

## A Research Question

As outlined in the personal history statement, the research question that prompts this application to the Learning Sciences PhD program revolves around the development in adult learners of skills in creating computer programs to solve novel problems. While I would be interested in other research questions, I have given some thought to how one might move forward with this particular topic.

## Literature

In a preliminary review of the literature, there seems to be relatively little concerning adult learners, let alone adult problem solving skills. Actually, the apparent dearth of research in adult learners is actually a bit encouraging. It seems to be a relatively untapped field of research. With the current interest in STEM topics and the increasingly common phenomenon of adults engaging in education to prepare for “second careers”, it seems that this would be a reasonable area for research, though it may be less well funded than research with younger student populations.

## Adult Learners

One area where there seems to be a reasonable body of literature about adult learning is second-language acquisition (SLA). It has long been recognized that young children seem to acquire language “organically”, simply by exposure to circumstances where there is communicative need in the target language. On the other hand, adult learners typically show marked “deficiencies” in SLA, most notably in phonology. Recent research shows that adult language learners benefit from instruction that can leverage their cognitive abilities.

Where young children apprehend and acquire distinctions implicitly, adults do better with explicit instruction regarding forms and their distinctions. As an example, the variation in second-person subject pronoun, based on number and formality: *tu* and *vous* in French; *du*, *ihr*, and *Sie* in German; *tú*, *vosotros*, *Usted*, and *Ustedes* in Spanish; where in English there is the sole contemporary form, *you*.

A common phenomenon in language acquisition, both first language learning by very young children and second language learning, is the memorization of chunks of language, stock phrases and sentences, particularly those that can be deployed in a number of circumstances. For example, in Spanish, “*Me gusta X*.” is the chunk for “I like X.” “*Me gusta la música*.” (I like the music.) “*Me gusta la comida*.” (I like the food.) Later, as grammatical knowledge increases, the chunks are analyzed and one sees a Piagetian style restructuring of language knowledge. To continue our example “*Me gusta X*” does not form grammatical sentences with plural nouns. “\* *Me gusta las*

*enchiladas.*” (I like the enchiladas.) This is because the apparent object (the patient, X) is the grammatical subject of the sentence, while the apparent subject (the agent, *me*) is expressed in the dative: “X is pleasing to me.” So, with a plural X, the verb must become plural: “*Me gustan las enchiladas.*” This dative structure is appears in a number of affective constructions in Spanish. So, this analysis not only helps with the appropriate grammatical form for this specific chunk, it also provides *transfer* to a number of parallel structures in the target language.

There is a significant amount of research in problem solving skills in young people. Here I cite findings from two studies with elementary school students, fifth grades, as it turns out. One study found that successful problem solving was positively correlated to metacognitive understanding of the problem space as evidenced by the content of the explanation of the problem to a peer. In the other study, intervention with metacognitive instruction was also shown to improve student outcomes, even when the metacognitive material was not directly related to the task being evaluated. So, metacognitive material may help prompt the analysis and restructuring of the knowledge used by the students.

Metacognition and knowledge restructuring is also dependent on having a sufficiently large body of knowledge to massage. So, work with entry-level students may be problematic. The students for the upcoming BAS degree may be a reasonable population, but the population is small: 25 per cohort for the initial years, projected to grow to 30 in the third year. If the application process becomes competitive, there may be relatively less variation within the student population. There are other potential problems. If I’m teaching in the BAS program, it may be more difficult to get the research approved through the IRB due to potential conflict issues. Moreover, the classes in the BAS program as currently scheduled to be offered only once a year. So, comparison between cohorts would be a long-term endeavor.

A more promising potential population for this study would be to draw from the students taking AMATH 301, Beginning Scientific Computing. It has a relatively advanced math prerequisite, second-quarter freshman calculus. So, the basic problem solving skills of the students should be adequate. It’s a large volume class, typically with more than 300 students per quarter during the academic year. It is essentially a programming course in MATLAB; so, a good deal of the work in the class is built on concepts of linear algebra and basic programming. In personal communication with instructors of this course, about half the students have background in programming and about half have background in linear algebra. So, about a fourth of the students sail through the class and about a quarter of the class struggles mightily. It shouldn’t be too difficult to find students who would be interested in tutoring for this class. Many of the qualitative research techniques are essentially analogous to standard tutoring techniques: for example, think aloud. As such, this will probably qualify for minimal-risk HSD approval.

While the BAS students may not be a reasonable population for the initial research, it does hold some interesting promise. The heart of the curriculum is a set of three sequences, each consisting of a more theoretical design class followed by a practicum class where the students implement a

prototype of a project for a local industry. The sequences look at web applications, mobile applications, and cloud (software as a service) applications. These sequences may provide a reasonable platform for action research in this area following the completion of the PhD.

I have spoken briefly with Dr. Kara Johnson about this research possibility. Unfortunately, I have been unable to talk with Dr. Philip Bell about it yet. It seems that either of them could well serve as the advisor for this work.

Respectfully yours,

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