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From Evidence to Action: Translating Year 2 Evaluation into Year 3 Design for an NSF CyberTraining Workshop

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Introduction

This paper accompanies a poster presented at the NSF Grantees Poster Session at the 2026 ASEE Annual Conference. Where the poster (see abstract at peer.asee.org) visually presents the evidence-to-action map, evaluation framework, and implementation checklist, this paper narrates the design rationale for six Year 3 refinements to WaterSoftHack (NSF Award #2320979), a CyberTraining initiative for the water science community. Full empirical findings are reported in a companion work-in-progress paper [6]; the present paper focuses on how those findings translate into design action. Following a design-based research orientation [1], each annual implementation is a refinement cycle, and two research questions guide the work: (RQ1) How does the program enhance data science competencies in water science contexts? (RQ2) What challenges and opportunities do participants encounter in integrating data science into professional practice?

Hackathon-centered formats can support engagement, rapid prototyping, and near-term transfer [2], particularly when skill acquisition is situated in authentic disciplinary tasks [3]. At the same time, intensive pacing can elevate cognitive load for participants with heterogeneous prior experience [4], and time-bounded teamwork can amplify socio-technical friction when roles and conflict-response supports are not explicitly designed [5]. These dual affordances and risks frame the present study.

Program and Evaluation Overview

WaterSoftHack is an NSF CyberTraining project that seeks to expand access to advanced cyberinfrastructure, i.e., computational tools, high-performance computing environments, and data pipelines, within the water science community. Year 2 served 18 Fellows through a virtual format organized around preparatory work, live instruction on advanced machine learning (ML) approaches (e.g., Long Short-Term Memory [LSTM] models and Transformers), and a team-based hackathon sprint. Program details are available at watersofthack.github.io. The evaluation is formative and improvement-oriented, guided by Kirkpatrick's Four-Level Model and the Context, Input, Process, Product (CIPP) framework. Data sources included pre-surveys (n=11), post-surveys (n=5, matched n=4), semi-structured interviews (n=10), and hackathon artifacts. Full methods, limitations, and coded data are reported in the companion WIP paper [6]; all claims here are formative rather than generalizable.

Year 2 Findings in Brief

Year 2 confirmed core strengths: satisfaction averaged 4.25/5, compared with the Year 1 average satisfaction of 3.8 [6], [7], with Fellows crediting stable Google Colab notebooks and applied, project-centered instruction. Matched pre/post data showed directional proficiency gains across all competency areas, with the largest increases in machine learning programming (+1.7) and CI prototyping (+1.5). Transfer was the strongest cross-source theme, as Fellows described adapting code for dissertation research, and multiple teams established manuscript development timelines from hackathon artifacts. Fellows also described continued professional discussions, including conference-related networking and future collaboration.

Two persistent challenges anchor the Year 3 redesign. First, cognitive overload from the compressed intensive format was the most consistent critique, intensifying relative to Year 1 as content grew more sophisticated [4]. Second, socio-technical friction during the hackathon, driven by mismatched experience levels and absent team norms, created participation inequities, with less experienced Fellows hesitating to contribute. The companion WIP paper reports these findings in full [6].

Evidence-to-Action: Suggested Year 3 Design Refinements

Each refinement below follows the Evidence-to-Interpretation-to-Action structure. The poster visualizes this mapping; this section provides the narrative logic.

"Week Zero" Scaffolding

Interviews attributed cognitive overload to variability in baseline ML knowledge. Activating and organizing prior knowledge before intensive instruction is among the most reliable mechanisms for reducing cognitive load [8]. Year 3 will introduce a mandatory 2–3 week preparatory period with curated readings and model-specific primers.

Streamlined Curriculum

Fellows identified the number of models introduced in Week 1 as a driver of overwhelm, and proficiency data reinforce this: areas least connected to hackathon tasks (e.g., edge computing) showed the smallest gains. Worked examples with visible sub-goal structure improve novice computing problem-solving [9]. Year 3 will limit theory to hackathon-relevant models and expand annotated walkthroughs, making parameter choices explicit.

Proactive Team Formation

Interviews documented conflict from absent norms and mismatched experience at the hackathon's outset. Structured teamwork training reduces friction in high-intensity collaborative environments [10]. The Year 3 design includes pre-workshop social events and idea-pitching sessions for earlier team alignment, paired with explicit training on team norms and role expectations.

Faculty Mediation Protocol

At least one conflict was perceived by the Fellow involved as inadequately mediated, and participants described uncertainty about real-time escalation. Conflict-response pathways should be designed as program infrastructure [5]. The Year 3 design includes a four-step protocol: (1) team self-resolution via a shared norms checklist, (2) facilitator check-in within 24–48 hours, (3) mediated meeting to re-scope tasks, and (4) reassignment if needed.

Pacing Redistribution

Multiple Fellows recommended extending the intensive workshop period, and the persistence of this finding from Year 1 to Year 2 suggests a structural constraint rather than a first-iteration artifact. However, practical constraints, i.e., participant availability, faculty time, and scheduling, argue for redistributing preparatory work rather than lengthening the intensive. Year 3 will maintain the intensive workshop structure while shifting readiness work to Week Zero, with daily pacing monitored formatively.

Outcome Tracking

Hackathon artifacts documented publication momentum, but post-workshop follow-through is vulnerable to attrition without structure. Year 3 will add writing sprints and check-ins for manuscript conversion, paired with modest incentives and clearer communications to improve survey response rates.

Year 2 Finding	Evidence Source	Year 3 Intervention
Cognitive overload, compressed timeline	Interviews, post-survey	Week Zero scaffolding, pacing redistribution
Steep learning curve, breadth over depth	Interviews, proficiency ratings	Streamlined curriculum, worked examples
Team conflict, absent norms	Interviews	Proactive team formation, norm-setting
Perceived mediation gaps	Interviews	Faculty mediation protocol
Publication momentum needs follow-through	Interviews, artifacts	Writing sprints, check-ins

Table 1. Evidence-to-action map connecting Year 2 findings to Year 3 interventions.

Discussion

Year 2 confirms that domain-authentic, hackathon-centered work produces meaningful learning gains and near-term transfer, consistent with Herrington and Oliver's framework for authentic learning [3]. It also makes clear that technical and socio-technical design are inseparable. Week Zero scaffolding and the streamlined curriculum operationalize cognitive load theory by reducing extraneous load; team formation and the mediation protocol operationalize teamwork research by treating norms and conflict-response pathways as designed infrastructure.

Implementation fidelity will likely vary across intervention types. Curricular refinements, e.g., streamlined content, worked examples, and preparatory materials, align naturally with how STEM-led programs already operate. Socio-technical supports, e.g., mediation protocols and norms training, require different expertise and may face greater adoption barriers in programs led primarily by domain scientists. Acknowledging this asymmetry matters for other CyberTraining PIs: the evidence base for socio-technical infrastructure is strong, but translating it into practice often requires cross-disciplinary collaboration. The Evidence-to-Interpretation-to-Action structure used here provides a practical format for justifying specific redesign choices, and the accompanying poster visualizes this mapping in a form adaptable to other intensive training contexts.

Conclusion

This paper presents the design rationale for six evidence-based Year 3 refinements to WaterSoftHack. Full empirical findings are reported in the companion WIP paper [6]; the accompanying poster visualizes the evidence-to-action map and provides an implementation checklist. By sharing this iterative process transparently, including the practical asymmetries between curricular and socio-technical adoption, WaterSoftHack offers an adaptable model for effective, equitable computational workforce development in STEM.

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