Motivational Effects of Badge Systems on Participation in Stack Exchange Social Q&A Online Community

Research-in-Progress

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ABSTRACT

Open, online social question and answer sites (SQAs) have captured the public attention in recent years. As SQAs become increasingly popular knowledge sharing platforms, issues about how open online community systems will evolve are becoming vital to our understanding of these systems. In this paper, we outline how an SQA site functions as a social learning community. The success of an SQA site depends not only on effectively organizing and delivering information, but also on whether it can attract participants and motivate them to contribute. We present early work investigating the effect of badges on users’ participation in an online SQAs community, Stack Exchange. This research-in-progress paper highlights factors that help users develop into literate and productive community contributors in social platforms and considers the design implications of these observations.

Keywords

SQAs, motivation and incentives, badge system, participation

INTRODUCTION

In today’s Web 2.0 environment, social question and answer sites (SQAs) play an increasingly significant role in knowledge sharing and information transfer. These sites allow individuals to both ask questions and provide answers. There are a range of SQAs, which cover different topics, types of dialogue, and a diversity of populations. Some SQA platforms concentrate on opinions and discussion of social issues, while others focus on factual exchanges (Adamic, Zhang, Bakshy, and Ackerman, 2008).

The popularity of SQAs has led to a growing body of research focused on understanding user’s online Q&A behavior and improving the functioning of these systems (Gardelli and Weber, 2012). Much of the prior work has focused on issues such as classifying questions and answers to facilitate better information transfer, identifying experts and novices, and helping individuals learn to be skilled community members based on a social learning approach (Hanrahan, Convertino, and Nelson, 2012; Harper, Moy, and Konstan, 2009; Logie, Weinberg, Harper, and Konstan, 2011; Oktay, Taylor, and Jensen, 2010). While this literature provides some insight into understanding of the issues involved in implementing SQAs, developing these sites as vibrant knowledge sharing communities remains a challenge.

Prior empirical studies of SQAs have implicitly worked from an information transfer perspective, focusing on how to efficiently classify and deliver content (questions and answers). While this is useful, it leaves unanswered questions of how to effectively motivate individuals to contribute well crafted questions and high quality answers. In this research, we draw from online community research and motivation theory to theorize and empirically examine how badge system design choices will motivate (or discourage) participation in SQAs. To do this we outline an analytical framework for conceptualizing SQA badge system design problems and discuss measures and analyses for studying the relationship between receipt of badges and individual’s participation and contribution in SQAs.
BACKGROUND

Responding to the growing popularity of SQA platforms such as Yahoo Answers and Stack Overflow, researchers have begun to examine different aspects of these specialized online communities. Some researchers have focused on describing differences in the community-wide dynamics of SQAs. Logie and colleagues (2011) found that Answerbag’s members asked more social, subjective questions, Metafilter’s community focused on more objective questions, and Yahoo Answers exhibited a wide variation in question types. Within a single SQA platform, such as Yahoo Answers, different topic areas also seems to have significantly different patterns of user behavior with technical forums tending to have fewer replies but longer posts and discussion-based topics handing to more replies (Adamic et al, 2008).

The Stack Exchange platform is an infrastructure for creating and operating SQA site. Originally developed to support Stack Overflow, a successful and influential SQA site for programmers (Anderson, Huttenlocher, Kleinberg, and Leskovec, 2012; Hanrahan, Convertino, and Nelson, 2012; Mamykina, Manoim, Mittal, Hripcsak, and Hartmann, 2011), Stack Exchange now supports nearly 100 SQA sites. Each of the Stack Exchange sites utilizes the same underlying platform, but serves unique populations of experts and enthusiasts interested in different content areas, ranging from cooking to database administration. Members of the Stack Exchange community engage in a group knowledge-creation process by asking and answering questions, editing questions and answers posted by others, and voting on the quality of the resulting content. Mamykina and colleagues (2011) argue that the overwhelming success of Stack Exchange is related to the features of the platform and how the community has developed over time. Affordances such as productive competition through points and badges, and tight interaction with a core expert and developer group, drove productive Q&A norms on the site. The end result is a collectively curated body of information that is useful not only to the original questioner, but also as a reference for all site users, present and future, who are interested in the topic.

One distinctive component of the Stack Exchange platform is its badge system. Participants in Stack Exchange earn badges when their questions and answers are accepted or when they accomplish specific tasks. The system allows a single participant to earn multiple badges. While the badge system has been argued to be a significant aspect of what make Stack Exchange sites successful (Mamykina, et. al 2011) the role of badges and badge systems within SQA sites has not be systematically or critically examined.

