

Understanding and supporting online communities of practice: lessons learned from Wikipedia

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Abstract In order to seek more effective ways to design and support online communities of practice, we examined how Wikipedia, a large-scale online community of practice, is developed and emerges over time. We conducted a Delphi study to explore the social, organizational, and technical factors that Wikipedia experts believe have supported the evolution of this community. Based on the findings, we present a model for thinking about online communities of practice and suggest it may serve as starting point to develop strategies of designing and supporting online communities of practice.

Keywords Community of practice · Learning community · Computer-supported collaboration · Wikipedia

Introduction

Recent decades have seen a shift away from explaining learning as a function of individual minds towards understanding learning in the context of social interactions (Vygotsky 1978; Resnick 1987). Situated learning theorists posit that learning is situated—that it is the product of the activity, context, and culture in which it occurs (Brown et al. 1989; Greeno 1998; Lave and Wenger 1991). Learning takes place in what Wenger (1998) defined as *communities of practice* (CoPs): groups of people sharing common practices who develop their knowledge and expertise together through interactions. Lave and Wenger (1991) observed that members of a community of practice not only develop the skills required to participate in community activities, but also gain knowledge about the community's goals, resources, and principles. This learning occurs through a process called *legitimate peripheral participation*. New members first participate in peripheral tasks that are less important to the group. Participation in peripheral tasks gives new members opportunities to access community resources and interact with other members. Through practice and

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interaction, new members gradually learn about the community's goals and organization and start to build skills and experiences that enable them to move to more central tasks. According to Lave and Wenger (1991), studying how people engage in CoPs provides an analytic approach to understanding learning. Barab and Duffy (2000) suggested that the framework of CoP provides insights into more effective ways to support learning in community settings.

Earlier research focused primarily on co-located CoPs in which the interactions rely on the geographic proximity of its members (Brown and Duguid 1991; Lave and Wenger 1991). Since the '90s, many communities have emerged online and researchers have used CoP theory to understand the nature of these virtual groups (Herrmann 1998; Johnson 2001). Many other researchers seek to support learning through designing and supporting online CoPs (Barab and Duffy 2000; Barab et al. 2004; Hoadley and Kilner 2005). However, Schwen and Hara (2004) pointed out that the evolutionary pattern of CoP is poorly understood, which makes designing CoPs difficult. A necessary first step, therefore, appears to be to understand more about how online CoPs work and identify the factors that make it possible for them to become established and thrive. For this purpose, we examined the community of practice behind the tremendously successful website, Wikipedia (<http://wikipedia.org>).

The case of Wikipedia

Wikipedia (<http://wikipedia.org>) is an online encyclopedia written by internet users. Since its founding in 2001, more than a million volunteer editors have contributed to create and refine Wikipedia content. As the result of the cumulative work, Wikipedia now features millions of entries covering a wide range of topics, and is one of the most-visited websites on the internet (Alexa.com 2009).

Wikipedia is based on wiki technology, which enables anyone with a web browser to participate in creating and editing the encyclopedia. At the top of every article's main page are five tabs: *Article*, *Discussion*, *Read*, *Edit*, and *View history* (see Fig. 1). Both the *Article* and the *Read* tab display the text of the entry itself. Clicking on the *Discussion* tab brings up the "Talk page" (Fig. 2). Yellow boxes located at the top of the talk page are Wikipedia templates that are designed to display standard notices, warnings, or information across multiple pages. One of the templates, "To-do list for Educational Technology," lists plans to improve the entry. The bottom half of the talk page allows users to post concerns about editing issues and request changes for the entry. Clicking the *Edit* tab allows any user to modify the article's content and publish the new version (Fig. 3). Clicking the *View history* tab reveals the time, editor, and content of every modification made to the article since its creation (Fig. 4). For example, the first "Educational Technology" entry was created in 2005 and was only nine words long: "The use of technology to improve teaching and learning" (Fig. 5). The entry has since been modified more than 800 times, although the entry editors are far fewer than 800 (most of the entry's editors have edited it more than once). The current version (as of March 5, 2010) is approximately 3,400 words with 14 subsections and includes lists of related entries and references. In case of vandalism to the article, one can easily restore the entry to any old version easily from within the *View history* functions.

As Wikipedia can be edited by anyone at any time, it is never a finished product. Instead, the online encyclopedia is continually being reviewed, evaluated, and edited by its users. While many are skeptical that indiscriminate internet users can generate meaningful information using such a chaotic process, several studies have shown that Wikipedia

Article [Discussion](#) Read [Edit](#) [View history](#)

Educational technology

From Wikipedia, the free encyclopedia

Educational technology (also called **learning technology**) is the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources.^[1] The term educational technology is often associated with, and encompasses, **instructional theory** and **learning theory**. While **instructional technology** covers the processes and systems of learning and instruction, **educational technology** includes other systems used in the process of developing human capability. Educational Technology includes, but is not limited to, software, hardware, as well as Internet applications and activities. But there is still debate on what these terms mean.^[2]

Contents [hide]

- 1 Explanation and meaning
- 2 History
- 3 Theories and practices
 - 3.1 Behaviorism
 - 3.1.1 Skinner's Contributions
 - 3.2 Cognitivism
 - 3.3 Constructivism
 - 3.4 Connectivism
- 4 Instructional technique and technologies
- 5 Theorists

Fig. 1 A sample Wikipedia entry

Article [Discussion](#) Read [Edit](#) [New section](#) [View history](#)

Talk:Educational technology

From Wikipedia, the free encyclopedia

 This article is within the scope of **WikiProject Psychology**, a collaborative effort to improve the coverage of **Psychology** on Wikipedia. If you would like to participate, please visit the project page, where you can join the discussion and see a list of open tasks. 

??? This article has not yet received a rating on the project's quality scale.

??? This article has not yet received a rating on the project's importance scale.

 This article is within the scope of **WikiProject Education**, a collaborative effort to improve the coverage of **education** and **education-related** topics on Wikipedia. If you would like to participate, please visit the project page, where you can join the discussion and see a list of open tasks. 

??? This article has not yet received a rating on the project's quality scale.

