Developing Humanized Information Services from Web2.0 User Mental Maps: An Empirical Study Using Naturalistic Observation

Authors: Gu Liping

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Abstract

Through naturalistic observation methods, this study investigates the different attentional foci of various user types during the learning process and discusses how to meet their information needs. It examines the function of establishing informal information exchange channels based on mind maps, information processing models for machines, users, and communities, as well as persona-based information service models. The conclusion is that libraries can enhance information services through reading mind maps. It is recommended that future research integrate structural equation modeling, factor analysis, cluster analysis, chi-square tests, structured interviews, naturalistic observation methods, and mind map models to create and use personas.

Full Text

Developing Personalized Information Services from Web 2.0 Users' Mental Maps: An Empirical Study Using Naturalistic Observation

Authors: Department of Library and Information Science, National Taiwan University, Taipei 10617; Run Run Shaw Library, City University of Hong Kong, Hong Kong

Abstract: This study employs naturalistic observation to investigate the different focus areas of various user types during their learning processes and discusses how to meet their information needs. Based on mental maps, we establish the functions of informal information exchange channels, propose information processing models for institutions, users, and communities, and develop a personalized information service model. The conclusion is that libraries can enhance information services by reading mental maps. Future research should combine

structural equation modeling, factor analysis, cluster analysis, chi-square tests, structured interviews, naturalistic observation, and mental map models to create and utilize personas.

Keywords: user research; blog; electronic bulletin board; email; user services
Classification Number: G250

1 Research Background and Purpose

Library services in the Web 2.0 era differ fundamentally from traditional information services, as Web 2.0 services can significantly expand the scope and depth of digital services [1][2][3]. However, an overabundance of service options can also lead to problems such as unfocused service delivery, delayed responsiveness, and insufficient depth, making them less effective than traditional information services in meeting user needs. To overcome these challenges, interaction design tailored to different end-user needs has become increasingly important in digital libraries. Persona models can depict the behaviors and needs of typical user groups, enabling more user-centered design. Additionally, even without involving actual interface design, personas can facilitate user outreach at various levels within existing service systems [4], thereby addressing most challenges of digital services.

Creating personas serves the function of collecting different types of data for mental maps. H. Lamberts (2002) argues that user-centered personas, combined with market segmentation, field research, and market research, enable us to learn who our users are, what their goals and core tasks entail, and what their work environments look like [5]. Conversely, mental maps can provide clearer depictions of user psychology for personas.

The term "mental map" refers to the observable graphical layout representing the cognitive structures that users internally construct [6]. When creating dynamic graphic animations, algorithm designers must consider additional aesthetic criteria for "mental map presentation" [7], which continuously raises the bar for mental map quality. Current mental map implementations serve multiple functions, including orthogonal, cluster, and topological representations [8]. While a good mental map can help people understand applications, inconsistent mental maps may cause misunderstandings [9]. Therefore, a more refined mental map should be a dynamic mental model that changes with context and is built upon empirical data. Another possible approach involves distinguishing different mental maps, which can be achieved through current persona research —this study follows this line of thinking.

As Web 2.0' s influence continues to expand, J. Booth et al. (2008) recently designed personas to describe text and context on social networking sites [10], demonstrating personas' specific contributions to Web 2.0 service mechanisms. However, current user research primarily relies on web logs, online questionnaires, or telephone surveys, which struggle to deeply explain user psychology and behavior for diagnosing or improving end-user service effectiveness. In

contrast, persona models, mental maps, and naturalistic observation based on fixed samples with long-term tracking are better suited for breakthroughs and innovations in addressing such challenges.

2 Latest Developments in Persona Research

In design process development, Z. Hussain et al. (2009) recognized through practice that personas should consciously or unconsciously enter team members' thinking during planning, development, or any decision-making process [11]. J. R. Goodall (2008) believes that in design teams, personas help logically and coherently design for actual user needs, creating a memorable story that gives all team members a shared understanding of project goals and priorities [12]. Furthermore, G. Zimmermann and G. Vanderheiden (2008) point out that personas not only help understand the rationale behind guidelines to avoid future mistakes but also increase the likelihood of implementing patches at appropriate times and in effective ways [13]. They vividly illustrate the process of creating and using personas in Figure 1 [Figure 1: see original paper].

