

Interaction Profiles for AI-Assisted UX Evaluation in Science Gateways

PAUL C. PARSONS[✉], Purdue University, USA

HAMED ABDULSALAM, Purdue University, USA

PHUONG BUI, Purdue University, USA

Scientific cyberinfrastructure supports diverse forms of work, including computational workflows, data discovery, learning, collaboration, simulation, and decision making. Yet UX evaluation of science gateways is often approached generically, despite the different evaluation needs these forms of work create. Through an interpretive review of more than 100 science gateways identified through UX consulting engagements and a public gateway catalog, we identify seven recurring interaction profiles and synthesize prior UX literature and practitioner experience to connect them with representative UX concerns. We present the profiles as a practice-derived lens for scoping UX evaluation rather than as a validated taxonomy. We then consider how they might ground AI-supported UX inquiry by helping teams generate context-sensitive hypotheses and evaluation questions. We frame AI-generated outputs as prompts for further investigation, not as evidence of user experience. The interaction profiles provide a practical vocabulary for connecting the work a gateway supports to its UX evaluation needs while clarifying a limited, supplemental role for AI.

CCS Concepts: • **Human-centered computing** → Human computer interaction (HCI); • **Applied computing**;

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1 Introduction

Scientific cyberinfrastructure increasingly mediates how researchers access data, software, computational resources, instruments, educational materials, and collaborative communities. Science gateways are a prominent manifestation of this ecosystem, providing interfaces through which users engage with complex technical resources and scientific workflows. Prior work has shown that gateway success depends on more than technical capability alone, highlighting sustainability, community engagement, governance, usability, and organizational support [4, 7]. Yet UX remains comparatively underdeveloped as a concept and practice within gateway development. Gateway teams often possess limited UX expertise and approach user-centered work primarily through interface evaluation or late-stage usability testing [15]. Recent work instead positions UX as a strategic concern connected to sustainability, community alignment, and long-term infrastructure development [13].

AI is also becoming an important topic within cyberinfrastructure. Recent work has examined how gateways might support AI-enabled research and integrate AI capabilities into gateway ecosystems [5, 17], but relatively little attention has been given to AI-supported UX inquiry. A central challenge is that gateways support different forms of interaction

Authors' Contact Information: Paul C. Parsons, parsonsp@purdue.edu, Purdue University, West Lafayette, IN, USA; Hamed Abdulsalam, habduls@purdue.edu, Purdue University, West Lafayette, IN, USA; Phuong Bui, bui42@purdue.edu, Purdue University, West Lafayette, IN, USA.

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work, which give rise to different UX concerns and evaluation needs. AI-generated critiques that lack this context may therefore emphasize generic interface issues while overlooking concerns central to the work a gateway supports.

This paper's primary contribution is a set of interaction profiles for scoping UX evaluation in science gateways. Through an interpretive review of more than 100 gateways, we identify seven recurring forms of interaction work and synthesize prior literature and practitioner experience to connect them with representative UX concerns. We present the resulting profiles as a practice-derived lens rather than a validated taxonomy. We also consider how the profiles might contextualize AI-supported inquiry within UX evaluation by helping teams generate hypotheses and evaluation questions grounded in a gateway's intended interactions. Such outputs are intended to inform practitioner judgment and subsequent empirical investigation, not to serve as evidence of user experience.

2 Background

2.1 Science Gateways, UX, and Interaction Work

Science gateways provide interfaces to data, software, computational resources, instruments, and other forms of cyberinfrastructure supporting scientific research and education [2]. Gateway research has shown that technical capability alone is insufficient for long-term success, emphasizing usability, sustainability, governance, outreach, workforce development, and community engagement [6, 7, 12, 15]. More recent work positions UX as a strategic concern influencing adoption, effectiveness, and long-term viability [13]. Yet UX expertise remains scarce and is often introduced late in development [8, 15]. This scarcity is consequential because gateways are not a homogeneous class of systems; computational workflows, information seeking, learning, collaboration, simulation, and decision making place different demands on users. We use *interaction work* to refer to these goal-directed forms of activity and treat them as a basis for differentiating UX evaluation needs.

2.2 AI-Supported UX Inquiry

Modern LLMs are increasingly being explored within cyberinfrastructure and UX practice. Gateway research has considered the integration of AI capabilities and support for AI-enabled research [5, 17], while UX research has examined AI support for ideation, evaluation, workflow integration, and synthesis [9, 16]. The usefulness of such support depends on how AI is situated within existing work practices, including when it is used, what context it receives, and how its suggestions are interpreted [18].