THEORETICAL FOUNDATION

Motivation theories are widely used to study human behavior and organizational performance in various contexts. Locke and Latham (2004) distinguished intrinsic motivation and extrinsic motivation. In SQAs, a user’s desire for self-actualization, an intrinsic motivation, and financial compensation or points, two extrinsic motivations, may coexist and simultaneously affect individuals’ behavior. Reeve (2008) elaborated 24 motivation theories from different philosophical perspectives, and under different disciplines/contexts. Ren and Kraut (2009) suggested a diverse set of psychological, technical, and social factors that can affect people’s participation and contribution activity. Together these theories provide a foundation for characterizing peoples’ motivation to engage in Stack Exchange and how they might be affected by badges and badge systems. In particular, the diversity of motivation theories highlights both the value of “motivation” as a framing concept and its limitations as a precise explanation of the mechanisms by which a badge system might affect a complex behavior such as participation in an online SQA site.

Online Community Commitment Theory with Badges

Bateman et al. (2011) introduced Online Community Commitment Theory arguing that members may develop psychological bonds to particular online communities based on (a) need, (b) affect, and/or (c) obligation. Antin and Churchill (2011) outlined a set of social-psychological functions of badges. Together these two frameworks provide a foundation for characterizing the range of ways that badge systems to motivate different participation activities in Stack Exchange: 1) Badges may act as a source of personal status affirmation and can spur future action. For example, individuals in Stack Exchange earn skill badges or social badges (e.g. supporter badge1), and these achievements signal a particular person’s status in the community. The individual may desire to earn more to get public recognition (Need) and as a result engage in certain contribution behaviors; 2) Badges are an information source for reputation; people in a social community may view badges as indicators of expertise or commitment, and this judgment may influence their future engagement (Reputation); 3) Badges influence a member’s goal setting activity; people in Stack Exchange might use badges to structure the educational activities they pursue and how they feel about their past and future participation in the community (Affect); 4) Badges can also act as a source of instruction or scaffolding. For example, to earn an expert badge a person is required to complete a

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1 Description of the types of badges used on Stack Exchange SQA sites are available at http://reverseengineering.stackexchange.com/badges
series of projects (e.g. the Marshal badge in Stack Exchange). In this way, an expert badge represents a significant commitment on the part of the user. This investment compels the user to want to help with other people due to their seniority in the system (Obligation).

Badges and badge systems can act as both controlling and enabling structures (Thompson, 2005). Control structures, such as content boundaries within an online community, shape member dynamics and community activity in both positive and negative ways (Butler and Wang, 2012). Consequently, the value and effects of structures can vary from context to context, from case to case. Like other aspects of online social systems, badge systems can promote certain activities for particular individuals, while discouraging other activities or participation. Designing effective badge systems for SQAs environments is a challenging problem because badges often simultaneously play different, potentially contradictory roles. The goal of this work is to better articulate “badge” as a complex socio-technical design problem, empirically examine various effects of badges on participant engagement in Stack Exchange, and use these ideas and findings to inform the further iterative design of the badge system. The proposed framework (Figure 1) is an initial attempt to characterize the diverse roles and effects badges may have in social computing platforms such as Stack Exchange (Figure 1).

**Figure 1. Badge Systems Effect Framework**

**RESEARCH DESIGN AND METHOD**

**Data Source, Sampling, and Measure Construction**

This study uses data from the April 2012 Stack Exchange data release. This releases contains comprehensive, anonymized data describe all users, user activity, and site content in the 64 Stack Exchange SQA sites as of April 2012. Each site’s data includes an XML data files with information about comments, post history, posts, users, and votes (Table 1).

<table>
<thead>
<tr>
<th>Record Type</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Comments</td>
<td>Logs each comment’s text, score, post id of the post the comment belongs to, and the user id of the commenter</td>
</tr>
<tr>
<td>Post History</td>
<td>Logs all changes users make to posts, title or content. In this study, we use posts that represent questions asked</td>
</tr>
<tr>
<td>Posts</td>
<td>A log of all questions and answers on the site, their creation date, accepted answer id (for questions), score, view count (questions), title and text, user id of contributor, last edits, last activity date, tags, answer count, comment count, favorite count, parent id (for answers) and close date if question is closed</td>
</tr>
</tbody>
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Table 1. Description of Data Types in Stack Exchange Datasets

From the 64 Stack Exchange sites for which data is available, we selected four that are similar in membership and overall activity levels: Android Enthusiasts, Database Administrators, Seasoned Advice (which we will refer to as Cooking), and Science Fiction & Fantasy. Aggregate statistics for the four communities are shown in Table 2. Because each Stack Exchange site is treated as a separate entity, user IDs in the raw data are not consistent across sites. User 1 in Stack Overflow is not the same as user 1 in Android Enthusiasts. To avoid problems arising from non-independence of observations, the dataset for each of the four communities will be created and analyzed separately.

