Article:

Li, X., Cox, A.M. and Ford, N. (2017) Knowledge Construction by Users: A Content Analysis Framework and A Knowledge Construction Process Model for Virtual Product User Communities. Journal of Documentation, 3 (2). pp. 284-304. ISSN: 0022-0418

https://doi.org/10.1108/JD-05-2016-0060

Knowledge Construction by Users: A Content Analysis Framework and A Knowledge Construction Process Model for Virtual Product User Communities

Journal:	*Journal of Documentation*
Manuscript ID	JD-05-2016-0060.R1
Manuscript Type:	Article
Keywords:	knowledge construction, virtual communities, problem solving, user knowledge construction, Knowledge processes, Communities

Knowledge Construction by Users: A Content Analysis Framework and A Knowledge Construction Process Model for Virtual Product User Communities

Abstract

Purpose–The p~~P~~urpose of this study is to develop a content analysis framework and from that derive a process model of knowledge construction in the context of virtual product user communities, organization sponsored online forums where product users collaboratively construct knowledge to solve their technical problems.

Design/methodology/approach–The study is based on a deductive, qualitative content analysis of discussion threads about solving technical problems selected from a series of virtual product user communities. This data is complemented with thematic analysis of interviews with forum members.

Findings–The~~is~~ research develops a content analysis framework for knowledge construction. It is based on a combination of existing codes derived from frameworks developed for Computer Supported Collaborative Learning (CSCL) and new categories identified from the data. Analysis using this framework allows the authors to propose a knowledge construction process model showing how these elements are organised around a typical "trial-and-error" knowledge construction strategy.

Practical Implications–The research makes suggestions about organizations' management of knowledge activities in virtual product user communities, including moderators' roles in facilitation.

Originality/Value– The paper outlines a new framework for analysing knowledge activities where there is a low level of critical thinking and a model of knowledge construction by trial and error. The new framework and model can be applied in other similar contexts.

1. Introduction

It is widely accepted that knowledge is a key source of competitive advantage for organizations (Nonaka, 1991; Nelson, 1991; Nonaka and Takeuchi, 1995; Spender and Grant, 1996; Brown and Duguid, 1998). Yet the types of knowledge that organizations need are various: they are not limited to patents or strategic knowledge. They also require knowledge of efficient processes, and fixes to simple product issues. Knowledge-related processes whereby users of products themselves contribute are~~is~~ both theoretically and practically important. Users can provide valuable innovative ideas for product development and contribute to marketing strategies (Wurster and Evans, 1997; Mahr *et al.*, 2014; Cui and Wu, 2015).However, there has also been considerable interest in knowledge construction by users within virtual communities where product users simply share their knowledge and solve technical problems collaboratively (Anderson, 2005). From such interactions producers may be able to gain knowledge of product usage and applications, discover design defects and improve product design (Anderson, 2005; Mahr et al., 2014). A “virtual product user community”, as such groups will be referred to here, can be defined as “a producer-sponsored customer aggregation existing on the Internet to share usage experience and collaboratively to find technical solutions to problems within specific brand products”. Examples would be support forums run by large IT companies such as Dell, HP or Lenovo.

Knowledge from such sources can be very important to organizations, but how is it constructed? The process through which knowledge is constructed is of theoretical and practical interest. In this context the Socialisation-Externalisation-Combination-Internalisation (SECI) model developed by Nonaka & Takeuchi (1995) has been a very influential theorisation describing organizational knowledge creation. However, it deals with the whole knowledge creation process at an organisational level and is rather abstract and hard to operationalise (Engeström, 1999; Bereiter, 2002; Paavola *et al.,* 2002; McLean, 2004; Gourlay, 2006). For knowledge construction in the context of collaborative online discussions of problem solving (i.e. where combing explicit knowledge) the SECI model does not supply a sufficiently detailed analytical framework. An alternative source of a model could be the various frameworks and tools that have been created for exploring knowledge construction in students’ asynchronous online discussions in formal Computer Supported Collaborative Learning (CSCL).However, these theories explore high-level cognitive engagement and development of critical thinking in online learning discussions. As such they may need to be adapted for product user communities, with their simpler problem solving purposes.

The purpose of the research described in this paper was to create a content analysis framework and using this to study common patterns of interaction to propose a possible model of knowledge construction for virtual product user communities. The empirical data used to develop the framework were taken from the Dell User Support Forum and other support forums from HP and Lenovo. Around 50 long discussion threads chosen systematically for theoretical relevance were analysed through a qualitative content analysis method, and a content analysis framework was developed. Thematic interview analysis served as a secondary source of data. ~~Researchers who are concerned with knowledge~~

~~construction in online communities, practitioners interested in managing and moderating the online communities, and community ICT support designers could benefit from understanding more clearly how to offer appropriate support and conditions for knowledge construction to occur.~~

The paper is organised as follows: The first section examines the existing literature relating to theories of knowledge construction and also reviews relevant analytic frameworks from CSCL. The second section explains the methodology of the research, based primarily on deductive content analysis. The findings are then set out, with a content analysis framework and a process model of knowledge construction being presented. Confirmation of the model from other forums and from interview data is outlined. The discussion section considers the reasons why a trial and error approach to knowledge construction, requiring little critical thinking, exists in this type of group. It explains how the approach taken here complements the SECI model. The conclusion section outlines the theoretical contribution of the study and suggests some practical implications to be drawn from it. Researchers who are concerned with knowledge construction in online communities, practitioners interested in managing and moderating the online communities, and community ICT support designers could benefit from understanding more clearly how to offer appropriate support and conditions for knowledge construction to occur.

2. Literature Review

2.1 Virtual Communities of Product Users

Many kinds of virtual communities composed of product users have been seen as having the ability to generate useful knowledge and innovative insights, such as virtual communiti~~y~~iesy of consumption (De Valck *et al.*, 2009; Kozinets, 1999) and online brand community (Muniz and O'Guinn, 2001; Amine and Sitz, 2004; Anderson, 2005; McAlexander *et al.*, 2002; Jang *et al.*, 2008). Another example would be what we refer to here as virtual product user communities. Readers will probably be familiar with the type of group run by many IT companies to support their products. These online communities populated by product users enable the business organization to incorporate community member generated knowledge and problem solving skills as external knowledge resources for innovation and thus gain competitive advantage (Lilien *et al.*, 2002; Füller, 2006; Wurster and Evans, 1997; Thomke and von Hippel, 2002; Ernst, 2002; Nambisan, 2002; Bretschneider et al., 2015; Mahr & Lievens, 2012). Bayus (2013) and Haavisto (2014) both show how online forums can contribute to product innovation. The customer is a unique knowledge resource for the company to collect information on product usage patterns, product applications, design defects and product improvement insights (Anderson, 2005; Bennett and Gabriel, 1999; Chase, 1997).

What we lack is a clear understanding of how knowledge is constructed in such virtual communities. A number of approaches are available for~~to~~ investigating such knowledge construction. For example, some researchers investigate customer knowledge creation and innovation from a technical perspective (Khodakarami and Chan, 2014; Peschl and

Fundneider, 2014). An interesting strand of recent literature explores how business intelligence can be gained by the large scale analysis of data extracted from many forums (Netzer et al., 2012; Chen et al., 2012; Pang and Lee, 2008). This is a promising approach both for organisations and for researchers to look at product users' potential contribution. Another approach, the one adopted here, is to examine micro level interactions to more fully identify the processes and underlying motivations that allow knowledge creation to occur.

2.2 Knowledge Construction

There has been literature on knowledge sharing in such communities, but the focus here is specifically on knowledge construction. Knowledge sharing is about exchanging already existing knowledge through interaction between different individuals. Knowledge construction can be defined as the creation of new knowledge through the interaction of community members and complex cognitive and information processing when requisite knowledge is not already known. For example, it is where individuals interactively create knowledge that is new to the group, rather than simply ~~sharing~~ share existing knowledge. In virtual product user communities knowledge to solve technical problems with products usually needs to be constructed when it cannot be acquired from experts or there is no ready answer.