??? This article has not yet received a rating on the project's importance scale.

 This article is within the scope of **WikiProject Technology**, a collaborative effort to improve the coverage of **technology** on Wikipedia. If you would like to participate, please visit the project page, where you can join the discussion and see a list of open tasks. 

??? This article has not yet received a rating on the project's quality scale.

 **To-do list for Educational technology:** edit • history • watch • refresh

1. Confirm what educational technology actually is. The Januszkewski book (reference in the article) appears to be a good source.
2. Expand the history section.
3. Expand the existing sections under "Theories and practices" (if still relevant) and incorporate the listed wikilinks into the text.
4. The Criticism section need to be formatted to match the article and citations need to be added.
5. The further reading section should be sectioned to make finding articles easier. Article titles and summaries should be made neater.

Contents [hide]

- 1 Cleanup request

Fig. 2 Talk page for “educational technology” Wikipedia entry

articles are actually quite accurate and reliable (Chesney 2006; Giles 2005; Rosenzweig 2006). How is this possible?

Viewing wikipedia as a community of practice

Some explain Wikipedia’s evolving accuracy to the “wisdom of the crowd,” or the open source philosophy that suggests errors are more likely to be found and fixed when more

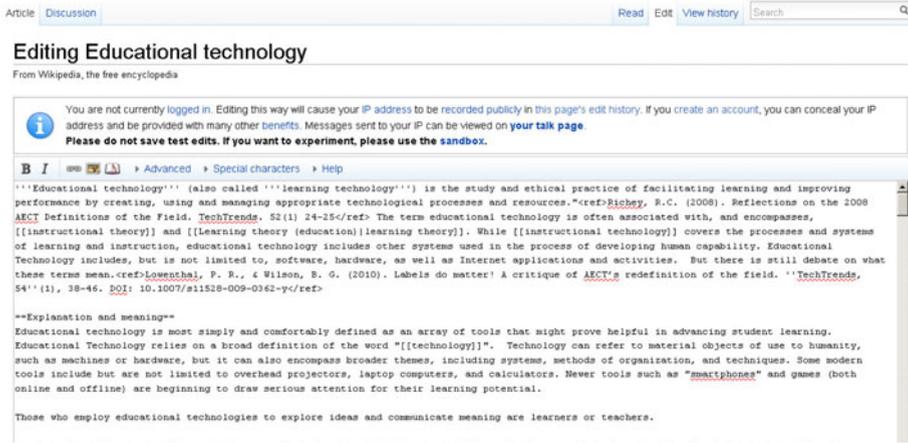


Fig. 3 Editing the “educational technology” Wikipedia entry

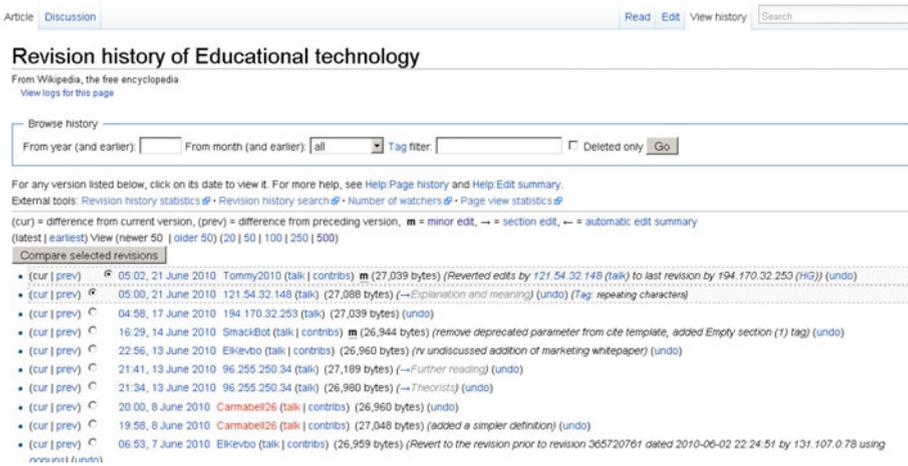


Fig. 4 Revision history of a Wikipedia entry



Fig. 5 An earlier version of the “educational technology” Wikipedia entry

people have access to them (Stalder and Hirsh 2002). However, others have attributed Wikipedia's achievements to its socio-technical structure that motivates contributions (Ciffolilli 2003; Rafaeli and Ariel 2008), promotes discussions (Viégas et al. 2007), resolves conflicts (Viégas et al. 2004), promotes quality work (Viégas et al. 2007), builds on norms (Ingawale et al. 2009), and facilitates peripheral participation (Bryant et al. 2005). Studies have revealed a reciprocal relationship between Wikipedia's content and its contributors: On one hand, interactions among contributors improve content quality; on the other hand, the complex process of creating and negotiating content promotes more interactions. Eventually, a social structure evolves to support the interactions. As its contributors work together to build the encyclopedia, Wikipedia exhibits the characteristics of a CoP as defined by Wenger (1998): a community where membership is defined by *mutual engagement* in editing, whose members share a *joint enterprise* of knowledge building, and in which a *shared repertoire* is developed and emerges over time.

Thus, it seems appropriate to examine Wikipedia more closely in an effort to begin identifying the factors that lead to the creation and evolution of a successful online CoP. To achieve this purpose, we used the Delphi method to learn more about the inner workings of Wikipedia's technology, content, contributors, procedures, and group social structures from a group of Wikipedia researchers.

Method

The Delphi method is a data-collection technique that uses sequential questionnaires and feedback for gathering and organizing a panel of expert opinions about a complex issue (Eggers et al. 1998; Murry and Hammons 1995). Originally developed as a forecasting tool (Dalkey and Helmer 1963), the Delphi method has been used extensively in educational research (see Dodge and Clark 1977; Fazio 1985; Pollard and Pollard 2005). Delphi studies often start with an initial, open-ended question(s) to be answered by a panel of carefully selected experts. The researcher then analyzes the experts' responses and "feeds back" those responses in a second-round questionnaire that asks experts to review, rate, and comment on the group's previous responses. In the third and any additional rounds, panel members receive feedback about the previous round and are asked to reevaluate their responses. This process is repeated until consensus is achieved, making the Delphi method particularly applicable for collecting subjective information from experts on a given topic (Linstone and Turoff 1975).

