and researchers in higher education. *Teacher Development*, *4*, 319–337.

Engeström, Y. (1999). Activity theory and individual and social transformation. In Y. Engestrom, R. Miettinen & R. Punamaki (Eds.), *Perspectives on activity theory* (pp. 19–38). NY: Cambridge University Press.

Fisher, T., Higgins, C., & Loveless, A. (2006). *Teachers learning with digital technologies: A review of research and projects.* Bristol, UK: Futurelab.

Gale, T., & Jackson, C. (1997). Preparing professionals: Student teachers and their supervisors at work. *Asia-Pacific Journal of Teacher Education*, *25*, 177–191.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, *2*(2–3), 87–105.

Gay, G., Mahon, S., Devonish, D., Alleyne, P. A., & Alleyne, P. G. (2006). Perceptions of information and communication technology among undergraduate management students in Barbados. *International Journal of Education and Development Using Information and Communication Technology*, *2*(4), 6–17.

Gilbert, P. K., & Dabbagh, N. (2005). How to structure online discussions for meaningful discourse. *British Journal of Educational Technology*, *36*(1), 5–18.

Goodyear, P., Jones, C., Asensio, M., Hodgson, V., & Steeples, C. (2004). Undergraduate students' experiences of networked learning in UK higher education: A survey-based study. In P. Goodyear, S. Banks, V. Hodgson & D. McConnel (Eds.), *Advances in research on networked learning* (pp. 91–121). Boston: Kluwer Academic Publishers.

Goodyear, P., & Zenios, M. (2007). Discussion, collaborative knowledge work and epistemic fluency. *British Journal of Educational Studies*, *55*(4), 351–368.

Greeno, J. G. (2006). Learning in activity. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 79–96). Cambridge: Cambridge University Press.

Gunn, C. (2003). Dominant or different? Gender issues in computer supported learning. *Journal of Asynchronous Learning Networks*, *7*(1), 14–30.

Hammond, M. (2005). A review of recent papers on online discussion in teaching and learning in higher education. *Journal of Asynchronous Learning Networks*, *9*(3), 9–23.

Hardy, V., Hodgson, V., & McConnell, D. (1994). Computer conferencing: A new medium for investigating issues in gender and learning. *Higher Education*, *28*(3), 403–418.

Hatton, N., & Smith, D. (1995). Reflection in teacher education: Towards definition and implementation. *Teaching and Teacher Education*, *11*(1), 33–49.

Hmelo-Silver, C. E. (2003). Analyzing collaborative knowledge construction: Multiply methods for integrated understanding. *Computers and Education*, *41*, 397–420.

Hsi, S., & Hoadley, C. M. (1997). Productive discussion in science: Gender equity through electronic discourse. *Journal of Science Education and Technology*, *6*(1), 23–36.

Jeong, A. (2006). Gender interaction patterns and gender participation in computer-supported collaborative argumentation. *American Journal of Distance Education*, *20*(4), 195–210.

Jeong, A., & Joung, S. (2004). *The effects of constraint-based argumentation on interaction patterns and argumentation in on-line threatened discussion.* Paper presented at the American Educational Research Association Conference, San Diego, CA.

Kimbrough, D. R. (1999). On-line "chat room" tutorials: An unusual gender bias in computer use. *Journal of Science Education and Technology*, *8*(3), 227–234.

Kozulin, A., & Presseisen, B. Z. (1995). Mediated learning experience and psychological tools: Vygotsky's and Feuerstein's perspectives in a study of student learning. *Educational Psychologist*, *30*(2), 67–75.

Land, S. M., & Zembal-Saul, C. (2003). Scaffolding reflection and articulation of scientific explanations in a data-rich, project-based learning environment: An investigation of progress portfolio. *Educational Technology Research and Development*, *51*(4), 65–84.

Lin, X., Hmelo, C., Kinzer, C. K., & Secules, T. J. (1999). Designing technology to support reflection. *Educational Technology, Research and Development*, *47*(3), 43–62.

Linn, M. C. (2005). Technology and gender equity: What works? In N. F. Russo, C. Chan, M. B. Kenkel, C. B. Travis & M. Vasquez (Eds.), *Women in science and technology.* NY: APA.

Luppicini, R. (2007). Review of computer mediated communication research for education. *Instructional Science*, *35*, 141–185.