If we are looking for a theorisation of knowledge construction, we would be likely to turn first to fundamental theory such as community of practice theory (Lave and Wenger, 1991; Wenger, 1998) or Nonaka & Takeuchi's (1995) SECI model. Community of practice theory gives us rich insights into how participants in a particular domain of activity construct knowledge. A shared domain of interest is the foundation for rich forms of mutual learning, knowledge sharing and creation, identity and belonging. However, it does tend to focus on sustained forms of interaction and does not theorise micro level interaction in great detail. The SECI model is the seminal conceptualisation of organizational knowledge creation. It suggests that the knowledge creation process consists of four modes: socialization (from tacit knowledge to tacit knowledge); externalization (from tacit knowledge to explicit knowledge); combination (from explicit knowledge to explicit knowledge); and internalization (from explicit knowledge to tacit knowledge).In the knowledge creation process, these four modes develop in a continuous and cyclic way, forming a "spiral" of knowledge creation via dynamic interaction between explicit knowledge and tacit knowledge (Nonaka and Takeuchi, 1995).The model's goal is to "formalize a generic model of organizational knowledge creation" (Nonaka and Takeuchi, 1995: ix), and it is also widely used and discussed in many research areas: for instance, new product development and organizational learning (Nonaka *et al.*, 2001; Lee and Choi, 2003). Its strength lies in capturing the big picture of knowledge creation at the organisational level.

However, the SECI model has been criticised for a number of reasons, including for being too abstract and oversimplified. It is hard to operationalise. It has been suggested that the SECI model is not capable of capturing the critical elements of knowledge work (Paavola *et al.*, 2002), and fails to answer the question "What are mechanisms, at a detailed level, that explain how these concepts work together to create knowledge in organizations?" (McLean, 2004:7). Due to heavy dependence on general statements, the theory is lacking in clearly defined testable hypotheses that can illustrate how the concepts relate to each other (McLean, 2004). The SECI model, in this sense, lacks clarity and precision (McLean, 2004).

2.3 Knowledge Construction Frameworks from CSCL

If the SECI model is hard to ~~easily~~ operationalise easily, in other fields there are much more detailed frameworks for analysing knowledge construction at a fine grained level. For example, in the CSCL literature there are many analytical frameworks based on the content analysis method for analysing collaborative knowledge construction in asynchronous online discussion contents. The researchers reviewed these frameworks and examined the communication contexts, conceptual bases, theoretical backgrounds, coding procedures used to apply them, and relationships between them. They identified that the following frameworks had the potential to provide the foundation for the development of a content analysis framework for describing the knowledge construction process. The most pioneering and influential is Henri's (1992) model. This centres on five dimensions: the participative dimension; the social dimension; the interactive dimension; the meta-cognitive dimension (referring to statements about reasoning); and the cognitive dimension (referring to the statements about clarification and judgement). Henri's (1992) model is the pioneering work for analysis of online discussions from a content analysis approach and it paved the way for subsequent research. Later models based on it include Garrison et al.'s (2001) four phases practical inquiry model, Gunawardena et al.'s (1997) interaction analysis model, Newman et al.'s (1996; 1997) Critical Thinking Analysis Protocols, Zhu's (2006) Analytical Framework for Cognitive Engagement in Discussion, and Veerman and Veldhuis-Diermanse's (2001) Classification of task-related and not task related messages.

Although these content analysis frameworks are created for exploring students' argumentative knowledge construction or critical thinking development, they also contain categories relevant to common knowledge construction. They describe parts of the process that exist in contexts where there is both a high and a low degree of critical thinking, for example, triggering events, the suggestion of new ideas, explanations, explorations, testing knowledge and problem resolution. Moreover, they also provide operational definitions for these categories. The presence or absence of the more complex cognitive factors related to critical thinking, such as meaning negotiation and construction, multiple and meta-cognitions, knowledge integration, complex exploration of dissonances among ideas and so on can be identified through the empirical data analysis in a new context. Constructivist educators believe that discussions in formal online learning communities contribute to students' higher-order thinking and help them actively engage in knowledge creation processes (Stein *et al.*, 2006). Therefore, instructors are required to play an active role in providing sufficient scaffolding to facilitate students' peer problem-solving process at high levels of critical thinking (Ge and Land, 2003; Davis and Linn, 2000; Ge and Land, 2004). This is not necessarily the focus in other contexts.

2.4 Repurposing CSCL Frameworks

Evidently, these content analysis frameworks cannot be directly applied to exploring knowledge construction embedded in virtual product user communities due to contextual differences, including differing goals and aims, memberships, off-line influences, facilitating strategies, and network attributes. The most important differences are that CSCL communities tend to be smaller in size, and more closed, more mandatory, more structured and focused on formal educational aims, than are product user communities. Nevertheless, these frameworks do provide a starting point for developing an appropriate framework for product user communities. Indeed, CSCL and virtual product user communities share the following characteristics: knowledge sharing and creation oriented online behaviour; the activity of moderators and instructors; a similar technical infrastructure~~s~~ and communication platform~~s~~. This suggests that there is a possibility to adapt elements from these content analysis frameworks to explore knowledge creation activities where there is no necessary requirement for critical thinking.

The purpose of the research described in this paper was firstly to develop an analytic framework suitable for describing knowledge construction in product user communities, drawing from the CSCL literature but also grounded in the data. Its second purpose was to use this to develop an answer to the main research question: What are the processes of collaborative knowledge construction in virtual product user communities?

3. Research Design

3.1 Methodology

In order to develop a framework for analysing knowledge construction processes, the primary methodology used was deductive and qualitative content analysis. Berelson (1952:18) offers an initial definition of content analysis as "a research technique for the objective, systematic, and quantitative description of the manifest content of communication". Krippendorff (1980:21) defines it as "a technique for making replicable and valid inferences from data to their context". This definition stresses interpretation of meaning of the content rather than simply summarizing surface features of the content. ~~Content analysis~~It goes beyond just manifest content to deal with interpretation of latent content (Graneheim and Lundman, 2003). It is an effective tool to "reveal information that is not situated at the surface of the transcripts" (De Wever *et al.*, 2006:7). The hidden patterns of knowledge construction embedded in discussion transcripts can be explored through the content analysis method.

There are two approaches to content analysis: quantitative and qualitative (Hsieh and Shannon, 2005). Rourke et al. (2001) find that in analysing transcripts of asynchronous text-based online discussions quantitative content analysis is mainly used for descriptive and experimental research designs. Given the "how" and "why" nature of the research questions pursued in this research, quantitative content analysis was not appropriate. Hsieh & Shannon (2005:1278) define qualitative content analysis as "a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns". Accordingly, qualitative content analysis was mainly used to explore characteristics of the textual language used for communication purposes, especially in terms of its content (/verbal meaning) or contextual meaning (Lindkvist, 1981; McTavish and Pirro, 1990; Tesch, 1990).

3.2 Data Collection and Analysis

To construct the model the starting point was samples of threads from Dell Support Forum (English), a forum sponsored by Dell and hosted on its official website. It is a platform set up for Dell product users to share best practices and solve their technical problems through collaborative effort. There are various sections and one sub-forum, whose threads focus on laptop/notebook computers and mobile workstations in Dell support forums, was selected for the initial stages of the research. Laptops and notebooks are personal electronic products that have more technical questions and problems in their usage compared to other types of home electronic appliances. These laptop users who encounter technical problems or have questions about their laptop will publish a post containing relevant questions in this sub-forum. Other peer users, some of whom have had the same type of problem, join the discussion thread, endeavouring to find a solution. Dell Support is a very active ~~forum~~ group with thousands of messages every day and a high percentage of problems with final solutions, sustained by hundreds of active users. The forum is moderated partly by~~e~~ Dell staff and volunteers given the handle “rockstars”.

The first step in the selection of a sample of content to analyse was that the researchers familiarised themselves with data by reading and rereading threads, as well as forum introductions and polices~~-~~. Theoretically important discussion threads which contained rich elements of knowledge construction were selected. These were defined as long ones with around one hundred responses, that had several suggested solution ideas (marked with the label “√ Suggested Answer”) and that also had an “accepted solution” contained within them. These longer threads were chosen because they were likely to contain the full range of types of knowledge construction element.