The initial question

The construction of the initial question(s) is key to a successful Delphi study. It is important to keep the question(s) neutral and non-directive to avoid influencing panel responses (Delberg et al. 1975). To identify the key characteristics of Wikipedia product, community, and interactions, we designed the following open-ended question:

Based on your perspective as a Wikipedia researcher, what are the factors that you feel have supported the creation and evolution of Wikipedia?

Selecting the expert panel

Expert panelists for a Delphi must be chosen carefully to ensure their expertise best matches the topic under study. Many Delphi studies identify experts as those with

experience in “publishing,” “conference presentation,” “practice,” and/or those who have been “nominated by peers” (see Long 1991; Raskin 1994; and Ritchie and Earnest 1999). We were interested in recruiting panelists who researched Wikipedia content, process, or technology. We therefore sought experts from the following pools: (1) researchers whose Wikipedia-related publications are recorded at the *Wikipedia in Academic Studies* (2008) webpage; (2) presenters at the 2007 *Wikimania* conference; and (3) Wikipedia research email list (wiki-research-l@lists.wikimedia.org) subscribers. We did not pursue peer nomination as Wikipedia is a relatively new phenomenon, making this recruitment strategy difficult.

The first author sent the initial question and an informational questionnaire to 169 potential expert panelists from groups (1) and (2) above and to the Wikipedia research email list. The questionnaire was designed to collect data on participants’ Wikipedia use and research experiences in order to identify experts whose backgrounds best matched the purpose of the study (see “Appendix” section). Questions included: “Are you a Wikipedia editor?” “Are you a Wikipedia administrator?” “Have you participated in Wikipedia projects in ways other than editing and administrating?” “Which language version of Wikipedia do you use the most?” “Please describe your Wikipedia research interests.” “Please describe your Wikipedia research experience to date.”

Thirty-five participants both completed the informational questionnaire and answered the initial question. Respondents’ demographic information is summarized in Table 1. All respondents reported to have engaged in Wikipedia research. To further ensure the expertise of our Delphi panel, we invited respondents who have published at least one journal article to serve as our panelists. As we are mainly concerned about Wikipedia as a social phenomenon, we excluded respondents whose research areas are less relevant to our study. In addition, since different language versions of Wikipedia operate independently, we decided to focus our study on the English Wikipedia and limit our experts to those who use or research English Wikipedia. With these criteria, we identified 18 experts. In the end, 12 of the 18 agreed to serve as panelists. Their demographic information is listed in Table 1.

Round 1

Thirty-five responses to the initial question yielded nine pages of text. We analyzed the 35 responses using the constant comparative method (Merriam 2001), hand coding them for recurring themes. We used “investigator triangulation” as a means to enhance the internal validity of the study (Denzin 2006). After the corpus data were initially coded by the first author, we met to compare and discuss identified themes, turning back to the raw data for guidance when needed. As a result of these discussions, we identified 44 recurring themes or “factors” that respondents reported to supported the creation and evolution of Wikipedia.

The list of 44 factors was randomly ordered and sent back to the 18 identified experts for further validation. The experts were asked if they would be willing to participate in the additional Delphi rounds and, if so, to review each factor and rate its effect on the creation and evolution of Wikipedia on a 1–5 Likert scale (1 = Large negative effect, 2 = Moderate negative effect, 3 = No effect, 4 = Moderate positive effect, 5 = Large positive effect). In addition, the experts were encouraged to suggest any changes to the factors. In this way, the Delphi technique includes a sort of “built in” member checking that occurs as a result of continuous verification throughout each round of the process (Adler and Ziglio 1996; Delberg et al. 1975; Linstone and Turoff 1975). Twelve out of 18 experts (66.7%)

Table 1 Demographics of participants throughout Delphi study

Category	Initial question (<i>n</i> = 35)	Round 1 (<i>n</i> = 12)	Round 2/3 (<i>n</i> = 9)
Gender			
Male	27	9	6
Female	8	3	3
Age			
18–29	15	4	4
30–39	13	6	4
40–49	4	2	1
50–59	3	0	0
Profession			
Student/graduate student	11	4	3
Faculty	10	5	4
Researcher	7	2	2
Other	7	1	0
Residence			
Europe	19	6	3
US/Canada	10	3	3
Asia/Pacific	5	3	3
Other	1	0	0
Use of Wikipedia (language version)			
English	21	11	8
German	8	0	0
English + other	4	1	1
French	1	0	0
Didn't answer	1	0	0
Use of Wikipedia (editing)			
Editor (>5 years)	3	2	0
Editor (3–5 years)	9	2	2
Editor (2–3 years)	4	0	0
Editor (1–2 years)	5	3	3
Editor (0–1 years)	1	1	1
Editor (all)	22	8	6
Non-editor	13	4	3
Use of Wikipedia (administrating)			
Admin	2	1	0
Non-admin	33	11	9
Use of Wikipedia (other than participation)			
Yes	18	5	3
No	17	7	6
Research area			
Social aspects	14	6	4
Content	8	5	4
Process	4	0	0
Technology	3	1	1
Other/didn't answer	6	0	0

agreed to participate further as “panelists” in the Delphi study and finished this first round. The factors and their mean ratings are listed in Table 2.

Round 2

All 44 factors from Round 1 had average ratings over 3, reflecting that experts agreed that all factors had some positive effect on the creation and evolution of Wikipedia. However, several experts suggested that, in order to make sense of all the factors, we needed to explore which factors were *essential* or “key” to Wikipedia’s success. Experts also suggested that we condense the factors into fewer items to focus the study. Based on the suggestions, we further identified and synthesized the “indigenous categories” that the experts had created to make sense of the creation and evolution of Wikipedia based on an *inductive analysis* of the data (Patton 2002). We were also guided by our own “sensitizing concepts” that we brought to the analysis based on our expertise as instructional designers. These concepts, like our understandings of interface design issues and motivation, were influential in that they provided general references and directions along which to look (Blumer 1969). However, we tried not to allow these constructs to dominate our analysis, but rather used them to facilitate our understanding of the data. The Fig. 6 is the “analyst-constructed typology” that emerged from this inductive analysis of the data (Patton 2002). It descriptively elucidated our findings and formed the basis of the subsequent Delphi rounds. So, while the figure itself was not presented to the experts for feedback, the questions asked in subsequent rounds helped to validate the model by effectively asking the experts in text whether the constructions made sense to them.