Figure 1: The Process of Creating and Using Personas (adapted from G. Zimmermann et al.; translated by the author)

In design technology development, R. Casas et al. (2008) developed a new generation of user modeling by creating and using personas, combining ambient intelligence (AmI) with user-centered design [14]. After interface design, A. Lindgren et al. (2007) demonstrated that the persona methodology brings important aspects such as individual differences and group-driven differences to the forefront [15].

In creative design development, Makoto Okamoto et al. (2007) confirmed that scenarios can effectively support participants. They distinguished two groups —development teams and user teams—to collaboratively create personas with lifestyle and cultural backgrounds [16]. Separating D-teams (who develop creativity and hypotheses) from U-teams (who describe scenarios and needs) facilitates cross-cultural communication and more accurate use of personas to solve cross-cultural creative teams in product design. On the other hand, E. J. de Silva and S. Sallaume (2007) developed marketing strategies and tools for online community websites by identifying and building personas for each document [17], illustrating personas' specific applications for Web 2.0 services.

Compared to international research, domestic persona research in China tends to focus on introduction, explanation, and application, such as the conceptual methods and systematic research by Wu Kan and Lu Changde [18], the universal design of mobile phones by Yi Li and Mo Weiping [19], the character roles and scenario analysis methods by Chang Lin [20], the usability engineering lifecycle improvement methods by Zhou Wei et al. [21], and the interaction design application research by Wang Xianhua [22]. However, persona research both domestically and internationally is still in its infancy, with much unexplored innovative space.

3 Research Questions and Design

In summary, creating personas to distinguish different mental maps and using these maps to enhance Web 2.0 services aligns with the latest developments in persona research. This study' s research framework is illustrated in Figure 2 [Figure 2: see original paper].

Figure 2: Conceptual Framework Combining Web 2.0 and Personas (source: drawn by this study)

Based on this framework, we formulated three research questions: (1) What are users' informal information exchange channels? (2) What user behaviors can libraries analyze from these channels? (3) How can libraries use these channels to develop information services?

Data collection through naturalistic observation was conducted via face-to-face interviews and email. Based on responses from preliminary questionnaire surveys [23] and interview surveys [24], we filtered representative users. The tracking observation lasted six months, from January 5, 2009, to June 5, 2009: an initial face-to-face interview was followed by two rounds of email exchanges and a final face-to-face interview. A total of 16 people were selected for tracking, with 8 completing the full study.

4 Results

Through long-term tracking using open-ended questions, respondents and the author collaboratively completed eight relatively complete mental map manuscripts; the remaining eight were either interrupted or could not be verified again. Based on these eight manuscripts, we identified four types of models, illustrated in Figures 3 [Figure 3: see original paper], 4 [Figure 4: see original paper], 5 [Figure 5: see original paper], and 6 [Figure 6: see original paper].

First Persona Type: During the research process, this type is primarily influenced by advisors, materials, professional skills, and career development. Their requirement for knowledge services extends beyond information research, bibliometrics, or scientific evaluation to "who can help me solve other problems so I can focus on my work."

Figure 3: First Persona Type (source: drawn by this study)

Second Persona Type: During the research process, this type is primarily influenced by goals at different levels, work environments at different levels, work requirements at different levels, work conditions at different levels, and professional skills. Their requirement for knowledge services extends beyond literature searching, technology novelty searches, or website/resource navigation to "who can help me confirm that my direction is correct."

Figure 4: Second Persona Type (source: drawn by this study)

Third Persona Type: During the research process, this type is primarily influenced by overall research planning, personal methodology, organizational conditions, helpers, and social needs. Their requirement for knowledge services extends beyond technology news, conference information, or funding project updates to "who can tell me what others are doing besides research."

Figure 5: Third Persona Type (source: drawn by this study)

Fourth Persona Type: During the research process, this type is primarily influenced by products, institutions, laboratories, and literature. Their requirement for knowledge services extends beyond intelligent retrieval, information recommendation, or data provision to "who can share practical experience with me."

Figure 6: Fourth Persona Type (source: drawn by this study)

5.1 Functions of Informal Information Exchange Channels

Preliminary survey results [23] showed that blogs, electronic bulletin boards (BBS), and email have increasingly become prominent academic exchange channels (see Figure 7 [Figure 7: see original paper]). This study further found that users can obtain "informal exchange" frontier information through these channels, including real-time information that is developing and gradually evolving into knowledge, and information with rich added value (for example: frequent comments or extensive discussions on a topic reflect the network community' s responsiveness, relevance, positive/negative evaluations, and related themes).