Following the method of deductive content analysis, the researchers first identified crucial concepts or variables as the initial coding categories, with the guidance of existing theory (Potter and Levine-Donnerstein, 1999).Threads were analysed in Excel, with emerging sub-~~e~~categories as columns and the posts in temporal order, in rows.

The authors were careful to ensure that these categories were exhaustive and mutually exclusive (Krippendorff, 1980). In the process of creating the categorization matrix, a category can be split into sub-categories, and sub-categories with similar events and attributes can be grouped together as a category (Roberson, 1993; Kyngas &Vanhanen, 1999). An initial definition and examples were developed for each category.

In the next step, the researchers supplied an operational definition for each category (Hsieh and Shannon, 2005). In the subsequent coding process, in order to gain the richest possible picture of the phenomenon, the researchers followed a coding strategy suggested by Hsieh & Shannon (2005) named directed content analysis. This strategy involves identifying and categorizing all factors related to a specific phenomenon. As a starting point, the researchers read the transcripts and highlighted the text according to the preconceived codes from the

CSCL literature. If a particular section of text could not be classified into any of the predetermined categories a new code was created (Hsieh and Shannon, 2005). In this research existing codes from CSCL were used to guide the creation of new codes.

The initial content analysis framework and knowledge construction model were created through analysing one long discussion thread. In addition, by looking at the structure of discussions an initial process model was outlined. In order to elaborate the emerging analysis framework and to validate the model, another ten discussion threads with accepted answers were selected from Dell User Support Forum (English), including three threads that included moderator participation.

3.3 Validation through confirmatory data analysis

a) Other discussion forums and communities

In the subsequent stages of the research, the same sampling strategy was adopted in selecting computer technical problem-solving discussion threads from a series of other organization sponsored virtual product user communities: Dell IdeaStorm Community, Dell Support Forum in Chinese, the HP Discussion Board in English, HP Technical Support Forum in Chinese, Lenovo Forum in English, and Lenovo Discussion Board in Chinese. In addition, threads from other types of virtual communities and networks were also selected from LinkedIn (a social networking website), a JISCMail group (a Listserv), and Slashdot (an Internet Forum). From each of these groups four threads which had relatively similar discussion subjects of technical solutions for the software and hardware problems of computers were selected for analysis. The purpose was to test the value of both the analytic framework and the emerging process model in different contexts, such as where there were technical differences in how the forum worked or linguistic and cultural differences. The approach developed in the Dell forums proved robust in supplying a framework which described the categories of posts being created and in describing a similar knowledge creation process.

b) Interviews

In addition to the content analysis, as a form of additional data to seek to confirm the model by understanding participants' perspectives on knowledge construction, semi-structured interviews were conducted with a purposive sample of 20 Dell Support Forum (English) participants, in summer 2013. Interviewees were chosen based on their varied level of experience and activity in the forum, in an attempt to capture the viewpoints of both novices and more active participants. Interviews were based on email interaction with an initial set of questions and a series of follow ups. Email interview h~~w~~as been shown to be a robust ~~as~~ a qualitative research method (Ratislavová & Ratislav, 2014). Firstly, the interview request along with a brief introduction of the research project and research ethics information was sent to ~~the~~ selected forum members via emails listed on the support forum. Then the initial set of interview questions were sent to those who agreed to be interviewed. After the first set of answers was received, another set of questions based on them were sent. Thus the interview process usually involved several stages and iterative interactions to follow up on answers given by interviewees. Interviewees were asked about participation motivations and barriers, experience of knowledge construction, opinions towards community moderation and management activities, and perceptions about community culture. The data was analysed by inductive thematic analysis: by a structured process of "careful reading and re-reading of the data" (Rice and Ezzy, 1999:258). After a process of familiarisation, through re-reading the texts produced, the data was coded, then codes developed into themes. The analysis yielded much material, e.g. relating to motivation and moderation, but for reasons of space only that relating directly to the knowledge construction process is reported here. In the context of this paper the interview material was primarily to validate the model derived from content analysis.

4. Findings

4.1 A Content Analysis Framework for Knowledge Construction

This section sets out the content analysis framework that was developed (shown in Tables 1-5). The framework consists of five main types of episode:

1. "Knowledge Construction" episodes (Table 1).
2. "Problem Description" episodes (Table 2).
3. "Non-Constructive" episodes (Table 3).
4. "Moderation" episodes (Table 4)
5. "Other" episodes.

Firstly, "Knowledge construction episodes" contain five sub-categories (left column in Table 1) directly related to building new knowledge to solve technical questions and problems, which are the key bricks for constructing new knowledge:

a) An "Initiation Episode" is where a question is asked, triggering a discussion.

b) A "New Idea Proposing Episode" describes messages where a new possible solution is suggested.

c) "Exploration & Explanation Episodes" are complicated processes involving asking and answering focused questions, refining or elaborating already stated ideas, and exchanging information.The sub-category "clarifying ambiguity (about the idea)" is distinguished from the sub-category "repeating/refining or elaborating already stated idea" because it involves interaction. However, together both these can be incorporated into one sub-category "clarifying ambiguity (about the idea)".

d) An "Evaluating & Testing Episode" is where users test proposed ideas by applying them or evaluating them by reasoning or existing facts.

e) Finally the "Resolution Episode" is the point at which it is officially or by consensus concluded that an acceptable answer has been found.

The second main type of episode the "Problem Description Episodes" (Table 2) is about clarifying the symptoms of the problem and gathering contextual knowledge about it. Problem description episodes were found to facilitate the knowledge construction process by providing knowledge about the problem and its context. They facilitate rather than form the main discussion (/knowledge construction) process. In addition, the reiteration of the technical problem by many community members attracts the attention of the community moderator and encourages other members to generate solution ideas. The Problem Description episodes contain the sub-categories

a) "Repeating same/similar problem". This differs from "clarifying ambiguity (about the problem)" in its non-interactive nature.

b) "Judging the existence of the problem".

The third main type of episode -"Non-Constructive Episodes" (Table 3) - consists of 3 sub-categories:

a) "Suggestion to give up finding a solution",

b) "Suggestion to wait for an authentic solution", and

c) "Raising unnecessary issues". This category refers to discussion content which does not actively push forward the knowledge building process~~es~~. In fact some such types of discussion can exert a negative influence on knowledge construction, such as by lowering participants' motivation to contribute.

The fourth main type of episode - "Moderation Episodes" (Table 4) - refers to activities conducted by both the formal moderator and community members themselves. It contains moderation activity including

a) "Comments about promoting/demoting the discussion idea"

b) "Mediating argument / stopping talk about unnecessary topics",

c) "Moderator labelling the status of the discussion thread",

d) "Claiming to bring knowledge from the community to the internal organization"~~, and~~

e) "Claiming to bring knowledge from the organization to the community".

These activities fall into the knowledge management (/processing) dimension, the knowledge construction dimension, and the social dimension. They can also influence the knowledge building process. The Categories (d) "Claiming to bring knowledge from the community to the internal organization" and (d) "Claiming to bring knowledge from the organization to the community" are relating to the moderator's knowledge transfer role, between the forum and the organisation.

The fifth main type of episode – "Other" (Table 5) - mainly refers to invalid posts, which do not form valid discussion content, such as repetitive posts. The label "Other" lends the framework flexibility and room to include other mutable sub-categories and deviant types of content if it were to be used in a new context. The framework of knowledge construction does not include categories of pure social information, which is not very common in virtual product user communities according to the thread analysis.

Table1: Knowledge Construction Episodes.