In this model, Wikipedia starts with editors who have both the motivation and technology access to generate or edit Wikipedia entries. Entries/edits generate collaboration, which, in turn, generates quality content. The content attracts readers, some of whom become editors. Eventually a community evolves in the process. The community provides additional motivation for those involved, and its goals and practices are negotiated by its members over time. Based on stages of the model, we derived nine key factors that appear to have supported the evolution of Wikipedia. We further drew connections between the original 44 factors and the 9 key factors, generating a subset of original factors under each key factor.

We provided experts the key factors together with related original factors. For each key factor we asked the experts to assess whether we had summarized it appropriately and to what extent they thought it was essential to the creation and evolution of Wikipedia (1 = not essential, 2 = somewhat essential, 3 = very essential). Nine of the 12 expert panelists responded to this second round of the Delphi study (75%). The number of experts who agreed the key factors were appropriate ranged from six out of nine to nine out of nine. Experts’ mean rating of the “essentialness” of the factors ranged between 1.33 and 2.78 (Table 3).

Round 3

In Round 2, key factor #9 had rated the lowest both in terms of appropriateness (6 of 9) and “essentialness” ($M = 1.33$). Upon further examination, it appeared all of the initial factors related to key factor #9 could be moved into other key factors. So we removed key factor #9, leaving eight key factors total. We revised some of the remaining key factors as recommended and sent them back to the experts again. All nine experts from Round 2 responded to this third round of survey. With one exception (one participant preferred the

Table 2 Factors that support the evolution of Wikipedia (Round 1)

Factors	Mean rating of factors
It empowers people to share knowledge	4.58
It covers a wide range of contents	4.58
It comprises a huge number of articles	4.58
It is a flexible, trial-and-error social process that allows the community to find best practices	4.50
New editions are published immediately	4.50
It makes it easy to find information	4.50
It has met the need for a free online resource of various knowledge	4.50
It is easy for users/readers to use	4.45
People get instant gratification seeing their edits applied instantly	4.42
Its software system is reliable	4.36
It is multilingual	4.33
It collects the wisdom of the people	4.33
It is free-licensed	4.27
It creates a sense of community	4.25
It allows editors to make something known to others	4.17
It is self-sustaining (many users turn into editors)	4.17
It benefits from the openness of the community	4.17
It allows anyone to edit	4.17
It enables knowledge sharing	4.17
It encourages collaboration	4.09
Editors get to feel good about their contributions	4.08
It's fun	4.00
Editors get to feel like experts	4.00
It is easy for editors to use	4.00
It has low barriers of entry	4.00
It implements strong neutrality policies	4.00
The quality of its content	4.00
Its creation has led to the evolution of specific social structures/community	4.00
Editors get to build and enhance their personal reputations	4.00
Policy and practices are negotiated among community members	3.92
It is influenced by the open source movement	3.91
It makes people feel like volunteers contributing to the greater good	3.91
It is the first of similar products	3.91
It awards and acknowledges contributions	3.91
There is a shared purpose and goal among members of the community	3.90
It comprises effective community building strategies	3.82
It allows authors to take ownership of their contributions	3.82
It focuses on mutuality	3.80
People contribute to it out of altruism	3.73
It allows editors to express themselves	3.58
It benefits from editors who are familiar with the Internet culture	3.50
It enables community members to establish identities	3.42

Table 2 continued

Factors	Mean rating of factors
It creates opportunities for people to meet others who share similar interests	3.36
It has strong leadership	3.33

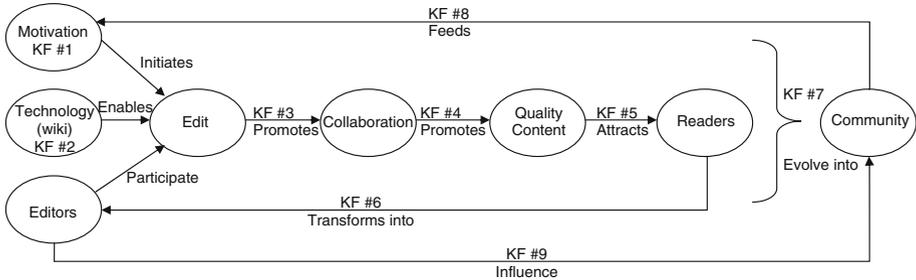


Fig. 6 A sequenced model of the development of Wikipedia

earlier version of key factor #2), all nine experts agreed on the changes to all key factors in this round. Having reached near-consensus, we concluded no further rounds were necessary. The final set of key factors and expert opinions are listed in Table 4.

Discussion

The Delphi study resulted in eight key factors that experts in the field regarded as essential to the evolution of Wikipedia. In this section we will discuss each of these key factors in more detail and, from our findings, present a model of Wikipedia as a CoP.

Key factors in the evolution of Wikipedia

Some editors are internally motivated to contribute to Wikipedia (“essentialness” rating M = 2.67)

Examining the motivations of Wikipedia contributors, Ciffolilli (2003) distinguished between personal and social motivations, and Peddibhotla and Subramani (2007) suggested differentiating “self-oriented” and “other-oriented” motives. Self- or personal motivations include satisfaction, enjoyment, self-efficacy, self-expression, and self-development. Other-oriented or social motivations include affiliation, belonging, altruism, reciprocity, reputation and cognition. For the purpose of this study, however, we have adopted slightly different classifications and distinguish between non-community-specific and community-specific motivations. This key factor deals with non-community-specific motivations that can be activated without involving a certain community. Although some of these motivations are social and other-oriented in nature (“making things known to others” and altruism), the motivations can come into play without a “Wikipedia community” in mind and, therefore, belong to this group. Community-specific motivations are discussed under key factor #8.