Markauskaite, L., Sutherland, M., & Reimann, P. (2006). Interaction and cognitive engagement in the community of practice: The contradiction of terms? In Kinshunk, R. Koper, P. Kommers, P. Kirchner, D. G. Sampson & W. Didderen (Eds.), *The 6th IEEE international conference on advanced learning technologies* (pp. 623–625). Los Alamitos, CA: IEEE Computer Society.

Markauskaite, L., & Sutherland, M. L. (2008). Exploring individual and collaborative dimensions of knowledge construction in an online learning community of practice. *Informatics in Education*, in press.

McConnell, D. (1997). Interaction patterns of mixed sex groups in educational computer conferences. Part I — Empirical findings. *Gender and Education*, *9*(3), 345–363.

McLoughlin, C., & Oliver, R. (1998). Maximising the language and learning link in computer learning environments. *British Journal of Educational Technology*, *29*(2), 125–136.

Mercer, N. (2000). *Words and minds: How we use language to think together*. London: Routledge.

Mewborn, D. S., & Stanulis, R. N. (2000). Making the tacit explicit: Teacher educators' values and practices in a co-reform teacher education program. *Teacher Education Quarterly*, *27*(3), 5–22.

Morrison, T. (2001). *Actionable learning: A handbook for capacity building through case based learning*. Tokyo: ADBI Publishing.

Muse, H. E. (2003). The web-based community college student: An examination of factors that lead to success and risk. *The Internet and Higher Education*, *6*(3), 241–261.

Myers, W., Bennett, S., & Lysaght, P. (2004). *Asynchronous Communication: Strategies for Equitable e-Learning*. Paper presented at the Australian society for computers in learning in tertiary education, Perth.

Ohlsson, S. (1995). Learning to do and learning to understand: A lesson and a challenge for cognitive modelling. In P. Reimann & H. Spada (Eds.), *Learning in humans and machines: Towards an interdisciplinary learning science* (pp. 37–62). London: Pergamon.

Pea, R. D. (2004). The social and technological dimensions of scaffolding and related theoretical concepts for learning, education, and human activity. *Journal of the Learning Sciences*, *13*(3), 423–451.

Pifarre, M. (2007). Scaffolding through the network: Analysing the promotion of improved online scaffolds among university students. *Studies in Higher Education*, *32*(3), 389–408.

Quintana, C. *et al.* (2004). A scaffolding design framework for software to support science inquiry. *Journal of the Learning Sciences*, *13*(3), 337–386.

Rourke, L., Anderson, T., Garrison, D. R., & Archer, W. (2001). Methodological issues in the content analysis of computer conference transcripts. *International Journal of Artificial Intelligence in Education*, *12*, 8–22.

Salomon, G., & Perkins, D. N. (1998). Individual and social aspects of learning. *Review of Research in Education*, *23*(1), 1–24.

Scardamalia, M., & Bereiter, C. (1987). Knowledge telling and knowledge transforming in written composition. In S. Rosenberg (Ed.), *Advances in applied psycholinguistics. Reading, witting and language learning* (Vol. 2, pp. 142–175). Cambridge: Cambridge University Press.

Scardamalia, M., & Bereiter, C. (1993). Technologies for knowledge-building discourse. *Communications of the ACM*, *36*(5), 37–41.

Scardamalia, M., & Bereiter, C. (2003). Knowledge building. In J. W. Guthrie (Ed.), *Encyclopedia of education* (2nd ed., pp. 1370–1373). NY: Macmillan.

Scardamalia, M., & Bereiter, C. (2006). Knowledge building. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 97–115). Cambridge: Cambridge University Press.

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. NY: Basic Books.

Schrum, L., & Hong, S. (2002). From the field: Characteristics of successful tertiary online students and strategies of experienced online educators. *Education and Information Technologies*, *7*(1), 5–16.

Shulman, L. S. (1998). Theory, practice and the education of professional. *The Elementary School Journal*, *98*, 511–526.

Shulman, L. S., & Shulman, J. H. (2004). How and what teachers learn: A shifting perspective. *Journal of Curriculum Studies*, *36*(2), 257–271.

Sloffer, S. J., Dueber, B., & Duffy, T. M. (1999, January 5–8). *Using asynchronous conferencing to promote critical thinking: Two implementations in higher education*. Paper presented at the 32nd Hawaii international conference on system sciences, Hawaii.

Symes, C., & McIntyre, J. (Eds.). (2000). *Working knowledge: The new vocationalism and higher education*. Buckingham: Open University Press.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1986). *Thought and language*. Cambridge, MA: MIT Press.