Types of Knowledge Construction Episode	Sub-category	Definition	Example
Initiation Episode	Triggering Question	The first post (or first few posts) which asks a question about a technical problem and triggers the following discussion about solutions.	"My new [model] laptop fan comes on for a second then turns off for a second, then repeats. Is this by design or a fault?"
New Idea Proposing Episode	Proposing a New Idea	An idea for solving the problem not mentioned before.	"Probably because Firefox cannot run ASP.NET. Try Internet Explorer with WINE or other emulator."
Exploration & Explanation Episode	Asking focused question (about the idea /about the problem)	Asking a specific question about the suggested solution, or requiring more detailed information about the problem.	1. About an idea: "Can we go back to trying an earlier OS? My laptop arrived last week so I've always had BIOS v1." 2. About the problem: "So I would like to find out if there is a common factor, a programme, utility or even a Windows update that has been installed on your system that is interfering with the new driver."
	Clarifying ambiguity (~~about~~ in the idea/ ~~about~~ the problem)	Providing relevant information to answer a focused question (~~about~~ in the idea/~~about~~ in the problem).	1. About an idea: "Well, I uninstalled the pre-loaded software before I even started working on the fan issue. I can list the pre-loaded apps as…" 2. About the problem: "Thanks for reply. My specs on the laptop are 256 gigabytes running Windows 8."

	Bringing outside knowledge	Releasing a webpage link directed to other information source or bringing outside knowledge to the discussion thread in order to enhance the possibility of solving the problem.	"A discussion about this annoyance has already taken place on another website: URL"
	Repeating/ refining or elaborating already stated idea	Repeating, refining or adding more detailed information to an idea that has been proposed.	"There's a workaround to the fan issue on page 4 of this thread."
Evaluating & Testing Episode	Evaluating suggested idea (by reasoning or existing facts or existing facts)	Evaluating the idea by reasoning or linking the idea with existing facts.	"Thanks, but...I have the latest drivers and BIOS. My fan problem still exists. In fact, I didn't have a problem until I upgraded my bios to the new version."
	Claiming to test the suggested idea	Statements of planning to test the suggested idea.	"Ok. I am definitely going to try this tonight. I'll report back."
	Testing the idea (usually by applying the idea)	Testing the suggested idea by applying it.	"Works fine for me in all modes. I played a game for two hours and the fans are pushing out a lot of hot air, but the machine is running ok."
Resolution Episode	Accepted answer (/s) for the question	A suggested idea which has been tested and shown to be workable, and/ or with the authentically accepted label.	"So I finally got it to work. Basically I followed X's suggestion at URL. So I installed Y and rebooted and the fan now appears to be working normally." (This posts is labelled with the icon ✔ Suggested Answer)

Table 2: Problem Description Episode

Problem Description Episode	**Sub-category**	**Definition**	**Example**

	Repeating same/similar problem	Content describing the same/similar technical problem the users have experienced.	"I'm having exactly the same problem with the fan of my brand new model X."
	Judging the existence of the problem	Statement about the fact of the problem's existence.	"What are you saying? It works! I just ordered a Dell system while using Firefox running on Linux. Everything works great on my end"

Table 3: Non-Constructive Episode

	Sub-category	**Definition**	**Example**
Non-Constructive Episode	Suggestion to give up finding solution	Comments about quitting finding a solution.	"I just decided to return the machine to the manufacturer. The fan problems were just too irritating."
	Suggestion to wait for an authentic solution.	A statement suggesting waiting for the company to release an official solution to solve the problem permanently or suggesting reporting the problem to the company for assistance.	"I suggest registering the problem with the manufacturer and see what they come up with."
	Raising unnecessary issues	Discussion of other irrelevant topics which have no direct relationship with the solution being discussed and cannot help to construct new knowledge for solving the problem.	"By exchanging information in a proprietary data format, we force the third world to also use such products and send large amounts of money back to a foreign country. You should learn about how the colonial domination and exploitation of the third world works and has always worked."

Table 4: Moderation Episode

	Sub-category	Definition	Example
Moderation Episode	Comment about promoting/demoting the discussion idea	Direct statement about promoting or demoting the idea in the forum.	“Thanks for the link. I just promoted your idea.”
	Mediating the argument/stopping talk about unnecessary topics	Comments related to mediating arguing /talking about an irrelevant and unnecessary topic.	“Please don't start an OS war in response to my suggestions. I respect your opinion about the companies concerned, but it’s not relevant…Can we stay focused in our comments regarding my idea and not go off on tangents?”
	Moderator labelling the status of the discussion thread.	Statement of processing the thread by giving it a status label.	“I have changed the status to UNDER REVIEW”
	Claiming to bring knowledge from the community to the internal organization	Moderator’s statement of bringing knowledge about the technical problem from the community to the engineers in the business organization.	“Which of the Linux OSes and browser versions are you using? I want to pass this information onto the teams that determine application and content compatibility.”
	Claiming to bring knowledge from the organization to the community	Moderator’s statement about bringing knowledge about the solution from the business organization to the community.	“I have asked engineering about the drivers and am waiting an answer. I apologize for the inconvenience here, and I hope to have more for all of you shortly.”

Table 5: Others

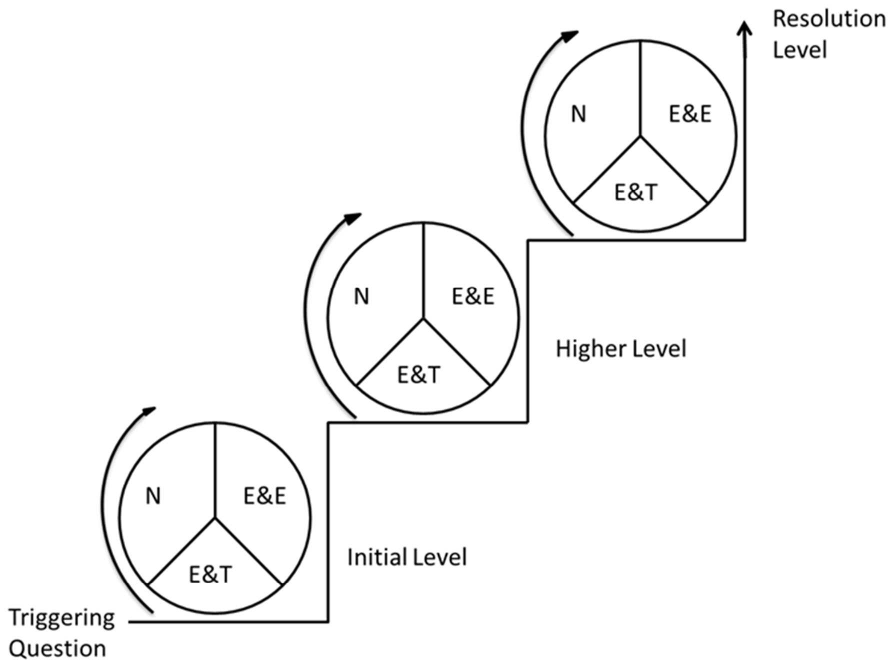
	Sub-category	Definition	Example
“Other” episode	Invalid posts	Posts lacking any relevance	“Duplicated post – deleted.”

All of these activities collectively constitute the process of knowledge construction. The main category of "Problem Description Episodes" as well as two sub-categories in the "Knowledge Construction Episodes", i.e. "asking a focused question (about the problem)" and "clarifying ~~the~~ ambiguity (~~about~~ in the problem)", are involved in providing two types of knowledge about the problem: knowledge about the symptoms, which tells "what the problem is", and contextual knowledge about the problem, which informs "what is the context of the occurrence of problem". This paves the way for diagnosing the causes of the problem and identifying which type of experiential knowledge is relevant.

There is a relationship between the "Non-constructive Episode" and "Moderation Episode" with regards to the social dimension. Moderation ensures the smoothness of the knowledge construction process, even without the involvement of a formally constituted moderator. In some cases, trolling behaviours in the virtual community, --for example, posts falling into the sub-category of "Raising unnecessary issues" -- are stopped through community members' collective moderation behaviour of "mediating the argument/ stopping talk about unnecessary topic". In contrast, some sub-categories in "Non-constructive Episodes" can lower forum users' motives to solve problems, such as the sub-category "Suggestion to give up finding a solution". Such negative influences can be offset by the sub-category "Comments about promoting/demoting the discussion idea".

4.2 The Knowledge Construction Model

Based on the results of the content analysis of the threads in the Dell User Support Forum and the technical solution-oriented discussion threads in the Dell IdeaStorm Community and other user support forums, with the aid of this newly developed content analysis framework, this study proposes a knowledge construction model. This consists of the key episodes in a knowledge construction process, i.e. "Initiation", "New Idea Proposing", "Exploration & Explanation", "Evaluating & Testing", and "Resolution", as shown in Figure 1.