Table 3 Key factors that support the evolution of Wikipedia (Round 2)

Key factor	Original factors with round 1 rankings	Appropriateness (#agree/total)	Mean ratings of essentialness
1. Some editors are internally motivated to contribute to Wikipedia	<ul style="list-style-type: none"> • People get instant gratification seeing their edits applied instantly (4.42) • It allows editors to make something known to others (4.17) • Editors get to feel good about their contributions (4.08) • It's fun (4.00) • Editors get to feel like experts (4.00) • It is influenced by the open source movement. (3.91) • It makes people feel like volunteers contributing to the greater good (3.91) • People contribute to it out of altruism (3.72) • It allows editors to express themselves (3.58) • It benefits from editors who are familiar with the Internet culture (3.5) 	9/9	2.56
2. Wikipedia's tools and processes make the basic task of editing easy to perform	<ul style="list-style-type: none"> • New editions are published immediately (4.50) • Its software system is reliable (4.36) • It is multilingual (4.33) • It is free-licensed (4.27) • It allows anyone to edit (4.17) • It has low barriers of entry (4.00) • It is easy for editors to use (4.00) 	8/9	2.78
3. The process of editing Wikipedia promotes communications and collaborations among editors	<ul style="list-style-type: none"> • It empowers people to share knowledge (4.58) • It enables knowledge sharing (4.17) • It encourages collaboration (4.09) 	8/9	2.22

Table 3 continued

Key factor	Original factors with round 1 rankings	Appropriateness (#agree/total)	Mean ratings of essentialness
4. Communication and collaboration among editors helps to improve the quality and quantity of Wikipedia content	<ul style="list-style-type: none"> • It empowers people to share knowledge (4.58) • It is a flexible, trial-and-error social process that allows the community to find best practices (4.50) • It collects the wisdom of the people (4.33) • It enables knowledge sharing (4.17) • It implements strong neutrality policies (4.00) • Policy and practices are negotiated among community members (3.92) • It is influenced by the open source movement (3.91) • It focuses on mutuality (3.80) 	9/9	2.56
5. The content of Wikipedia attracts readers	<ul style="list-style-type: none"> • It comprises a huge number of articles (4.58) • It covers a wide range of contents (4.58) • New editions are published immediately (4.50) • It makes it easy to find information (4.50) • It has met the need for a free online resource of various knowledge (4.50) • It is easy for users/readers to use (4.45) • It is multilingual (4.33) • It is free-licensed (4.27) • The quality of its content (4.00) • It's fun (4.00) • It is the first of similar products (3.91) 	9/9	2.67

Table 3 continued

Key factor	Original factors with round 1 rankings	Appropriateness (#agree/total)	Mean ratings of essentialness
6. Wikipedia's tools and processes make the transition from the role of reader to editor easy	<ul style="list-style-type: none"> • It allows anyone to edit (4.17) • It is self-sustaining (many users turn into editors) (4.17) • It benefits from the openness of the community (4.17) • It has low barriers of entry (4.00) 	7/9	2.11
7. The design of Wikipedia's communication/collaboration tools facilitates the evolution of a community	<ul style="list-style-type: none"> • It empowers people to share knowledge (4.58) • It creates a sense of community (4.25) • It enables knowledge sharing (4.17) • It encourages collaboration (4.09) • Its creation has led to the evolution of specific social structures/community (4.00) • Policy and practices are negotiated among community members (3.92) • There is a shared purpose and goal among members of the community (3.90) • It comprises effective community building strategies (3.82) • It benefits from editors who are familiar with the Internet culture (3.50) • It enables community members to establish identities (3.42) • It creates opportunities for people to meet others who share similar interests (3.36) • It has strong leadership (3.33) 	8/9	2.00

Table 3 continued

Key factor	Original factors with round 1 rankings	Appropriateness (#agree/total)	Mean ratings of essentialness
8. Editors are further motivated to contribute by the acknowledgement and rewards from the community	<ul style="list-style-type: none"> • Editors get to build and enhance their personal reputations (4.00) • It awards and acknowledges contributions (3.91) • It is influenced by the open source movement (3.91) • It allows authors to take ownership of their contributions (3.82) • It enables community members to establish identities (3.42) • It creates opportunities for people to meet others who share similar interests (3.36) 	7/9	1.78
9. Wikipedia's communication/collaboration tools and processes enable editors to influence community goals, policies, and practices	<ul style="list-style-type: none"> • It is a flexible, trial-and-error social process that allows the community to find best practices (4.50) • It implements strong neutrality policies (4.00) • Policy and practices are negotiated among community members (3.92) • There is a shared purpose and goal among members of the community (3.90) • It focuses on mutuality (3.80) 	6/9	1.33

Table 4 Key factors that support the evolution of Wikipedia (Round 3)

Round 3 key factors	Round 2 key factors	Round 3 expert opinions (#agree/total)
1. Some editors are internally motivated to contribute to Wikipedia	Same as Round 3	9/9
2. Wikipedia's tools and processes make the basic task of editing <i>accessible</i>	2. Wikipedia's tools and processes make the basic task of editing <i>easy to perform</i>	8/9 (One participant preferred Round 2 version)
3. The process of editing Wikipedia promotes communications and collaborations among editors	Same as Round 3	9/9
4. Communication and collaboration among editors helps to improve the quality and quantity of Wikipedia content	Same as Round 3	9/9
5. The content of Wikipedia attracts readers	Same as Round 3	9/9
6. Wikipedia's tools and processes <i>enable</i> the transition from the role of reader to editor	6. Wikipedia's tools and processes <i>make the transition from the role of reader to editor easy</i>	9/9
7. <i>Wikipedia's communication/collaboration processes</i> facilitate the evolution of a community	7. <i>The design of Wikipedia's communication/collaboration tools</i> facilitates the evolution of a community	9/9
8. <i>Contributions to Wikipedia are acknowledged and rewarded by the community, which motivate some editors to contribute</i>	8. <i>Editors are further motivated to contribute by the acknowledgement and rewards from the community</i>	9/9

Note: Differences between the key factors in Round 2 and 3 are highlighted in italics

Applying uses and gratification theory from media research (Katz et al. 1973), Rafaeli and Ariel (2008) found Wikipedia editors' top motivations include cognitive (desire to acquire information or knowledge), affective (desire for pleasure and entertainment), personal integrative (desire to have high self-esteem) and social integrative (desire to belong to a group) motives. In addition, Nov (2007) found "fun" and "a desire to support the open source movement" among Wikipedia contributors' most significant motivators. Our findings were consistent with these earlier findings, except the experts did not bring up cognitive motivations. Additionally, one factor suggested Wikipedia's success is partially due to editors being familiar with the internet culture. This may imply that editors contribute to Wikipedia because they are used to participating in online activities, a motivation not found in earlier studies.