Weinbeger, A., Ertl, B., Fischer, F., & Mandl, H. (2005). Epistemic and social scripts in computer-supported collaborative learning. *Instructional Science*, *33*(1), 1–30.

Wideen, M. F., Mayer-Smith, J., & Moon, B. (1996). Knowledge, teacher development and change. In I. F. Goodson & A. Hargraves (Eds.), *Teachers' professional lives* (pp. 187–204). London: Falmer Press.

Wood, D., Bruner, J., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry*, *17*, 89–100.

Yukawa, J. (2006). Co-reflection in online learning: Collaborative critical thinking as narrative. *International Journal of Computer-Supported Collaborative Learning*, *1*(2), 203–228.

Appendix A

Student experience survey.

Component of the Instrument	Number of Items	Assesses	Factors Extracted [Number of Items]	Variance Accounted for
Program learning approaches[a]	20	Study approaches in the program	Surface learning [8] Deep learning [8]	14% 18%
Course learning experiences[b]	10	Student teachers' beliefs about the impact of the core components' of the course on their professional knowledge	Individual Learning [3] Interactive Learning [4] Problem-based Learning [2]	19% 17% 15%
Online learning experiences	21	Feelings about using technologies and online learning experiences in the course	Meaningfulness of online learning experience [12] Design and organization [3] Approach to labels [3]	30% 14% 10%
Course learning and ICT use	3	Three interval variables measuring how many hours per week student teachers allocated for various ICT use and independent learning activities in the course	Independent Study 1 work [1] Computer use for non-learning [1] activities Computer use for learning activities [1]	NA NA NA

Note: NA = Not Applicable

[a]Adapted Revised Study Process Questionnaire (R-SPQ-2F), from Biggs, J., Kember, D., & Leung, D. Y. P. (2001). The revised two-factor Study Process Questionnaire: R-SPQ-2F. *British Journal of Educational Psychology*, *71*(1), 133–149.

[b]Following approach described in Goodyear, P., Jones, C., Asensio, M., Hodgson, V., & Steeples, C. (2004). Undergraduate students' experiences of networked learning in UK higher education: A survey-based study. In P. Goodyear, S. Banks, V. Hodgson & D. McConnel (Eds.), *Advances in research on networked learning* (pp. 91–121). Boston: Kluwer Academic Publishers.

Appendix B

Study Approaches: Rotated Factor Matrix.

Items	Factor Loadings				
	DLA	SLA	—	—	—
6. I find most new topics interesting and often spend extra time trying to obtain more information about them	0.84				
14. I spend my free time finding out more about interesting topics which have been discussed in different classes	0.71				
9. I find that studying some topics can at times be as exciting as a good novel or movie	0.67				
13. I work hard at my studies because I find the material interesting	0.63				
1. I find that at times studying gives me a feeling of deep personal satisfaction	0.62				
5. I feel that virtually any topic can be highly interesting once I get into it	0.50				
10. I test myself or reflect on important topics until I understand them completely	0.48				
17. I come to most classes with questions in mind that I want answering	0.48				
20. I find the best way to pass assessments is to try to remember answers to likely questions		0.57			
15. I find it is not helpful to study topics in depth. It wastes time, when all you need is a passing acquaintance with topics		0.55			
4. I only study seriously what is given out in class or in the course outlines		0.55			
11. I find I can get by in most assessments by reading and summarising key sections rather than trying to understand them		0.54			
8. I learn some things by rote even if I do not understand them		0.54			
12. I generally restrict my study to what is specifically set as I think it is unnecessary to do anything extra	−0.30	0.53		−0.33	−0.30
7. I do not find my course very interesting so I keep my work to the minimum		0.53			
3. My aim is to pass the course while doing as little work as possible		0.51			0.44
19. I see no point in learning material which is not likely to be in the assessment			0.87		
16. I believe that lecturers shouldn't expect students to spend significant amounts of time studying material everyone knows won't be assessed			0.45		
18. I make a point of looking at most of the suggested readings that go with the lectures				0.67	

(*Continued*)

Items	Factor Loadings				
	DLA	SLA	—	—	—
2. I find that I have to do enough work on a topic so that I can form my own conclusions before I am satisfied					−0.47
Cronbach's α	0.84	0.79			
M	2.07	1.10			
n	162	162			
SD	0.74	0.64			