The reason for using personas in digital library design is that they can provide better segmented services: primary personas represent the majority or important target groups, while subordinate personas represent service objects with additional requirements [25]. Through user behavior research on frontier academic exchange channels, mental maps can delve into the details of segmented services.

Figure 7: Frontier Academic Exchange Channels (source: drawn by this study)

5.2 Information Processing Models for Specific Institutions, Users, and Communities

By systematically, scientifically, and strategically collecting and applying these information "raw materials"(see Figure 8 [Figure 8: see original paper]), creating personas can transform such informal exchange information into high value-added production (HVA Production).

Figure 8: Information Processing Model for Specific Institutions, Users, and Communities (source: drawn by this study)

For email information, computer programs can be used to standardize and organize it, such as collecting professional RSS information, user questions or

requests, and document delivery titles. This information helps enrich reference materials for academic research and analyze the scarcity of information categories not found in journal literature, e-books, or conference proceedings.

For blog information, relational charts can be used to store and analyze blog data from relevant personnel. This involves not only consolidating content and feedback from key blogs across various fields and analyzing connections and responsiveness between blogs or between blogs and non-blogs but also establishing a foundation for understanding researchers' interpersonal networks and reorganizing virtual teams.

For electronic bulletin board information, classification, organization, and structuring are relatively straightforward. Branded BBS exchange content on the internet has already formed relatively stable online communities, where users clearly understand what kind of people and topics belong to these spaces.

5.3 Developing Personalized Information Services

What are personas? Alan Cooper defines them as: "Personas are not real people, but they represent them throughout the design process. They are hypothetical archetypes of actual users" [26]. J. Coney and M. Steehouder (2000) point out that personas enable website designers to communicate with users, and successful websites depend on how completely these personas can explain the relationship between website design and evaluation [27].

After receiving user information, we can identify users' actual information needs based on persona models, select different components from existing information products, combine information products according to different user needs, and choose appropriate channels and methods for delivery. While users receive and digest messages, we prepare optimal service combinations. Based on accumulated experience serving users, we gradually grasp potential needs of service objects, develop new products, and propose new functional requirements to the information service system. This process is illustrated in Figure 9 [Figure 9: see original paper].

Figure 9: Personalized Information Services (source: drawn by this study)

User services should be considered from fundamental behavioral trends reflected by personas. If services can be flexible and varied according to persona models, digital library services can align closely with user behavior. As Grudin and Pruitt (2002) emphasize, adding names and photos helps R&D teams recognize and remember personas, and creating and using personas should be based on empirical data rather than the intuition of a few "geniuses" [28]. This study further argues that persona models are not single fixed entities but evolving forms —like biological evolution—representing the best way to use persona models.

6.1 Research Significance

Appropriately summarizing the different characteristics, behaviors, traits, and needs of various service objects into certain personas—rather than binding complex user behaviors to a few limited types—allows continuous subdivision and evolution of the model through mental maps. Using personas will enable libraries to more clearly understand distinctions and differences among service objects. For instance, when designing a new generation of digital libraries, we must consider the contradiction between wanting to be large, comprehensive, and all-inclusive while actually only being able to be small, focused, and partial. Using personas will bring more nuanced thinking and design.

6.2 Research Limitations

Unlike questionnaire surveys, naturalistic observation does not pursue sample representativeness but rather the completeness of a fuzzy phenomenon or concept in selected cases. Unlike structured interviews, it involves a series of interviews with the same object that can be divergent question-and-answer sessions. Unlike in-depth interviews, naturalistic observation is a long-term tracking survey. Therefore, this research method is suitable for this study, but its drawback lies in sample limitations, so other relevant research should be consulted when making inferences from the results.

6.3 Future Research

Future research could first use structural equation modeling to calculate and model users' attitudes, behaviors, and cognition overall, then use factor analysis and cluster analysis to classify personas from a medium-model perspective. Finally, chi-square analysis could be used to test correlations among variables in individual classified groups, thereby reflexively proving the reliability of classification principles and obtaining more rigorous and accurate models. Based on behavioral type distinctions, combined with structured interviews and the model of using naturalistic observation to depict mental maps to reveal user psychology and behavioral characteristics, future studies can more deeply explain behavioral causes and propose corresponding service practices.

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Author Biography: Gu Liping, male, born in 1978, postdoctoral researcher, has published 15 papers.

Note: Figure translations are in progress. See original paper for figures.