For UX work, these dependencies make the role and limits of AI especially important. AI may assist with generating candidate risks, scenarios, and evaluation questions, but it cannot establish users' actual needs, behaviors, constraints, interpretations, or the severity of a problem. Nor does it by itself close the UX capability gap: teams still need methodological judgment and access to users or behavioral evidence. Within the broader area of AI-assisted UX evaluation, we use *AI-supported UX inquiry* to describe a supplemental role in which generated outputs inform practitioner judgment and empirical investigation. Such outputs should be treated as hypotheses rather than evidence of user experience, consistent with critiques of AI as a substitute for human expertise or a source of frictionless efficiency [14].

3 Interaction Profiles, UX Concerns, and AI-Supported Inquiry

To develop the profiles, we conducted a manual, iterative interpretive review of more than 100 science gateways between February and June 2026. The corpus was drawn from prior UX consulting engagements through SGCI and SGX3 and from SGX3's gateway catalog. The available materials varied by gateway and included public descriptions, project

documentation, and, for consulting cases, knowledge developed through those engagements. Our coding focused on each gateway's stated purposes and the forms of interaction work it was designed to support, including users' principal goals, activities, and interactions.

All three authors participated in reviewing and coding the corpus. Gateways could be associated with multiple candidate profiles, with a primary profile representing the gateway's dominant focus. We met regularly to compare classifications, discuss ambiguous and multi-profile cases, and refine the profile definitions through comparison across the corpus. Differences were resolved through discussion and consensus. Because profile assignments were intended as useful interpretive characterizations rather than objectively correct labels, we did not calculate formal agreement statistics.

This process produced seven profiles: HPC/workflow, data discovery, educational, simulation, community, decision support, and enterprise/job-oriented systems. We present them as practice-derived abstractions rather than as an exhaustive or validated taxonomy. Table 1 summarizes the forms of work represented by each profile and UX concerns synthesized from prior literature and practitioner experience. These concerns function as prompts for scoping evaluation, not as predictions that a problem exists in a particular gateway; their presence and significance must be investigated empirically.

Table 1. Interaction profiles, forms of interaction work, and representative UX concerns.

Profile	Interaction Work	Representative UX Concerns
HPC / Workflow	Configuring, executing, monitoring, and troubleshooting computational processes.	Workflow visibility, abstraction transparency, resource awareness, parameter burden, error diagnosis and recovery.
Data Discovery	Searching, evaluating, interpreting, and reusing information resources.	Discoverability, metadata comprehension, provenance, trust, data reuse decisions.
Educational	Learning concepts, developing skills, and progressing through instructional content.	Onboarding, scaffolding, learning progression, prerequisite knowledge, conceptual clarity.
Simulation	Exploring scenarios, configuring models, and interpreting outputs.	Parameter configuration, model assumptions, uncertainty communication, interpretation of outputs.
Community	Participating, contributing, collaborating, and sharing resources.	Participation barriers, trust, contribution pathways, resource discovery, collaboration support.
Decision Support	Interpreting information to inform planning and action.	Trust calibration, uncertainty interpretation, explanation quality, actionability of recommendations.
Enterprise / Job	Managing access, accounts, scheduling, and operational workflows.	Authentication, account management, scheduling, allocation tracking, administrative visibility.

3.1 Computational Workflows and Scientific Software

Computational workflow gateways support the configuration, execution, monitoring, and troubleshooting of processes running on complex cyberinfrastructure [3]. Although interface abstractions can make these resources more accessible, they may also obscure system state and complicate diagnosis when failures occur. Evaluation should therefore examine how users configure parameters, understand resource requirements, monitor progress, interpret outputs, and recover from errors. AI-supported inquiry may help generate workflow scenarios, identify potential failure points, critique error messages, and surface dependencies for subsequent investigation.

3.2 Information Seeking and Data Discovery

Data-oriented gateways organize work around finding, evaluating, interpreting, and reusing information resources. Users must assess the relevance, quality, provenance, and suitability of data before deciding whether it supports their goals [11]. Evaluation should therefore attend to search behavior, metadata comprehension, trust, and data-reuse decisions. AI-supported inquiry may help generate search scenarios, identify potentially opaque terminology, review metadata descriptions, and formulate questions about provenance and reuse.

