Exploring Students' Problem Context Preferences

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Abstract

An authentic problem context can motivate students, or it can raise cognitive load and hinder transfer. We describe lessons from our iterative process finding contexts of interest to our students and integrating them into labs. Our success in creating exciting labs is tempered by mixed results in measures of engagement. We conclude with takeaways for other designers and researchers in this space.

CCS Concepts

• **Social and professional topics → Student assessment**.

Keywords

context, motivation, assignment design

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1 Introduction

An authentic context for a computing problem can show the utility of course material and motivate students to engage with otherwise-abstract tasks. However, contextualization can also increase cognitive load and hinder transfer beyond the problem domain [1, 2].

UBC CPSC_V 210 (Software Construction) is a second CS course focused on OOP and design patterns. CPSC 210 includes weekly programming labs, and a term project in which students choose their application domain. Evaluations praise the project, but labs receive more negative feedback. Labs *are* contextualized… but often shallowly "pasted on" to an abstract problem. We aim to redesign labs to capture some of the engagement seen in the project.

Self-Determination Theory (SDT) suggests that extrinsically-motivated (reward-driven) tasks—like our labs—can reduce learning [4]. However, SDT also posits that tasks closely aligned with student interests may yield positive outcomes [4]. Prior research supports this, showing that students see personal interest as the strongest factor in domain-related engagement [3].

Thus, we iteratively redesigned labs around compelling domains to improve motivation. We identified interesting domains from student surveys and work products. We redesigned labs to align with these interests and integrate problem domains deeply. However, student responses challenged our assumptions: some found the new contexts engaging; many found them frustrating. This suggests that when a domain is surface-level, it can be enough to satisfy casually-interested students, but when a domain is deeply integrated, they must engage with it, amplifying negative outcomes. In this paper, we share our design process and our key takeaways.

2 Iterative Process

We identified a need for contextualized labs from student evaluations. In response, we engaged in cycles of analysis and redesign.

To find good contexts, we conducted an open-ended survey asking students: "What domains or application areas would you find interesting and motivating? For example, healthcare, sustainability, … [sic]" (We included examples to clarify the meaning of "domain".)

89 students provided 165 suggestions, spanning 87 unique domains. The most common were healthcare (17), sports (10), video games (8), and no domain (8). Responses varied vastly in breadth, e.g., "education" vs. "blood donation bank"; so, we consolidated to 15 broad categories. The most common were: entertainment (e.g., video games, social media; 21), university subjects (e.g., CS, Math; 20), and health-related topics (e.g., healthcare, medicine; 20). Fewer students were interested in food (4), business (4), or social good (3).

With other CPSC 210 staff, we picked two labs to replace that were far apart in the term and "weak on" context; our analysis above also showed low interest in their domains. **Food Services**: Students implement payment transactions with a loyalty program. **School Trip**: Students manage school bus rosters to practice bi-directional relationships; this lab was also "weak on" concepts.

In the next term, we surveyed students after the labs with a grade incentive. Their responses, shown in Figure 1, formed a baseline for our redesign. (The abbreviated prompts were "The example the lab was applied to felt relatable to my life"; "I feel interested to continue and add new features to this project"; "The lab effectively connected subjects we learned in class to real-world applications".)

We also analyzed the domains students chose with their own effort at stake, using a random sample of 100 projects from two terms. We open-coded the project descriptions, e.g., "Golf scoreboard" and "Music organizer". We aggregated these to a granularity similar to our open-ended survey, e.g., "Business operations" and "Restaurants". Last, we mapped those to our 15 broad categories.

Results were somewhat similar to the survey. The most common categories were: entertainment (28), personal (15), business (14), food (11), and health (7). Project requirements favor to-do-list-like

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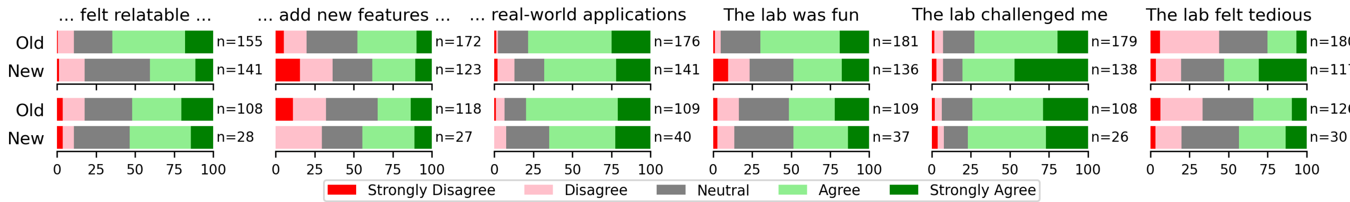

