Community Growth: Achievements Enhanced by SGCI/SGX3 Services

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***Abstract*—Community growth is one of the cornerstones contributing to the sustainability of a science gateway. Achieving community growth requires careful planning and a multifaceted approach. The Science Gateways Community Institute (SGCI) and the Center of Excellence for Science Gateways (SGX3) offer services such as UX advice, sustainability training via the Focus Week, and an annual conference to support the science gateway community with developers and users. This panel will discuss four successful use cases – QUBES, MyGeoHub, CHEESE, and the Hawaii Behavioral Health Dashboard – where the teams utilized various SGCI/SGX3 services, which significantly contributed to their community growth. The discussion will highlight specific strategies and outcomes from these use cases, providing valuable insights into the effective practices that drive community engagement and sustainability in science gateways. Additionally, panelists will share lessons learned and good practices that can be applied to other science gateways seeking to enhance their community presence and impact.**

***Index Terms*—SGX3, Center of Excellence, science gateways, community growth, SGCI**

I. Introduction

Sustainability is a significant concern for many science gateways. It depends on many aspects, such as funding cycles, the framework's maintainability, an evangelist's enthusiasm to sustain a science gateway, and community buy-in [1]. For many successful science gateways, there are also as many that have been not successful [2]. Sustaining a gateway requires careful planning, design, development, deployment, and maintenance, as well as attention to the needs and expectations of the target user community. The Science Gateways Community Institute (SGCI) [3] and the Center of Excellence for Science Gateways (SGX3) [4] aim to address topics such as sustainability and assist the community in various tasks, ranging from using to developing and providing science gateways. Established in 2016 under the National Science Foundation's (NSF) software sustainability institute program, SGCI's funding concluded in July 2023, though it continues to offer paid services to clients. SGX3, funded in August 2022, is part of the NSF Center of Excellence program. Both SGCI and SGX3 emphasize the importance of usability [5] [6], reusability, and sustainability in science gateways while focusing on community growth across all research domains.

Over the past six years, it has become apparent that SGCI's community growth has been more significant in computer science and engineering than in other research fields, highlighting the need for increased attention to the user community for continued growth. Consequently, SGX3 services have been restructured based on lessons learned from SGCI. These lessons are derived from various engagements with SGX3 activities, including demographics of conference attendees, client interactions, post-event surveys, and website metrics. Additionally, services have been reorganized to align with the NSF Center of Excellence's framework.

Below is the current list of SGX3 services:

1) Usability/User-experience (UX) evaluation and design engagements lasting up to three calendar months
2) Technology evaluation and gap analysis
3) Science Gateway architecture design
4) Once annually Science Gateways Focus Week sustainability sessions
5) Focus Week follow-on sustainability coaching
6) Summer Coding Institutes
7) Rising Stars program
8) Summer faculty and student internships
9) Science Gateway Hackathons
10) Gateways conference series
11) Gateways Central site for gateway listing, software listing, and partnership formation
12) SGX3 On the Road outreach to scientific communities where they meet
13) Blueprint Factory sessions to develop the future roadmap for Science Gateways serving new domain science needs

Community growth has been identified as a major aspect of

Identify applicable funding agency here. If none, delete this.

the sustainability of a science gateway. Active engagement and expansion of the user base elucidates the value of such science gateways as workspaces for sharing simulations, data and workflows that transform results into knowledge. Community growth fosters a diverse and dynamic ecosystem of users who contribute to developing, refining, and disseminating the gateway's resources. Collaborations contribute to creating new ideas, feedback, and expertise, which are crucial for maintaining the relevance and efficacy of the gateway.

Moreover, a thriving community enhances the gateway's resilience and adaptability. As more researchers adopt and integrate the gateway into their workflows, they create a robust support network that can collectively troubleshoot challenges and innovate solutions. This collaborative environment accelerates scientific progress and builds a sense of investment among users, encouraging sustained use and advocacy for the gateway. Fostering community growth is not merely a strategy for expanding user numbers but a fundamental necessity for ensuring a science gateway's long-term sustainability, relevance, and impact.