Wikipedia's tools and processes make the basic task of editing accessible (M = 2.78)

This key factor rated the highest in "essentialness" in Round 2, suggesting that experts reportedly believed it to be the most essential to the creation and evolution of Wikipedia. Indeed, people often associate Wikipedia's success with its open accessibility. Although anyone can edit, as Wikipedia is getting more complex in terms of editing styles and procedures, editing becomes more complicated for average users. Experts expressed concern that "the ease of use on Wikipedia is low" and "I would argue that the basic task of editing in Wikipedia is not easy to perform." These comments led us to revise this key factor from "Wikipedia's tools and processes make the basic task of editing easy to perform" to "... make the basic task of editing accessible." However, one expert in Round 3 preferred the earlier version, noting there are disagreements over whether editing Wikipedia is easy or not. In addition to the wiki technology, participants also identified the reliability of Wikipedia's software system and its multilinguality to be factors that make editing accessible.

The process of editing Wikipedia promotes communications and collaborations among editors (M = 2.22)

Since editing Wikipedia is a collective action, communication and collaboration evolve naturally in the process of editing Wikipedia. It could be argued that editing itself is a form of communication in that, when editing an article, one communicates with all previous editors through writing. More direct communication occurs in the "talk pages" (Fig. 2), which are discussion pages accompanying each Wikipedia article. On talk pages editors discuss the content and editing issues of the corresponding article, often including requests for coordination and/or more information. Viégas et al. (2007) found that more heavily edited articles are more likely to have non-blank talk pages, suggesting that complex editing processes are more likely to induce communication. Kittur et al. (2007) found that the ratio of non-article edits (including talk page edits, user profiles, and administrative activities) to article edits increased dramatically with time, also indicating that interactions increase during editing processes.

Communication and collaboration among editors helps to improve the quality and quantity of Wikipedia content (M = 2.56)

According to Benkler (2002), open source projects such as Wikipedia must go through two phases: content creation and quality control. This key factor involves the latter. The Delphi

experts identified collaboration, coordination, negotiation, and policies as keys to assuring quality control and their opinions appear to be supported in the literature. Wilkinson and Huberman (2007) found a strong correlation between the number of comments on talk pages and the quality of the corresponding article. Kittur and Kraut (2008) found article quality improved when editors used appropriate coordination techniques. Many quality control processes are based on policy-guided negotiation: In an interview by Riehle (2006), veteran Wikipedia contributors explained how larger editing judgments—like decisions to remove a low quality article—are made:

Any user can decide to list (an article in need to be deleted) on the ‘Articles for deletion’ page. Firstly, they put the deletion tag on the article by typing (a specific tag). Second, they create a page where this deletion can be discussed.... Finally, they add this to the daily log of articles listed for deletion.... Then, everyone discusses it for five days. People vote ‘support’ or ‘oppose’, but it’s not strictly a vote. Reasons matter, and the admin who closes the debate five days later is expected to take into account the reasons for deletion, relevant policies, and whether or not the article has been edited and improved since it was listed for deletion. That admin then closes the debate and deletes or keeps the article. Kept articles have their ‘listed for deletion’ tag removed, and a link to the discussion is put on the article’s talk page (so that people know not to list it again too soon). The decision to delete or keep is based on ‘rough consensus’ (p. 3).

According to Butler et al. (2008), rules and policies can be seen as rational efforts to organize or coordinate Wikipedia. Policies are negotiated by community members and can be adapted to fit the community’ purpose better (Viégas et al. 2007).

The content of Wikipedia attracts readers ($M = 2.67$)

Original factors related to this key factor were rated highest among all groups, suggesting experts regarded this key factor to be very important in the evolution of Wikipedia. One expert commented, “I think that if there wasn’t a large readership, Wikipedia would not be growing.” This key factor considers Wikipedia as an information resource, which, according to Burnett (2000), is one of the most important reasons that users are drawn to virtual communities. Similarly, Hoadley and Kilner (2005) suggested that the content of a knowledge-building community attracts members by providing immediate value. Some factors in this group also suggested that Wikipedia benefits from being the first among similar products, and implied that novelty may have an effect on readership.

Wikipedia’s tools and processes enable the transition from the role of reader to editor ($M = 2.11$)

As Wikipedia attracts many readers and provides them with the tools to edit, some of these readers become editors, thereby making Wikipedia self-sustainable. Bryant et al. (2005) studied role transformation among Wikipedia users and discovered patterns of legitimate peripheral participation. As users become more experienced, they adopt different goals, identities, tools, and perceptions of the community.

The Delphi experts expressed concern about this key factor being too similar to key factor #2. However, taking into account the model of Wikipedia development (Fig. 1), we believed it necessary to distinguish between editors who are motivated to edit Wikipedia from the start, and those who start off as readers and participate through legitimate

peripheral participation. This idea is supported by Panciera et al. (2009), who found that behavior patterns of frequent editors and casual editors differ significantly from the start. While casual editors make fewer edits, their contributions comprise a large percentage of Wikipedia content. Kittur et al. (2007) found that the proportion of Wikipedia content contributed by casual editors is increasing and suggested that, although Wikipedia was driven by “elite” users early on, the workload has been shifting to “common” users.