Note: Method — Principal Axis Factoring with varimax rotation, listwise deletion (n = 149). Loadings 0.3 and above are shown. DLA = Deep Approach, SLA = Surface Approach. Original item numbers are shown (Biggs *et al.*, 2001). M = Mean, SD = Standard Deviation, n = number of respondents for individual factor score. Question: "The questions in this section ask you about your attitudes towards your studies and your usual way of studying in MTeach program. There is no right way of studying. It depends on what suits your own style and the course you are studying. It is accordingly important that you answer each question as honestly as you can. If you think your answer to a question would depend on the subject being studied, give the answer that would apply to the subject(s) most important to you in MTeach program and related to your future job as a teacher. Please choose the one most appropriate response to each question". Scale: 0 = Never or almost never, 1 = Sometimes, 2 = Half of the time, 3 = Frequently, 4 = Always or almost always.

Appendix C

The Impact of Study-1 Course on Professional Knowledge: Rotated Factor Matrix.

Items	Factor Loadings		
	IDL	ITL	PBL
10. The learning portfolio assessment task	0.86		
8. Maintaining a learning journal	0.70		
3. Your weekly readings	0.52		
1. The weekly focus sessions (lectures)	0.36	0.34	
4. Your peers' comments on weekly readings		0.69	
5. The teacher's postings and comments on weekly readings		0.57	
7. The face-to-face seminars		0.54	
6. The school observation visits		0.48	
2. The case studies			0.91
9. The case study assessment task			0.73
1. The weekly focus sessions (lectures)	0.36	0.34	
M	2.09	2.6	2.41
n	162	160	160
SD	0.77	0.72	0.86
Cronbach's α	0.78	0.69	0.86

Note: Method — Principal Axis Factoring with varimax rotation, listwise deletion (n = 155). Loadings 0.3 and above are shown. IDL = Individual Learning, ITL = Interactive Learning, PBL = Problem-Based Learning. Original item numbers are shown. M = Mean, SD = Standard Deviation, n = number of respondents for individual factor score. Question: "Please rate the impact of the following aspects of the Study-1 unit on your understanding of learning and teachers' work. Choose the one most appropriate response." Scale: 0 = None or almost none, 1 = Little, 2 = Some, 3 = High, 4 = Major.

Appendix D

Online Learning Experience: Rotated Factor Matrix.

	Factor Loadings		
Items	MOL	DOR	ALA
9. My interaction with peers was effective in the online environment	0.78		
*12. The online communication was NOT really useful and/or meaningful in this unit	0.77		
13. The online component had significantly contributed to my understanding of learning and teachers' work	0.73		
11. In the online activities of the Study 1 unit, I felt I was part of group of people who were committed to learning	0.72		
2. The online discussion forum was an appropriate learning method to organize weekly readings in Study 1 unit	0.68	0.35	
15. The online component of Study 1 was intellectually stimulating	0.65		
*16. The online component contributed very little to my professional and/or personal development	0.60		
10. Our communication with teachers was effective in the online environment	0.59		
14. The online learning of the Study 1 unit enhanced my understanding about the use of ICT in teaching and learning	0.58	0.34	
*3. The use of ICT was NOT particularly meaningful in this unit	0.58	0.38	
*18. I would be happier doing this course without using technologies	0.58		
1. The objectives of the online component were clear to me	0.44	0.31	
*7. The online component was NOT sufficiently well designed and organized		0.80	
5. The online learning process was appropriately organized and managed		0.77	
4. The online environment was well designed and easy to use		0.69	
19. The labels helped me to structure my arguments in my postings			0.84
*20. The labels were meaningless in the Study 1 online discussion forum			0.82
21. I used the labels on a regular basis in the Study 1 online discussion forum			0.42
Cronbach's α	0.92	0.85	0.74
M	2.16	2.02	1.85
n	157	157	157
SD	0.73	0.92	0.91

Note: Method — Principal Axis Factoring with varimax rotation, listwise deletion ($n = 151$). Loads 0.3 and above are shown. MOL = Meaningfulness of Online Learning, DOR = Design and Organization; ALA = Approach to Labels. *M* = Mean, *SD* = Standard Deviation, *n* = number of respondents for individual factor score. Original item numbers are shown (items 6, 8 and 17 removed prior to factor analysis). Question: "The following questions ask you about the online component of the Study-1 unit. Please choose the one answer that most closely reflects your feelings about using technologies to learn this unit." Scale: 0 = Strongly disagree, 1 = Disagree, 2 = Neutral, 3 = Agree, 4 = Strongly agree. *Reversed scale.