In this panel, we will discuss which of SGCI's and SGX3's services have contributed to the community growth in the examples of QUBES [7], MyGeoHub [8], CHEESE [9], and the Hawaii Behavioral Health Dashboard [10].

II. Background

SGCI was structured to provide a variety of services, training, and community engagement opportunities. SGCI structure:

- Incubator - training and consulting services with regard to financial and technological sustainability, cybersecurity, and usability/user-experience.
- Extended Developer Support (EDS) - placement of a 0.25 full-time equivalent technologist from SGCI staff into projects needing to solve difficult technical problems and instill best practices.
- Workforce Development - training developers in Science Gateway development skills, training faculty in incorporating Science Gateway development in curricula, student hackathons, and summer- and semester-long internship programs, all with a special focus on diversity.
- Scientific Software Collaborative - gathering of a comprehensive inventory of existing science gateways, software used in science gateways, and Tech Summit activities [1] that bring together Science Gateway stakeholders to develop software elements for the community.
- Community Engagement and Exchange - outwardly focusing on dissemination of SGCI results through an annual conference, a vibrant website, webinars, blogs, success stories, and a variety of other publications and postings for public dissemination.

SGX3 aims to extend computing resource access to diverse audiences with varying skill levels, expand the community of science gateway developers and users, and promote sustainable practices for science gateways. SGX3's main work thrusts include:

- Growing a Diverse Community
- Developing the Workforce
- Serving as Community Experts
- Envisioning the Future

To deliver on these four thrust goals, the following activities will happen under SGX3:

- Blueprint Factories - collaborate to understand the cyberinfrastructure needs of research communities and national-scale providers.
- Workforce Development - build a supportive HPC/Gateways community for teaching faculty, and provide training and support; offer opportunities for students to enhance their HPC/science gateway skills through coding institutes, hackathons, and internships.
- Consulting - provide expert advice on project lifecycle sustainability, user interface and design improvements, and develop technical roadmaps for science gateway projects.
- Gateways Central - reimagine the science gateways catalog to serve as a central point for stakeholder interaction.
- Science Gateway Outreach - engage with science gateways and domain scientists/scholars where they are (SGX3 on the Road), collect community knowledge, celebrate community achievements through the annual Gateways conference, and share information via the Science Gateways Community website and mailing list.

SGCI's funded period ended in July 2023, but it will continue to offer services on a paid basis. SGX3, operating under SGCI, will be a funded activity, and community members who require more intensive engagements can access these services through SGCI on a paid basis.

III. Success Stories

The teams behind the following successful science gateways have experienced significant community growth, partly due to the activities and services provided by SGCI/SGX3.

A. QUBES

The Quantitative Undergraduate Biology Education and Synthesis (QUBES) gateway was originally funded by the National Science Foundation from 2014 to 2022 and is now sustained as a project of the BioQUEST Curriculum Consortium. Since the inception of SGCI in 2016, QUBES has utilized nearly all services, including hands-on consulting services (software development and usability evaluation), Gateways Focus Week training, inclusion in the Gateway Catalog, the Gateways conference series, and the Workforce Development program. QUBES participated in one of the original sustainability training workshops, the SGCI Bootcamp - now known as Focus Week, in April 2017, which was critical in helping to create a vision and mission that extended beyond the initial proposal and adopted a business model primed for sustainability. The usability design guidance and software

[1] https://sciencegateways.org/our-services/sgci-tech-summit

development work measurably increased the publication, adoption, and adaptation of open educational resources (OER). QUBES now hosts nearly 3,000 OER, some of which interface with computational and data tools hosted on the Gateway. However, one of the most valuable SGX3 resources is the annual Gateways conference, which has created a community of practice around building, hosting, and sustaining Gateways.