Figure 1: Survey responses for old and new labs. Top row: Food Services/Puppy Caller; bottom: School Trip/Wait Times.

apps, which may have led to more business and food projects; we saw many meal-tracking (food) and inventory (business) apps.

Informed by these results, we iteratively developed replacement labs with authentic tasks in interesting domains. **Puppy Caller**: A game where the user "calls" dogs by typing their names. Students implement the input handling logic. Entertainment—particularly games—ranked highly in our domain interest explorations, and I/O in a game loop is common in games. **Wait Times**: Students plot real wait time data from local hospitals. They extend a given analysis, contrast design alternatives, and create analysis on a new factor. Health was also a strong interest from our explorations. We reused the post-lab survey for the new labs, as shown in Figure 1.

3 Discussion

Figure 1 shows the post-lab survey results for Food Services/Puppy Caller. We anticipated that students would find the new lab harder. Contextualization added new supporting code that students had to navigate. The ability to "walk up to" a codebase and understand its structure is a key CPSC 210 learning goal, but the new lab became a first solo experience of that. In response, we simplified the lab and adjusted earlier labs to create a smoother difficulty curve.

We meant for the greater difficulty to be balanced by greater engagement, but surveys did not support that. Students found the "surface-level" Food Services domain more relatable and fun than Puppy Caller's deeply integrated domain. Difficulty may have shaped perceptions in other ways, e.g., only students who correctly completed the lab got the benefit of creating a playable game.

Students show genuine interest in entertainment—nearly a third of sampled projects fell into this category—yet this enthusiasm did not carry over to the lab setting. One possible explanation is the deep integration of the domain within the assignment. We observed diverse interests among students, and although we chose popular domains, no one context was widely favored. When context is a thin layer on top of the assignment, uninterested students can largely ignore it and focus on underlying CS concepts. However, when the domain is tightly coupled to the problem, disinterested students must engage with it, possibly amplifying frustration, just as it may amplify motivation for interested students. In making a lab more engaging for some, we risk making it less engaging for others.

The second pair of labs (bottom of Figure 1) follow a similar but less pronounced pattern.[1] Students *did* express more interest in continuing work on the new lab. So, while the redesign did not obviously increase overall engagement, it may have fostered a sense of autonomy and ownership. As with Food Services, students perceived the School Trip lab as authentic, despite course staff universally agreeing its context was so minimal as to be meaningless.

Our methodology has limitations. First, the examples in the open-ended survey may have influenced student responses. Furthermore, while project analysis provided insight into preferred domains, the project's criteria likely influenced domain selection. Triangulating across data sources mitigated both concerns. Finally, the new labs differed from their predecessors beyond just theme. Although our redevelopment efforts were guided by domain integration, broader structural changes make direct comparisons difficult.

[1] Wait Times was intentionally much harder than the simplistic older lab.

4 Conclusion

Identifying engaging assignment domains is challenging. Triangulating surveys, feedback, and student choices (as with our term projects) can help, but no individual context will appeal to everyone.

Another key takeaway is that we educators are not our students. A "thin coat of paint" context may feel surprisingly authentic to students. If the goal is to design assignments that *feel* authentic, making them truly realistic may not always be the best approach.

Finally, deep domain integration has pitfalls. The same elements that engage some can alienate others. With tight coupling of lab objectives and context, students alienated by the domain may be more frustrated than motivated, leading to a polarizing effect.

Our broader hypothesis is that a "good lab" balances multiple factors, including engaging domains, opportunities for growth, and both technical and real-world impact. This study focuses on domains of interest. Our findings push us to further examine how these other elements contribute to engagement.

Our results also suggest that combining an authentic domain with an open-ended component (as in Wait Times) can inspire more students to explore on their own. We hope to study how combining this with a breadth of domains could engage many students in self-directed learning. We also hope to examine how the level of domain integration "tunes" motivation and frustration.

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