(N= New Idea Proposing Episode; E&E= Exploration & Explanation Episode; E&T= Evaluating & Testing Episode)

Figure 1: Model of the Knowledge Building Process within a Virtual Product User Community

The process starts from an "Initiation Episode" (i.e. the triggering question), and ends with "Resolution Episode" (i.e. finding accepted answers to the question). Between these two episodes, the discussions usually follow the sequence of a "New Idea Proposing Episode", "Exploration & Explanation Episode", and "Evaluating &Testing Episode" in a cumulative and progressive order. This process repeats itself in a cyclical way until a proposed idea is identified as the feasible and permanent solution, after evaluation and testing. The model illustrates a progressive process of knowledge construction in the virtual product user community. The hierarchical level of ideas proposed in each stage is also reflected in this description. The newly proposed idea is usually based on previous ones and is oriented so as to be more reliable.

The main problem solving strategy is of "trial-and-error" and this is used in constructing new knowledge in order to find the most effective solutions. Different solutions are continuously proposed until one is tested and found to be widely accepted as a workable answer. The effectiveness and efficiency of this strategy is highly relevant to the nature of newly constructed knowledge in the virtual product user community: the proposed ideas can be immediately applied to the products or be evaluated with existing facts. During this process, the latest idea is usually proposed based on previous ones, and becomes more and more reliable as the discussion proceeds.

This model captures all the essential components that form the knowledge building process in the discussions of solving technical problems. It represents the process of knowledge construction in an idealised form. In reality, the order of knowledge construction episodes is mutable and subject to change. Knowledge construction activities occurring in reality may take the form of various combinations of these episodes, and involve non-constructive episodes and more social messages. Therefore, it can be considered as a simplification and abstraction to shed light on understanding how knowledge is constructed in the virtual product user community and other similar contexts.

4.3 Confirmatory findings from Thematic Interview Analysis

The interviewee data confirmed the analysis of the threads, supporting the trial and error nature of knowledge construction. It also provided some more details of how problem solving worked, that inevitably was not present in the threads themselves. For example, this interviewee's comments confirmed that a "trial- and-error" strategy is used to construct new knowledge to solve problems through trying different ideas until a workable solution is identified:

> *"Many problems are asked again and again and it gets easier and easier to simply provide the answer/solution. Some problems require generic debugging skills. It is not clear what the solution might be, but it is clear what the path of diagnosing is. For example, suggesting rebooting, going back to an earlier restore point, reinstalling the app, etc could solve many problems that are specific to the one user."*

Interviewees supported the importance of asking questions to clarify the problem as part of "exploration and explanation episodes" – though they apparently used other sources too:

> *"If a person posts a question but omits necessary details, someone will usually ask for more information. This is an area where experience helps. One learns to pay attention to every detail of the post, including the subject heading, the main text, and the tag field. It is also useful to go to the poster's "profile" page where there are links to all of their postings on the Forum. Many times I can learn missing context or specific information, such as model number or operating system, from reading their other posts."*

Sufficient contextual knowledge about technical problems is vital for diagnosing causes and proposing solutions. This is because the solution is usually quite specific, depending on different contextual elements (i.e. the hardware and software environment, and even usage methods). Thus, most of the problems being discussed cannot be solved by a generalised script, and the solution~~it~~ has to emerge through interaction.

The interviews suggested that solutions are based on experience. According to the interview data, the active community members' knowledge has a strong experiential nature, that is to say, it is mainly gained from experience of participating in the discussions of solving practical technical problems in the forum or learned from reading other's solution discussion threads, rather than from their work or a pre-existing script, such as typically used by moderators.

Interviews also confirmed observations of the forum that suggested that those who contribute questions are often visitors or low active members. Interviewees rightly valued their contribution: new problems are a key resource generating activity. Those who propose solutions are usually from a smaller group of highly active community members with a high level of knowledge.

5 Discussion

5.1 A New Knowledge Construction Model

The new model created in this article offers a clear description of how knowledge is constructed in product user communities. It represents knowledge construction as a cumulative and progressive process. Knowledge construction chiefly proceeds in one direction: it starts at the stage of a "triggering question" (i.e. an Initiation Episode), and moves towards and stops at the resolution stage. These stages, develop in an iterative and progressive way, and overall in a hierarchical order– yet it is not a linear process. The model is an idealisation of what happens in practice. In reality there can be wrong turns, dead-ends and irrelevant argument. But the model does capture a key, repeated, underlying pattern. Thus, it is not a simple linear conception of knowledge construction, and it is consistent with a conception of knowledge creation as a fuzzy, complex, non-linear, continuous, and iterative process (Nonaka, 1994; Nonaka and Takeuchi, 1995; Huber, 1991; Kim, 2000; Fischer, 2001; Samaddar and Kadiyala, 2006). The~~is~~ model is a useful lens to understand in a precise way how knowledge is constructed. It captures the essential knowledge construction components, illustrates its progressive processes, discussion directions, and hierarchical order of constructed new ideas. In addition, when the model is applied it can be adjusted by changing the combination of knowledge construction episodes to describe the process in different situations.

5.2 The Value of User's Experiential Knowledge

The paper has also provided insights into the main sources of knowledge from which new knowledge is constructed. The findings from the interview analysis reveal that diagnosing the causes of technical problems and the proposal of solutions by active community members are based on a type of experiential knowledge. This appears to be of two types. Often participants had long experience of solving technical problems in their daily lives. Their knowledge was also obtained from direct or indirect participation in the discussions about solving technical problems. Thus recalling previous discussions and searches in the forum archives were important sources of information. Solutions identified are usually quite specific due to the varying hardware and software environments of products. Thus, the idea proposer needs contextual knowledge about the problem to identify what area of their experiential knowledge is able to find a solution. That is to say, their knowledge has a strong situated and tacit nature. This is also in accordance with the nature of knowledge as "localized, embedded and invested in practice" (Carlile, 2002); situated and tacit (Suchman, 1987; Cook and Brown, 1999); and ambiguous (Van Wijk *et al.*, 2008). Providing contextual knowledge about the problem can help the knowledge expert recall his relevant experience and practices, and thus enable him to identify and utilize the requisite contextual knowledge embedded in previous direct or indirect practice. The subcategories of "asking focused question (about the problem)" and "clarifying ambiguity (about the problem)" usually focus on contextual knowledge about the problem. These two subcategories are essential in the category of knowledge "Exploration & Explanation Episode" and also the whole knowledge construction process in terms of overcoming knowledge ambiguity.

5.3 The Trial-and-error Strategy

A key aspect of the model is to show how the trial and error approach to knowledge construction is effective without requiring critical thinking or the support demands that developing such a level of cognitive engagement would require. Solutions are efficiently produced through the input of many individuals' small efforts, with low levels of coordination or deep or sustained engagement by particular individuals. Unlike in online learning, the discussion of solutions to technical computer problems does not involve much high-level cognitive engagement or critical thinking. Li and Cox (2016) identify that the main aim of virtual product user community members is to find a workable and permanent solution for technical problems in the most efficient way. This requires the process to be simple and cognitive effort to be low. It is characteristic of the model that many users, regardless of their level of knowledge, can add value in simple, low-effort ways, such as asking a question or making a suggestion. The trial and error approach and lack of need for critical thinking are defining characteristics of knowledge construction and of how the whole online community works.

"Proposing a new idea" as a solution by active community members is based on contextual knowledge about problems, which enables the participant to identify the requisite area of their experiential knowledge. The "Exploration & Explanation Episodes" included in this new analytical model are mainly realized through "asking and answering" for clarification. This process does not involve complex conceptualizations and meaning negotiation, comprehension, knowledge synthesis and so on, which are important cognitive elements in knowledge construction of formal online learning contexts. Again the "Evaluating & Testing Episodes" are achieved through evaluating the suggested solution ideas against existing facts or through testing by applying the idea. This is also different from that in CSCL context, where the evaluation of knowledge is achieved through critical reflection (Veerman and Veldhuis-Diermanse, 2001).Thus none of the three episodes in the model involves critical thinking. Nor does it involve the deep participation and implications for identity and belonging implicit in the community of practice concept. It offers a model of participation that supports effective, goal-directed often rather fleeting engagement, rather than the deeply social participation in a community around a common practice.