B. MyGeoHub and CHEESE Gateways

During the development phase of the MyGeoHub geospatial science gateway, the MyGeoHub team participated in a Focus Week workshop where they specifically looked into the sustainability of the gateway from more of a business perspective, i.e., identifying the unique value, potential strategies of targeting different user groups with specific capabilities, and business funding model and ways to stay vibrant in the longer run. With a clear vision and plan, we secured a large grant that funded the development of several key data-driven workflow solutions. These capabilities enabled the team to expand partnerships, create new services, and provide research opportunities for our RSEs. MyGeoHub has been in operation for nearly 10 years and supports approximately 11,000 users annually, ranging from K-12 students to multi-disciplinary scientists. It continues to evolve to support emerging technologies and host new projects. The team also used the usability consulting service successfully. The CHEESE project (Cyber Human Ecosystem of Engaged Security Education) sought to provide hands-on experience with common cybersecurity issues and mitigation strategies via a web-based demonstration platform. Most of the users were K-12 students and undergraduates, so usability was a key concern. The CHEESE team partnered with the SGCI usability team to improve the usability of the CHEESE website and demonstration applications. Six usability tests were carried out which identified ten areas of improvement in the visibility of actions, UI intuitiveness, and a lack of instant feedback. The usability team also provided a heuristic evaluation and a cognitive walkthrough to evaluate the user-friendliness of common workflows on the website. Three key areas of improvement were identified: consistency and standards in user interface elements, improving a sense of direction in multi-step workflows, and including vital information on the page. The CHEESE team implemented over 50% of these recommendations, which greatly benefited the usability of the CHEESE gateway.

C. Hawaii Behavioral Health Dashboard

The State of Hawaii Behavioral Health Dashboard (HBHD) [10], is an interactive online platform that provides data on substance use, mental health, and crisis care in Hawaii. The dashboard was developed as part of the Overdose Data to Action (OD2A) project funded by the Centers for Disease Control and Prevention (CDC). The OD2A project aims to expand public health surveillance and use data to drive prevention strategies for drug-related misuse and overdose morbidity and mortality [11]. During the development of the HBHD, the development team partnered with SGCI to leverage usability and user-experience consulting services. The SGCI usability team evaluated the initial beta release of the HBHD throughout a three month engagement. The usability team and the HBHD team engaged in 4 phases: Initial questions & background about the dashboard, Competitive analysis of similar dashboard, user-experience audit of the existing dashboard and user-centered design recommendations and mockups. The outcomes of the usability engagement were the redesign of some of the dashboard navigation, interfaces involved in query/filtering, and design templates for three common patterns within the dashboard. The usability team provided a summary report of their in-depth evaluation of the HBHD and mockups and templates in Figma that the HBHD team could use to refactor the dashboard. The HBHD team incorporated the results of the usability analysis into a final dashboard product with a friendly interactive user interface that has served important substance use and overdose information related to Hawaii for over 34,000+ visits since October of 2022.

IV. Summary

Sustainability of science gateways has many facets and a healthy growth of the community of a science gateway contributes to its sustainability. SGCI and SGX3 offer services such UX consulting and sustainability training that can positively influence the community growth. Each of the panelists representing one of the science gateways will give a short introduction to their science gateways and the services they received from SGCI and SGX3. The Co-PI of SGX3 will give a brief overview on the services. Afterwards, we will discuss questions in the panel such as

- How has UX consulting provided by SGCI/SGX3 impacted user engagement and satisfaction within your science gateway community?
- In what ways has sustainability consulting influenced the long-term viability and growth of your science gateway's user base?
- Can you share specific examples of how improvements in user experience (UX) have led to increased community participation and collaboration?
- How have the consulting services on financial and technological sustainability helped in attracting and retaining a diverse group of users for your science gateway?
- What experiences and feedback have you gathered from your community that highlight the importance of UX and sustainability consulting in their ongoing use of the science gateway?

Questions from the audience for the panelists will be prioritized. We expect a lively discussion about which factors lead to community growth, lessons learned, impact of SGCI and SGX3 services and good practices that can be applied to other science gateways.

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