

Moon Zoo: Engaging the public in geomorphology, learning, and community. P. L. Gay¹, S. Cormier², S. Brown¹, D. Huang¹, E. Prather², G. Brissenden², C. Daus³ and the Moon Zoo Team⁴, ¹The Center for Science, Technology, Engineering and Mathematics Research, Education and Outreach at Southern Illinois University Edwardsville, ²Department of Astronomy, University of Arizona, ⁴The Department of Psychology, Southern Illinois University Edwardsville, ²Department of Astronomy, University of Arizona, and ³Citizen Science Alliance.

Introduction: The Moon Zoo citizen science project launched on 2010 May 10 and by December 6 had introduced 40,696 people to classifying the lunar surface. These individuals made 5,043,360 annotations of geomorphological features and spacecraft hardware on the Moon. In order to better understand the population who have volunteered so many hours to being part of the lunar science pipeline, we have devised three studies investigating the motivations that bring people to the project, how individuals interact with the webcontent, and what lunar concepts are understood by users who have different numbers of annotations or who have been part of the site for different amounts of time. Using these results we can better revise the Moon Zoo website and better construct new citizen science projects that directly address our populations motivations, content needs, and learning needs.

Project Overview: The Moon Zoo website launched on 2010 May 11, bringing Lunar Reconnaissance Orbiter (LRO) images to the interested public along with the simple question: What do you see? Users indicate their answers by clicking on images with tools selected from a graphical menu. They can indicate the presence of boulders, outline craters, and, via drop down menus, provide more detailed information on the locations of specific features, such as "sinuous channels," "elongated pits," and "boulder tracks." Helping users to understand both these features and the purpose of the work they are doing are educational articles, videos and interactive flash simulators. The majority of this content is an aggregation of materials created by various NASA missions and centers, by Astronomy 101 instructional designers, and by educational researchers. Along with these materials, we present users with "Quiz" questions that test their conceptual understanding of lunar geology. To support communications and social learning, we also have blogs, twitter feeds, and forums. These are not discussed here.

Site Usage: The Moon Zoo website consists of four categories of pages: science tasks, tutorials, educational content, and pages over viewing the project and project science. We track how logged in users interact with these pages. No data on users who have not logged in (and who we thus know have agreed to be part of the project) are used in this research. As would be expected, the majority of users visit the science task pages (32,030 people). As with many websites, the bulk of the users only visit briefly before moving on,

with just 42% of the users annotating 10 or more images. It is the active minority, the 9% of the users who annotated 100 or more images, who account for the majority, 77%, of all images annotated.

Perhaps unsurprisingly, few people take advantage of the optional tutorial. We find only 4,835 people – 15% the number who made classifications - accessed the tutorial. Interestingly, a much larger number of people accessed other forms of content, with 12,215 people viewing educational and project related content other than the tutorials. The most accessed page is the Moonmeter, a page showing the current number of images annotated and the equivalent surface area, with 29% of content page views. The other most viewed pages in decreasing order are: the lunar content index page, the lunar glossary, and pages on the lunar atmosphere, lunar observing, and spacecraft. Beyond consuming content, we also give our users the ability to look deeper into the images they've annotated. We found 1,971 users took advantage of this feature.

Motivations of Users: During the first stage of a two-stage research study, we interviewed a sample of participants to determine their motivations for participation. The selected users formed a stratified sampling designed to include users across categories such as frequency of usage, length of membership, forum participation as well as participation in other Zooniverse projects. Users from each bin of characteristics were randomly selected by software and were contacted by email and invited to partake in the interviews. Those expressing a willingness to participate were interviewed via the voice-over-IP software Skype (for voice interviews, often connecting to the interview subject's regular telephone) or through text-instant messaging for a scheduled interview. A total of 51 interviews were conducted and transcribed where necessary.