There are multiple reasons why this problem solving does not involve development of critical thinking:

1). The forum's purpose and design is to seek answers to questions. There is no requirement for deep critical engagement.

2). The users' own purposes in using the forum relate to finding a solution to their problems in the most efficient way with least cognitive effort, and they are usually in a hurry to fix an immediate problem.

3). The nature of proposed technical solutions is such that they can be evaluated on the basis of existing facts or tested by applying them to specific cases.

4). Unlike the critical knowledge creation process aspired to in the online learning context, the trial-and-error strategy which community members adopt does not create a need to engage in effort in critical thinking.

5). Lack of sufficient facilitation from the moderator due to the large number of members and discussion threads, appears to reduce the possibility of higher level engagement. In the virtual product user community, due to different responsibilities and purposes, the moderator cannot pay as much attention as the instructor does in online learning. Thus, without tailored and sufficient scaffolding, the problem solving process in the virtual product user community cannot develop into a very complicated discussion with high-level criticality.

However, the fact that knowledge construction is through a lower-level cognitive engagement in a virtual product user community does not necessarily mean that the knowledge building is "inferior" to that in a CSCL context. On the contrary, this type of knowledge construction is an effective way for these community members to reach required solutions to technical problems. There is also no suggestion that community members do not learn through the discussion of technical problems.

5.4 Absence of Social Messaging

Another notable finding of the study and salient difference from CSCL is that social messages, which refer to a "statement or part of a statement not related to formal content of subject matter" (Henri, 1992: 126), are very rare in this type of virtual product user community. According to Hara et al. (2000), social cues can include self-introduction, greetings, jokes, expressions of personal feelings, the use of symbolic icons, and so on. There are multiple reasons why social messages in virtual product user communities are not common. It could be related to the purpose of the community, the sponsor's moderation, or community culture. Thus this type of community is mainly established by the producer to help its customers to solve technical problems in the most effective and efficient way, rather than to focus on building social relations among community members. Its community culture values the "helpful role" in solving technical problems rather than "social role" in building social ties. Again, this has a different flavour from community of practice theory's stress on the social bonds and learning that arise from common practice. Li and Cox (2016) suggest that social messages can promote interaction and motivation when discussion participation is not active and thus facilitate the knowledge creation process. Without active interaction of social messages to enhance the tie, the function of the community can still be achieved through the clear definition of its aim, a well fostered community culture, active community members' contributions, and effective moderation work.

The exclusion of the social dimension in this framework does not mean to deny its importance in the knowledge sharing and building process. Social messages among the community members are not salient in the discussion threads yet, according to interviewees social interaction is quite strong in the private sub-community, consisting of the most active community members in the Dell User Support Forum. Its discussions are not generally related to technical issues. This finding suggests that the social dimension still plays an important role in facilitating knowledge construction by promoting connections and a community sense of active knowledge contributors, although this may occurs in an indirect way.

5.5 Supplementing the SECI Model

The knowledge construction model proposed in this paper aims to reveal the precise knowledge construction process taken in solving technical problems through collaborative group discussion, in the context of virtual product user communities. This process can be located in the "Combination" mode (i.e. from explicit knowledge to explicit knowledge) in the SECI model. The technical problems and solutions embedded within the discussion contents are explicit and articulated knowledge published at the group level (i.e. from explicit knowledge to explicit knowledge). Moreover, the phase of knowledge construction is achieved through collaborative group discussions (i.e. at the group level). –Therefore, the whole knowledge construction process consisting of varying episodes conducted by different roles is related to the knowledge combination mode. Thus, the model presented here can be understood as a detailed examination of one part of the organizational knowledge creation process.

The SECI model is often said to be too broad, too vague, and too difficult to use. However, by focusing on just one aspect of knowledge creation (i.e. knowledge construction in the codified discussion threads) in a specific context (i.e. virtual product user community), and by providing detailed and operationalizable concepts, a more detailed picture of the knowledge construction process can be depicted from the micro perspective adopted in the research reported here, and this enables the researcher to address these common criticisms of the SECI model with a detailed picture of one aspect of it.

The knowledge construction model proposed here consists of clear concrete concepts with precise definitions of both main-level episodes and sub-categories. In addition, corresponding to the knowledge construction model, a content analysis framework consisting of relevant categories and sub-categories was also created. This overcomes the operationalization problems of SECI model. These features enable the newly developed model to be testable in empirical studies of virtual product user communities or other contexts by other researchers, thus providing sufficient room for further developing or extending them in the future.

Logically, this also suggests that the other three modes of SECI model can be elaborated by creating more micro-models with concrete process descriptions. Moreover, a conceptual tool box or an analytical framework can be created for each mode of the SECI model in different contexts in future research.

6 Conclusion

The analytic framework developed in this study captures key elements of knowledge behaviours in contexts where critical thinking is not a key aspect, and can be used to study not only virtual product user communities, but also other similar contexts. Unlike knowledge construction in formal learning contexts, these activities may be widely practised by people in their daily lives and work, yet are less explored. Thus, the framework can complement existing analytical frameworks and tools exploring high-level cognitive development and critical thinking in CSCL. It encapsulates the key knowledge construction constituents in this type of problem solving and clarifies the relationships between their main categories.

This research also contributes a knowledge construction model which illustrates how knowledge is constructed in solving technical problems in this specific form of user community. It encapsulates the key knowledge construction constituents and also depicts the process. The simple trial and error approach reflected in this model is distinct and efficient. People with all sorts of level of knowledge can contribute. It does not make great demands on participants in terms of effort or to develop higher order skills or on moderators to prompt reflection and deeper forms of learning. It is therefore a highly effective form of knowledge construction, that operates relatively autonomously from formal moderation. It seems to work in multiple contexts and on different platforms. This knowledge construction model provides a theoretical lens to understand the process of knowledge construction in a virtual product user community. Within the debate about how users create knowledge for organisational benefit, it identifies one low level process through which users can construct knowledge relatively autonomously. It seems probable that there could be other models, but the research has shown this is a robust one. It is an important supplement to the influential SECI model by providing a detailed and micro-level picture of one mode in the specific context of virtual product user communities. It also has the capability to be adapted by other researchers in other contexts.

The findings of this research have several important implications for the future practices of business organizations (i.e. community sponsors); virtual product user community moderators; forum designers, and product users and forum members. The model shows how knowledge construction works in virtual product user communities. It is therefore a potential guide to more effective management of the process. The model, with its focus on multiple contributions each playing a small role in finding a solution, ~~It~~ points to the value of developing an appropriately participatory culture. Guidelines to people asking questions could include reminders to include relevant contextual information; this would save time~~e~~. Yet questions are a resource to the community, so question asking could also be rewarded. Indeed, the model shows that a wide range of ~~All~~ forms of participation —~~—~~often seemingly fleeting and trivial - are of value. Forum users should be encouraged to actively participate in the discussion activities in spite of their worries about their low level of expertise. Their participation in the discussion, whether by asking a focused question or repeating the problem, is an important and necessary part of knowledge construction. Forum designers should consider incorporating~~e~~ more interactive functions into the whole support forum for community members, and provide more reward mechanisms for participation. The model suggests that s~~S~~upporting cultures of trial and error is more important than trying to foster critical thinking or a deep collaborative culture, as modelled in community of practice theory. Active participants who answer questions have long been recognised to be an important resource. This study suggests they have a role in moderation as well as question answering. This behaviour could be recognised and rewarded to reduce the cost.

Not only do the knowledge construction episodes need participation from varying community members with different knowledge levels, but so do ~~other episodes of~~ "Problem Description Episodes" and "Moderation Episodes". These play an important role in supporting knowledge construction, and also need their participation~~ and contributions~~. Therefore, to encourage varied contributions in the discussion, the community should be given more freedom and less heavy control from formal moderators. Even trolling behaviours can be controlled by users' own collective moderation. This is consistent with the community culture of preferring less formal moderation. In addition, multiple methods should be adopted to promote participation, including monetary and reputational rewards.