Table 2: Aggregate Activity in the Stack Exchange Communities

The datasets released by Stack Exchange contains an essentially unfiltered log of all elements (e.g. users, badges, posts, votes, etc.) and all interactions that users have had with the system, including to content of questions, answer, and comments. This raw data was used to develop analysis datasets focused on describing the role and consequences of badges in Stack Exchange. At the community level, measures were constructed which describe the frequency with which different badges are earned/awarded and how levels of activity and membership change over time. At the individual level, events datasets were constructed which assess each persons levels and type of participation before and after receiving each badge that they earned. Construction of these analysis dataset based on the log data was informed by direct observations of the StackExchange.com website to ensure that the constructed measures are consistent with how people go about: (a) joining Stack Exchange communities, (b) interacting with peers, and (c) participating in Stack Exchange SQA sites. By explicitly considering how these critical interactions with the Stack Exchange community are realized in the system interface, the raw log data, and the constructed measures, we are able to avoid misinterpreting the quantitative data and increase the validity of the analyses and conclusions.

This ongoing project explores the role of badge systems in motivating continued participation (in all it forms) by concentrating our data investigation on understanding the characteristics of users and their corresponding badges. The dual strategy of combining direct observation of activity within the system and development of quantitative metrics and measures also support the goal of the study of engage the diversity of possible impacts of badges in the full range of possible participation behaviors.

Data Analysis

In our continued research, these datasets, documents, and observations will be used to understand and describe the basic characteristics of Stack Exchange SQA forums. We will examine specific questions about the nature of Stack Exchange badges, such as: What are the features of different badges? What assessment strategies do badges use? What institutional linkages to badges contain? What types of activities are different badges associated with? Answers to these questions will be used to categorize and cluster the badges and participation activities present within Stack Exchange SQA sites.
These datasets will be used to test longitudinal models of the impact of badges on individuals’ participation activity. We will examine questions such as: What impact does earning a badge have on a user’s long-term participation (Figure 2)? It is expected that badges playing different roles within the SQA site will have different patterns of impact. For example, if a user’s motivation is primarily to earn a badge (i.e. the badge is functioning as a goal), then receiving the badge is expected to have negative impact on the user’s long-term engagement in the relevant participation activities (Figure 2a). Alternatively, if the badge is functioning as a reinforcing reward for a user then it should motivate continued or greater participation (Figure 2b). If a badge is acting as recognition or documentation of activity it is likely that receiving the badge may have no impact on an individual level of activity (Figure 2c). Lastly, if the badge is acting as a control structure, then it may be have the effect of delaying decline in activity – resulting in a seeming sustained level of participation activity which resumes a steady decline after the badge is awarded (Figure 2d). These quantitative studies based on analysis of Stack Exchange data will provide foundational empirical results that begin to map out the features, functions, and impacts of badges in online SQA sites.

Figure 2a. Earning a Badge Causes a Decrease in Participation  
Figure 2b. Earning a Badge Causes an Increase in Participation  
Figure 2c. Earning a Badge Has No Impact on Participation  
Figure 2d. Earning a Badge Causes a Decrease in Participation Over a Period of Time  
Figure 2. Alternative Hypotheses Regarding the Impact of Badge Earning on Participation
We will also complement the quantitative analyses with interviews of Stack Exchange badge earners. Our goals with the interviews will be to gain deeper insight about the social and cultural aspects of badges. We will draw on Antin & Churchill’s (2011) taxonomy of badge functions to enrich Stack Exchange’s design vision. We will ask participants about their perceptions, intentions, and uses of badges to understand their commitment to Stack Exchange. Specifically, we will explore questions such as: Do participants recognize different purposes/functions of badges? If so, what are the cues they use to distinguish them and what are the implications of these cues for the role and function of the badge? Quantitative analyses allow us to identify and model patterns of motivation occurring within the Stack Exchange badge ecosystem, and qualitative analysis and interviews will provide a rich understanding of how Stack Exchange participants perceive and are affected by the badge system.

**CONCLUSION**

Overall, our study has both theoretical and practical contributions. Theoretically, we synthesize various motivation factors identified by previous studies; we develop a badge system effect framework based on Online Community Commitment Theory which helps enrich our understanding of the differential effects of commitments on participation in Stack Exchange. Practically, the results of this work will be used to inform the design of badge system SQA sites and also inform the broader thinking about badge systems across open online communities, perhaps even allowing future badge systems to include a dashboards for tracking badge or provide indicators about whether certain badges are well designed for their intended (or realized) functions.

**ACKNOWLEDGMENTS**

This project is supported by the National Science Foundation (OCI-1257347). We would like to thank June Ahn, Cindy Weng, Alisha Alim, and Shashank Dewjee for their comments and assistance with this work.

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