3.3 Learning and Community Participation

Educational and community gateways respectively foreground developing capabilities and participating in shared activities. Educational gateways raise concerns about onboarding, prerequisite knowledge, conceptual clarity, scaffolding, and learning progression. Evaluation should examine whether users can identify appropriate starting points, understand core concepts, and recognize how activities contribute to learning goals. Community gateways instead foreground participation barriers, contribution pathways, resource discovery, collaboration, and trust. Evaluation should consider how users enter the community, locate relevant people and resources, understand expectations, and contribute effectively. AI-supported inquiry may help generate learner and contributor scenarios, identify potentially opaque terminology, review instructional or contribution guidance, and formulate questions about participation and trust.

3.4 Simulation, Decision Support, and Operations

Simulation and decision-support gateways require users to configure or interpret outputs before acting. Simulation gateways emphasize parameter configuration, model assumptions, uncertainty communication, and interpretation of results. Decision-support gateways add concerns about trust calibration, explanation quality, and the actionability of recommendations. Enterprise/job-oriented gateways support operational activities such as authentication, account management, scheduling, allocation tracking, and administrative oversight, making system status and workflow visibility particularly important. AI-supported inquiry may help generate edge cases and operational scenarios, surface assumptions, review explanations and status messages, and identify questions for empirical evaluation. These activities can direct attention to possible concerns but cannot determine how users understand, trust, or act on a system's outputs.

4 Discussion

4.1 Interaction Profiles as a Scoping Tool

The primary value of interaction profiles lies in helping gateway teams scope UX evaluation under constraints such as limited expertise, access to users, and competing technical priorities. Broad recommendations such as “conduct usability testing” offer little guidance about what an evaluation should investigate. Instead, teams can identify the gateway's primary profile based on its dominant interaction work and consult the corresponding concerns as possible areas of attention. Secondary profiles can be added when a gateway supports other materially different forms of work. For example, a computational workflow gateway may warrant attention to workflow visibility and error recovery, while an educational gateway may foreground onboarding and learning progression. The profiles do not determine which problems are present or prescribe a particular method; they provide a structured starting point for prioritizing questions and allocating evaluation resources.

4.2 A Workflow for AI-Supported UX Inquiry

Interaction profiles can also structure a limited, supplemental role for AI. Teams can first identify relevant profiles and combine their representative concerns with gateway-specific context such as interfaces, documentation, intended users, and workflows. They can then use AI to generate candidate risks, scenarios, assumptions, and evaluation questions. Practitioners must subsequently assess those outputs for plausibility and relevance, prioritize questions, and select appropriate methods for empirical investigation.

Without direct user involvement, AI may assist with brainstorming, preliminary inspection, scenario generation, review preparation, and consideration of alternative perspectives [1, 9, 10]. It cannot establish users' actual needs, behaviors, constraints, interpretations, or the prevalence and severity of a problem. Such claims require evidence from interviews, observation, usability testing, analytics, or other empirical methods. AI-generated outputs should therefore be treated as hypotheses for investigation rather than findings about user experience. Interaction profiles may help focus those hypotheses, but they do not make the outputs empirical or remove the need for UX judgment.

4.3 Limitations and Future Work

The interaction profiles were produced through an interpretive review of gateways represented in consulting engagements and a public catalog. Available information varied across cases, alternative characterizations are possible, and we did not test the profiles' coverage, discriminative value, or reliability as a classification scheme. The relationships among profiles, UX concerns, and AI-supported inquiry likewise synthesize literature and practitioner experience rather than constitute a validated framework. We have not established that these mappings improve evaluation planning or that profile-informed prompting produces more useful outputs than generic prompting.

Future work should assess how gateway teams interpret and apply the profiles, whether they improve evaluation planning and method selection, and how well they characterize gateways beyond the present corpus. Studies of AI-supported inquiry should compare generic prompting, profile-informed prompting, gateway-specific configuration using local documentation or custom instructions, and approaches combining profiles with local context. Outputs could be assessed by practitioners for relevance and actionability and examined for how well they support subsequent empirical UX work.

5 Conclusion

Science gateways support diverse forms of interaction work, yet UX evaluation is often discussed in generic terms. We introduced seven practice-derived interaction profiles as a vocabulary for connecting the dominant forms of work a gateway supports to representative UX concerns and for scoping evaluation. The profiles can contextualize AI-supported inquiry within evaluation planning, but they do not turn generated outputs into user evidence; those outputs remain hypotheses requiring practitioner judgment and empirical investigation.

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