The analysis also suggests that moderators' roles involved in direct knowledge construction can be proscribed. Even without ~~the~~ a moderator's ~~high~~ strong engagement, the community members themselves ~~still~~ can solve problems through collaboration. Indeed, the interview analysis suggests that identifying feasible solutions mainly relies on users' own specific and experiential knowledge. This type of knowledge requisite for solving problems usually cannot be found in the generalised scripts that moderators use, due to varying and complex hardware and software environment. Thus, we can infer that ~~–~~moderators' involvement in knowledge construction activities can be reduced to the minimum level and ~~let~~ the users themselves allowed to lead the discussion. ~~is not welcomed by community members because their knowledge is from generalised scripts rather than specific knowledge requisite for solving problems.~~ Thus, the forum moderators' roles should concentrate on maintaining a helpful and workmanlike online environment, fostering the development of the community, and transferring knowledge across the boundaries between the virtual product user community and the business organization.

The overall conclusion of the study is to recognise the power of user communities with relatively little moderation and input to generate immense value in solving problems with products. This is achieved best, not by direct moderation or crude reward systems, but by fostering a culture and rewarding all ~~sorts~~levels of participation. This suggests a much more light handed approach to community management.

References

Amine, A. and Sitz, L. (2004), "How does a virtual brand community emerge? Some implications for marketing research", *Cahier de Recherchede l'IRG-Paris*, Vol.XII,pp.1-16.

Anderson, P. H. (2005), "Relationship marketing and brand involvement of professionals through web-enhanced brand communities: the case of Coloplast", *Industrial Marketing Management*, Vol.34 No.1, pp.39-51.

Bennett, R. and Gabriel, H. I. (1999), "Organizational factors and knowledge management within large marketing departments: an empirical study", *Journal of Knowledge Management*, Vol.3 No.3, pp. 212-225.

Bereiter, C. (2002), *Education and mind in the knowledge age*, Lawrence Erlbaum Associates, Hillsdale, NJ.

Berelson, B. (1952), *Content Analysis in Communication Research*, Free Press, Glencoe, IL.

Bretschneider, U., Leimeister, J. M., and Mathiassen, L. (2015), "IT-enabled product innovation: Customer motivation for participating in virtual idea communities", *International Journal of Product Development*, Vol. 20 Vol.2, pp. 126-141.

Brown, J. S. and Duguid, P. (1998), "Organizing knowledge", *California management review*, Vol.40 No.3, pp. 91.

Bayus, B. (2013), "Crowdsourcing New Product Ideas over Time: an Analysis of the Dell IdeaStorm Community", *Management Science*, VoL.59 No.1, pp. 226-244.

Carlile, P. R. (2002), "A pragmatic view of knowledge and boundaries: Boundary objects in new product development", *Organization science*, Vol.13 No.4, pp. 442-455.

Chase R. L. (1997),"The Knowledge-Based Organization: An International Survey", *Journal of Knowledge Management*, Vol.1 No.1, pp. 38 -49.

Chen, H., Chiang, R.H. and Storey, V.C. (2012), "Business Intelligence and Analytics: From Big Data to Big Impact.", *MIS Quarterly*, Vol.36 No.4, pp.1165-1188.

Cui, A.S. and Wu, F.J. (2016), "Utilizing customer knowledge in innovation: antecedents and impact of customer involvement on new product performance", *Journal of the Academy of Marketing Science*, Vol. 44 No.4, pp. 516-538.

Cook, S. D. and Brown, J. S. (1999), "Bridging epistemologies: The generative dance between organizational knowledge and organizational knowing", *Organization science*, Vol. 10 No.4, pp.381-400.

Davis, E. A. and Linn, M. (2000), "Scaffolding students' knowledge integration: Prompts for reflection in KIE", *International Journal of Science Education*, Vol.22 No.8, pp. 819–837.

De Valck, K., van Bruggen, G.H. and Wierenga, B. (2009), "Virtual communities: A marketing perspective", *Decision Support Systems*, Vol.47 No.3, pp.185-203.

De Wever, B., Schellens, T., Valcke, M. and Van Keer, H. (2006), "Content analysis schemes to analyze transcripts of online asynchronous discussion groups: A review", *Computers & Education*, Vol.46 No.1, pp. 6-28.

Engeström, Y. (1999), "Innovative learning in work teams: Analyzing cycles of knowledge creation in practice", in Engeström, Y. Miettinen, R. and Punamäki, R.L. (Ed.), *Perspectives on activity theory*, Cambridge University Press, Cambridge, pp. 377-404.

Ernst, H. (2002), "Success factors of new product development: a review of the empirical literature", *International Journal of Management Reviews*, Vol.4 No.1, pp.1-40.

Facione, P. A. (1990), "Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction". *The Delphi Report: Research findings and recommendations prepared for the committee on pre-college philosophy*. (*ERIC Document Reproduction Service No. ED 315-423*).American Philosophical Association, Washington. http://eric.ed.gov/?id=ED315423 (accessed January 29, 2014)

Fischer, M. M. (2001), "Innovation, knowledge creation and systems of innovation", *The Annals of Regional Science*, Vol.35 No.2, pp. 199-216.

Füller, J. (2006), "Why Consumers Engage in Virtual New Product Developments Initiated by Producers". *Advances in Consumer Research*, Vol.33 No.1, pp.639-646.

Garrison, R., Anderson, T. And Archer, W. (2001), "Critical thinking, cognitive presence, and computer conferencing in distance education", *American Journal of Distance Education*, Vol.15 No.1, pp.7-23.

Ge, X. and Land, S. M. (2003), "Scaffolding students' problem-solving processes in an ill-structured task using question prompts and peer interactions", *Educational Technology Research and Development*, Vol.51 No.1, pp.21–38.

Ge, X. and Land, S. M. (2004), "A conceptual framework for scaffolding III-structured problem-solving processes using question prompts and peer interactions", *Educational Technology Research and Development*, Vol.52 No. 2, pp. 5-22.

Gourlay, S. (2006), "Conceptualizing knowledge creation: a critique of Nonaka's theory", *Journal of Management Studies*, Vol.43 No.7, pp. 1415-1436.

Graneheim, U. H. And Lundman, B. (2003), "Qualitative content analysis in nursing research: Concepts, procedures and measures to achieve trustworthiness", *Nurse Education Today*, Vol.24 No.2, pp.105–112.

Gunawardena, C. N., Lowe, C. A. and Anderson, T. (1997), "Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing", *Journal of Educational Computing Research*, Vol.17 No.4, 397–431.

Haavisto, P. (2014), "Observing discussion forums and product innovation – A way to create consumer value? Case heart-rate monitors". *Technovation*, VoL.34 No.4, 215-222.

Hara, N., Bonk, C.J. and Angeli, C. (2000), "Content analysis of online discussion in an applied educational psychology course", *Instructional Science*, Vol.28 No2, pp. 115-152.

Henri, F. (1992), "Computer conferencing and content analysis", in Kaye, A.R. (Ed.), *Collaborative learning through computer conferencing*, Springer-Verlag, London, pp. 117-136.

Hsieh, H. and Shannon, S.E. (2005), "Three approaches to Qualitative Content Analysis", *Qualitative Health Research*, Vol.15 No.9, pp. 1277-1288.

Huber, G. (1991), "Organizational learning: The contributing processes and the literatures", *Organization Science*, Vol.2 No.1, pp. 88-115.

~~Li, X. & Cox, A. (2016), "A comparative study of knowledge construction within online user support discussion forums in Chinese and English language cultural contexts", *Telematics and Informatics*, Vol.33 No. 4, pp.1048-1056.~~

Jang, H.,Olfman, L.,Ko, I.,Koh, J. and Kim, K. (2008), "The Influence of On-line Brand Community Characteristics on Community Commitment and Brand Loyalty", *International Journal of Electronic Commerce*, Vol.12 No.3, pp.57-80

Khodakarami, F. and Chan, Y. E. (2014), "Exploring the role of customer relationship management (CRM) systems in customer knowledge creation", .*Information & Management*, Vol.51No.1, pp. 27-42.