Wikipedia’s communication/collaboration processes facilitate the evolution of a community (M = 2.00)

While it is difficult to determine exactly when and how a “Wikipedia community” fully emerged, studies show evidence of a shared sense of community among active editors (Bryant et al. 2005; Rafaeli and Ariel 2008). McMillan and Chavis (1986) summarized four elements of sense of community to be *membership* (belonging and identification), *influence* (members being able to influence the community), *integration and fulfillment of needs* (members feeling rewarded for their participation), and *shared emotional connection*. All four elements can be seen in Wikipedia (Rafaeli and Ariel 2008) and are noted by the Delphi experts. Additionally, key factor #9, which was eliminated in Round 3, involves specifically how Wikipedia processes enable members to influence community policies and practices. It can be seen as a subset of this key factor.

Several other implications can be drawn from this key factor: First, while the community was deemed as important, it was rated only somewhat essential to the evolution of Wikipedia ($M = 2.00$). This may be due to the fact that the community is not immediately visible to common users (Bryant et al. 2005). Second, the Wikipedia community has evolved over time rather than being “designed” *per se*. One expert specifically suggested we remove the word “design” from the Round 2 version of this key factor in order to emphasize the point. Third, while the development of personal relationships is often perceived as a characteristic of virtual communities (Rheingold 1993; Schwier 2001), it is not prominent in Wikipedia. In this study, the only factor that discussed personal relationships (“it creates opportunities for people to meet others who share similar interests”) rated very low on its effect on Wikipedia’s development ($M = 3.36$). There does not currently appear to be any research studying the development of personal relationships in Wikipedia, which may be an area for further exploration.

Contributions to Wikipedia are acknowledged and rewarded by the community, which motivate some editors to contribute (M = 1.78)

As discussed earlier, some motivations for contributing to Wikipedia are community-specific and only become relevant when individual editors begin interacting with the community. Such motivations include reputation, recognition, and ownership of contribution. Kollock (1999) proposed that the desire for prestige within a community can serve as a motivation for making contributions. Cifollilli (2003) and Adler and de Alfaro (2007) agreed, suggesting that authors of long-lived Wikipedia contributions gain reputation over time. Although claiming personal ownership of contributions is discouraged by community norms (Wikipedia 2009), it is technically possible to track editors’ contributions by examining historical versions of articles. In fact, Bryant et al. (2005) have observed a sense of individual ownership among editors. In some extreme cases, this sense of personal ownership of articles drives editors to try preventing their contributions from being reverted (Thom-Santelli et al. 2009).

Although rewards and recognition from the community can motivate editors to contribute, experts disagreed somewhat on the importance of such motivators. In Round 2, one expert suggested the motivation can be temporary as editors tend to lose their connection to the content they produced over time. However in Round 3, another expert commented that most editors are motivated by recognition from the community. Probably as a result of the disagreement, this key factor also rated the lowest among all key factors in “essentialness” ($M = 1.78$) after removing key factor #9.

A model of Wikipedia as a CoP

On further examination of the key factors, six elements occurred repetitively: individuals, practice, content, interactions, community, and technology. Figure 7 illustrates how we believe the six elements are interrelated.

Individuals

Individuals refer to the people using and editing Wikipedia. As readers, individuals are attracted by the content. Motivated users can use the available technology to start practicing at generating content. As they practice, they start peripheral participation within the

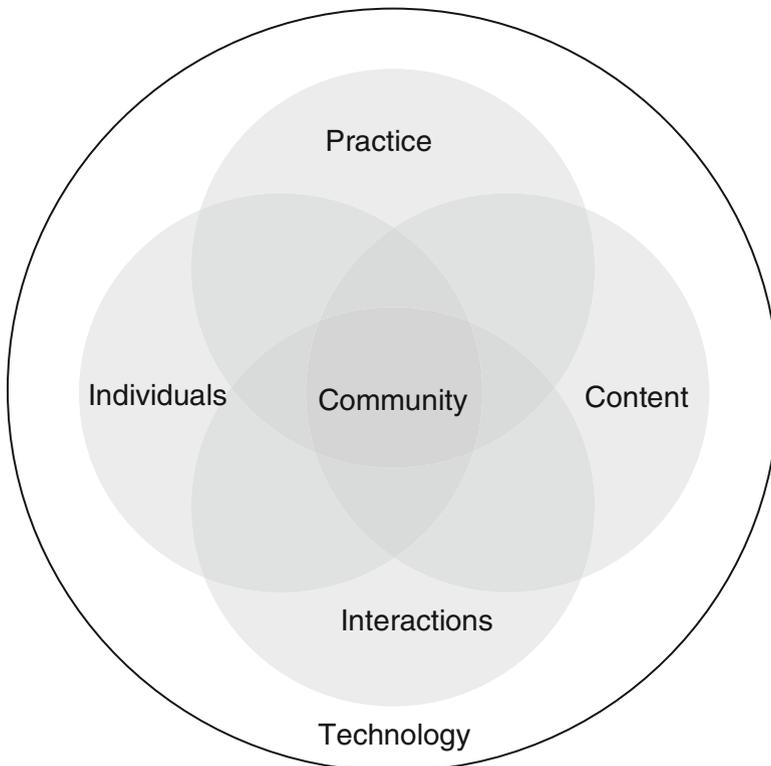


Fig. 7 Visual representation of the relationship of the six elements in Wikipedia that produce a CoP

community. As the community starts to form, these individuals can be further motivated to practice by affiliation, belonging, and recognition from the community.

Practice

Practice refers to the activities that people engage into create Wikipedia content. Generating Wikipedia content involves different practices: Some can be conducted at the individual level, such as composing a single page; other practices, such as coordinating a project, need to be conducted by the community at large. Practice defines Wikipedia as a community of “practice.” Practice generates content. And practice promotes and provides a context for individuals’ interactions.

Content

As a collection of articles and documents, content is essential to the community of Wikipedia: First, it serves as the purpose of the community, as every action within Wikipedia revolves around the purpose of building the content. Second, it provides value to attract newcomers, as Wikipedia would not be able to recruit new members if the content did not meet their needs for information. Again, the content is the product of both the individual’s and the community’s practice: While individuals can perform editing tasks alone, the quality control process of Wikipedia calls for interactions and community processes, including policies, coordination and differentiated roles.