Three researchers identified statements of motivation in the interviews and placed them into categories using a modified grounded theory approach. The coders then compared their lists of motivation categories to identify a fixed list of agreed upon categories. Using this fixed list as a framework, all motivation statements were then classified as a check of the reliability of the classification scheme. Due to the small number of interviews conducted, we cannot address how frequently different motivations occur in the Moon Zoo population. During a second phase of this project we will use this list of motivations in a web survey to determine

the prevalence of each motivation. The determined motivations are as follows:

- Apollo Mission related motivation, “I am a child of the 1960's and have a personal interest.”
- A motivation based on the beauty of and other image characteristics, “The wonderful LRO images are amazing to watch.”
- A community related motivation, “It is fun to make friends from all around the world.”
- Motivated by the desire to contribute to research, “I am excited to contribute to original scientific research.”
- Motivated by the possibility of making a discovery, “I might discover something scientifically interesting.”
- A motivation to help where they feel needed, “I am happy to help do what I can.”
- Motivated by the potential of learning, “I was looking for ways to learn about the moon.”
- An emotional motivation based on the nearness of the moon, “I'm in love with the nearby moon.”
- Motivated by an interest in lunar science, “Lunar science is important for future exploration.”
- A general motivation related to science, “I find science interesting.”
- Motivations related specifically to the nature of the project, including the Zooniverse as a whole, “I'm interested in everything the Zooniverse does”, and a project specific motivation, “I wanted to see how this project / crowd sourcing works.”

We see very clear categories of motivations within our sample that represent typical work motivation factors, such as human needs and values (learning, contribute); affect and emotion (moon-emotion); social motives (community) and contextual sources such as ‘project’ and ‘science’. This suggests that participants of citizen science projects in general make decisions to participate based, not only on their interest in the subject matter, but also on the nature of the task to be completed and other factors external to their immediate needs. Additionally, we find project specific motivations that include personal relations with the Earth's Moon as well as factors concerning the umbrella Zooniverse project and the sister project Galaxy Zoo.

Learning Research: One of the primary, non-lunar science questions being asked by Moon Zoo is, do people learn science by doing citizen science projects like Moon Zoo? This question is complicated by an inability to know what pre-existing information our users bring to the project, and in what context our users are participating in Moon Zoo. We have no way to correct for users who have a Ph.D. in geophysics or who are doing Moon Zoo as students in a geology class, and are thus learning concepts from external, not

necessarily self-selected, content. Recognizing these and other limitations on our research, we developed a set of multiple-choice lunar concept questions that were verified within the context of an Astronomy 101 (non-majors) course as having appropriate distracter answers. Certain compromises on how to distribute these questions had to be made to avoid question fatigue, and to avoid distracting users from the primary website task: doing science. This means we could not make the questions mandatory, and we could not ask users to complete the entire set of questions on a regular schedule. Taking all these considerations into account, we opted to present users with the option to answer one randomly selected question every time they logged in. The plea to participate is very subtle, and thus does not distract from other site usage. As of 2010 December 06, 2951 users opted to answer questions, with 304 users answering more than 1 question. Determination of learning gains is ongoing. We are looking to see if the frequency that the correct answer is given increases as a function of how long someone has been part of Moon Zoo or how many annotations they have done. Simply doing the Moon Zoo tutorial and annotating images doesn't teach users the concepts within the quiz questions, and such gains would indicate that participating in Moon Zoo is driving users to self-select to learn about the Moon outside of their image annotation activities.

Conclusions: We find that the majority of people participating in Moon Zoo swoop in, annotate a small number of images, and then leave. This is consistent with typical website usage. A small cadre of interested users, however, stays for longer periods and makes large numbers of classifications. There is also a population interested in exploring content about the moon, and following the progress they and their peers are making. These actions are reflected in the project motivations, where we see people interested in doing the science for a variety of reasons: A motivation to help, to contribute to science, to discover, to be part of the Apollo legacy, and to be a part of this Zoo and the Zooniverse as a whole. We also see motivations related to community that are reflected in how the Moonmeter is watched, and a desire to learn about the moon that speaks to the content being consumed. More work is needed to understand how specific individuals motivations are reflected in site usage, and to find out why certain pages – such as the tutorial – are and are not being regularly accessed.

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