Kim, L. (2000), "Absorptive capacity, co-opetition, and knowledge creation", in Nonaka, I. And Nishiguchi, T. (Ed.), *Knowledge Emergence: Social, technical, and evolutionary dimensions of knowledge creation*, Oxford University Press, Oxford, pp. 270-285.

Kozinets, R.V. (1999), "E-tribalized marketing? The strategic implications of virtual communities of consumption", *European management Journal*, Vol.17 No.3, pp. 252-264.

Krippendorff, K. (1980), *Quantitative content analysis: An introduction to its method*, Sage Publications, Beverly Hills.

Lave, J. and Wenger, E. (2001), *Situated learning: Legitimate peripheral participation*. Cambridge university press.

Lee, H. and Choi, B. (2003), "Knowledge management enablers, processes, and organizational performance: An integrative view and empirical examination", *Journal of Management Information Systems*, Vol.20 No.1, pp. 179–228.

Li, X. & Cox, A. (2016), "A comparative study of knowledge construction within online user support discussion forums in Chinese and English language cultural contexts", *Telematics and Informatics*, Vol.33 No. 4, pp.1048-1056.

Lilien, G. L., Morrison, P.D., Searls, K., Sonnack, M. and von Hippel, E. (2002), "Performance Assessment of the Lead User Idea-Generation Process for New Product Development", *Management Science*, Vol.48 No.8, pp.1042-1059.

Lindkvist, K. (1981), "*Approaches to textual analysis*", *in* Rosengren, K. E. (Ed.), *Advances in content analysis*, Sage, Beverly Hills, CA, pp. 23-41.

Mahr, D., and Lievens, A. (2012), "Virtual lead user communities: Drivers of knowledge creation for innovation", *Research policy*, Vol. 41 No.1, pp.167-177.

Mahr, D., Lievens, A. and Blazevic, V. (2014),“The value of customer cocreated knowledge during the innovation process”, *Journal of Product Innovation Management*, Vol.31 No.3, pp.599-615.

McAlexander, J., Schouten, J. and Koenig, H. (2002), “Building brand community”, *Journal of Marketing*, Vol.66 No.1, pp. 38–54.

McLean, L. D. (2004), “A Review and Critique of Nonaka and Takeuchi’s Theory of Organizational Knowledge Creation”, in *Fifth International Conference on HRD Research and Practice across Europe by AHRD and UFHRD*, 2004, Limerick, Ireland. http://mcleanglobal.org/public/MGC/publications/Nonaka%20and%20Takeuchi.pdf. (accessed August 15, 2014)

McTavish, D. G. and Pirro, E. B. (1990), “Contextual content analysis”, *Quality and Quantity*, Vol. 24 No.3, pp. 245-265.

Muniz, A.M. and O’Guinn, T.C. (2001), “Brand community”, *Journal of Consumer Research*, Vol.27 No.4, pp. 412–432.

Nambisan, S. (2002), “Designing virtual customer environments for new product development: Toward a theory”, *Academy of Management Review*, Vol. 27 No.3, pp. 392-413.

Nelson, R.R. (1991), “Why do firms differ, and how does it matter?”, *Strategic Management Journal*, Vol.13 No.S2, pp.61-74.

Netzer, O., Feldman, R., Goldenberg, J., and Fresko, M. (2012), “Mine your own business: Market-structure surveillance through text mining”, *Marketing Science*, Vol. 31 No.3, pp. 521-543.

Newman, D. (1996), “Teaching Sociology in the 90's: The Three Faces of Relevance”, *International Journal of Sociology and Social Policy*, Vol.16 No.11, pp. 81-94.

Newman, D.R., Johnson, C., Webb, B. And Cochrane, C. (1997), “Evaluating the quality of learning in computer supported cooperative learning”, *Journal of the American Society of Information Science,* Vol.48 No.6, pp.484-495.

Nonaka, I. And Takeuchi, H. (1995), *The Knowledge-Creating Company*, Oxford University Press, New York.

Nonaka, I. (1991), “The knowledge-creating company”, *Harvard Business Review*,Vol.69 No.6, pp.96–104.

Nonaka, I. (1994), “A dynamic theory of organizational knowledge creation”, *Organization Science*, Vol.5 No.1, pp.14-37.

Nonaka, I., Konno, N. and Toyama, R. (2001), “Emergence of “Ba”: A conceptual framework for the continuous and self-transcending process of knowledge creation”, in Nonaka, I. & Nishigushi, T. (Ed.), *Knowledge Emergence: Social, Technical and Evolutional Dimensions of Knowledge Creation*, Oxford University Press, Oxford, pp. 3-29.

Paavola, S., Lipponen, L. and Hakkarainen, K. (2002), “Epistemological foundations for CSCL: A comparison of three models of innovative knowledge communities”, in Stahl, G. (Ed.),*Proceedings of the Computer-supported Collaborative Learning: Foundations for a CSCL Community,2002,* Lawrence Erlbaum, Hillsdale, NJ, pp. 24-32.

Pang, B. and Lee, L. (2008), "Opinion Mining and Sentiment Analysis", *Foundations and Trends in Information Retrieval*, Vol.2 No.1-2, pp. 1-135.

Peschl, M. F.and Fundneider, T. (2014), "Designing and enabling spaces for collaborative knowledge creation and innovation: From managing to enabling innovation as socio-epistemological technology", *Computers in Human Behavior*, VoL.37, pp.346-359.

Potter,W. J. and Levine-Donnerstein, D. (1999), "Rethinking validity and reliability in content analysis", *Journal of Applied Communication Research*, Vol.27 No.3, pp.258-284.

Ratislavová, K., and Ratislav, J. (2014), "Asynchronous email interview as a qualitative research method in the humanities", *Human Affairs*, Vol.24 No.4, pp.452-460.

Rice, P. and Ezzy, D. (1999), *Qualitative research methods: a health focus*, Oxford University Press, Melbourne.

Rourke, L., Anderson, T., Garrison, D. R. and Archer, W. (2001), "Methodological issues in the content analysis of computer conference transcripts", *International Journal of Artificial Intelligence in Education (IJAIED)*, Vol.12 No.1, pp. 8-22.

Samaddar, S. and Kadiyala, S. S. (2006), "An analysis of interorganizational resource sharing decisions in collaborative knowledge creation", *European Journal of operational research*, Vol. 170 No.1, pp.192-210.

Spender, J. C. and Grant, R. M, (1996), "Knowledge and the firm: overview", *Strategic management journal*, Vol.17 No.S2, pp. 5-9.

Stein, D. S.,Wanstreet, C. E., Engle, C. L., Glazer, H. R., Harris, R. A., Johnston, S. M. and Trinko, L. A. (2006), "From personal meaning to shared understanding: the nature of discussion in a community of inquiry", in *Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education*,2006, St. Lollis, Missouri.

Suchman, L. A. (1987), *Plans and situated actions: the problem of human-machine communication*, Cambridge university press, New York.

Tesch, R. (1990), *Qualitative research: Analysis types and software tools*, Falmer, Bristol, PA.

Thomke, S. and von Hippel, E. (2002), "Customers as innovators", *Harvard Business Review*, Vol.80 No.4, pp.74–81.

Van Wijk, R., Jansen, J. J. and Lyles, M. A. (2008), "Inter-and Intra-Organizational Knowledge Transfer: A Meta-Analytic Review and Assessment of its Antecedents and Consequences", *Journal of Management Studies*, Vol.45 No.4, pp.830-853.

Veerman, A. and Veldhuis-Diermanse, E. (2001), "Collaborative learning through computer-mediated communication in academic education", in *Euro CSCL 2001*, McLuhan institute, University of Maastricht, Maastricht, 2001, pp. 625–632.

Wenger, E. (1998), *Communities of practice: Learning, meaning, and identity*. Cambridge University press, Cambridge.

Wurster, T.S. and Evans, P.B. (1997), "Strategy and the new economics of information", *Harvard Business Review*, Vol.75 No.5, pp.71-82.

Zhu, E. (2006), “Interaction and cognitive engagement: An analysis of four asynchronous online discussions”, *Instructional Science*, Vol.34 No.6, pp.451-480.