Interactions

As practice continues, more interactions evolve as required by the task of content making. Interactions can foster individuals’ attachment to other members and to the community (Rafaeli and Ariel 2008), and thus interactions become the social basis of the community through which people are connected.

Community

At the center of the model is community, which is a result of the interaction of the four elements above. The community is defined by social practice, has a shared goal of content building, and is built on interactions. As community forms, it creates a sense of belonging for individuals. Individuals build identities and reputations while participating in community practices, and are further motivated to contribute by recognition from the community.

Technology

In Wikipedia, technology supports all elements above, and is represented by the larger circle encompassing all other elements in Fig. 7. The wiki technology gives individuals access to the practice, to the content, and to the community. The technology archives history, organizes documents, and allows information to be easily retrieved, which increases the value of the content. Technology also mediates community members’ communication and interactions online. Overall, technology plays a critically important role in support of the community.

Lessons learned

We believe the six elements are not only relevant to Wikipedia but also to other CoPs. Within our model, we especially emphasize the interaction between practice and content. Wenger (1998) argued that, although a CoP is built upon practice and experience, there must be processes that give form to the experience and turn it into “thingness,” which he defined as reification. Reification and participation comprises a fundamental duality of CoPs. Participation and reification correspond to practice and content in our model—two crucial elements without which CoPs would fall apart. This point seems to be supported by other research. Hung and Chen (2002) concluded that many online CoPs fail because the communities can only share discourse of practice (reification) instead of actual practice. For example, while a doctor can practice medicine in a “real” medical community, he can only talk about medical practice in an online community. Difficulties to integrate practice and reification might also explain some of the challenges researchers have observed when trying to establish CoPs online for teachers (Barab et al. 2004). Wikipedia is different from these cases as both its practice and the outcomes of its practice (content) are located online. Based on our model, we believe a key to the success of an online CoP may be for both the practice and the outcomes of practice to be accessible, somehow, online. In particular, in order to build a successful online learning community, it is necessary to design a technical environment that enables both learning activities and a reification of the learning outcomes to coexist. Design-wise, practice, content and interactions are best integrated within the same interface, as illustrated by Wikipedia’s history, article and discussion pages. The close proximity of the functions not only creates a better user experience, but also further connects the CoP elements to one another.

Although Wikipedia’s peripheral and core participants differ in their use patterns and motivations, it appears both are crucial to sustaining and developing the CoP. Similarly, we believe the evolution of a CoP requires distinguishing between peripheral and core participants and addressing their needs differently. Successful CoPs fulfill the needs of both groups while facilitating the transition from peripheral to central participation. Many of Wikipedia’s practices, such as anonymous editing for casual visitors and advanced features for experienced editors, may represent valuable “best practices” for other CoPs to follow.

Limitations

Limitations of this study include: The research is based on self-report data that may not be reliable. Responses to the initial questions were submitted by volunteer participants and may not represent opinions of all Wikipedia researchers. The expert panel was selected based on purposeful sampling within a very small population. Attrition among the experts was fairly high, which may further bias the findings. And, while every attempt was made to maintain neutrality during the analyses, researcher bias may still exist as a general limitation of the Delphi methodology. In addition, this study examines key elements of Wikipedia as a CoP solely from researchers’ perspectives and does not include opinions of Wikipedia users. And, finally, the conclusions we draw here are based on the community of Wikipedia and may not be generalizable to other CoPs. All that being said, the findings from this study do suggest some interesting implications for design and future research.

Implications for design and future research

As mentioned earlier, the Wikipedia community was not “designed” *per se* by any one individual or groups of designers. That said, certain conditions appear to exist that have moved Wikipedia forward through the community’s elaborate arrangements of efforts and resources. There is no better way to search for design strategies aimed at supporting online CoPs, than learning from successful practice. While Schwen and Hara (2004) argued the descriptive nature of CoP theory makes it difficult to be applied in design, we believe the key elements identified in this descriptive study could serve as a starting point for a prescriptive design solution. We suggest the next step should be finding ways to link the six interdependent and interacting elements in our preliminary model of online CoP.

Additionally, it appears the wiki technology may be crucial to the success of Wikipedia. It serves as an instant editing tool, a search tool, a discussion tool and a collaboration tool. It ensures low barriers of entry, records editing histories, and is resistant to vandalism. Although the wiki technology has contributed a lot to the Wikipedia community, the effect of wiki on online community building has not been thoroughly studied. Much additional research is needed to explore the potential wikis as a community building tools.

As an online CoP, Wikipedia is massive, complex, energetic and ever evolving. It provides rich resources for us to advance our understanding of online CoPs. Our study only identifies the most dominant factors that influence the creation and evolution of Wikipedia. We look forward to conducting additional, in-depth studies on Wikipedia’s features, policies, and processes in order to refine our model of Wikipedia CoP. We are especially interested in incorporating Wikipedia users’ viewpoints in our model development.

Appendix

Informational questionnaire

1. Gender [pull-down]
2. Age [pull-down]
3. Which country do you live in? [pull-down]
4. What is your profession? [fill-in]
5. Are you a Wikipedia editor? [yes/no pull-down]
 - a. If yes, how long have you been an editor? [pull-down: 0–1 year, 1 < 2 years, 2 < 3 years, 3 < 4 years, 4 < 5 years, more than 5 years]
 - b. If yes, how often do you edit? [pull-down: once or twice a year, once a month, once a week, once a day, several times a day]
6. Are you a Wikipedia administrator? [yes/no pull-down]
 - a. If yes, for how long have you been serving as an administrator? [pull-down: 0–1 year, 1 < 2 years, 2 < 3 years, 3 < 4 years, 4 < 5 years, more than 5 years]
 - b. If yes, what is your responsibility as an administrator? [fill-in]
7. Have you participated in Wikipedia projects in ways other than editing and administrating? [yes/no pull-down].
8. If yes, in what other ways have you participated? [fill-in]

9. Please describe your Wikipedia research interests: [fill-in]
10. Please describe your Wikipedia research experience to date (studies conducted, results presented, publications, and the like): [fill-in]
11. Which language version of Wikipedia do you use the most? [pull-down]

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