Student Conceptions of Expertise

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Abstract: We report on student beliefs about what constitutes expertise. Our population is a group of first-generation and deaf/hard-of-hearing students participating in a pre-matriculation university program designed to encourage reflection and metacognitive practice. Students first worked in small groups to articulate criteria that defined expertise and then engaged in a class discussion in which a formal definition was developed. All activities were recorded and student discourse analyzed, revealing a nuanced and evolving understanding of expertise.

Keywords: epistemology, expertise, student understanding

Introduction

Incoming student expectations about course content and epistemology (e.g. Redish et al, 1998) have a significant impact on student learning. Less well studied, however, is the student conception of expertise, the traits that define mastery of a subject. Explicit discussions of expertise and success -- especially among at risk or underrepresented groups -- can develop students' self-assessment skills and thereby improve their persistence in college (Mani 2012). The differences between experts and novices have been studied in a variety of contexts (e.g. Macnamara, 2014), however, novices' perception of expertise is understudied. Motivated by work that suggests metacognitive framing (Elby, 1999) can influence learning, we study first generation (FG) and deaf and hard-of-hearing (DHH) students' perceptions of expertise in a pre-matriculation university program.

Theoretical framework

We focus on two different areas of research on expertise: the differences between experts and novices and the types of practice that may allow one to transition from novice to expert. Chi (2006) summarized the different ways that experts display mastery, including quickly generating best solutions (e.g. in chess, de Groot 1965) and detecting features in a problem or situation that remain hidden to novices (Chi et al., 1981). Experts spend time analyzing problems qualitatively, monitoring their status of comprehension, an important metacognitive trait. This is particularly noticeable in physics (e.g. Larkin et al., 1980), where students tend to work backwards from what is asked while experts work forward, starting with the information given. Macnamara et al. (2014) investigated the effects of deliberate practice on improving expertise. Through meta-analysis of 88 studies, they found that deliberate practice could only account for some of the variance in performance, with the amount explained varying widely across disciplines and no more than 26% in any discipline. An important absence in all of this, however, is the novice's *conception* of what is meant by expertise. That is, what differences does a novice perceive exist between their current state and that of an expert. Work on self-assessment (e.g. Dunning & Kruger, 1999) suggest that novices do not understand the significant gap that exists between them and an expert and, in particular, do not even recognize important specific areas in which they need to improve. This is complicated by the tendency to interpret experiences/feedback in a way that supports a pre-conceived narrative of one's expertise. (Crictcher & Dunning, 2009) Put simply, novices will inflate the importance of characteristics they believe they possess in order to justify their self-assessment as experts. In this study we directly ask novices to discuss traits that *they believe* constitute expertise.

Context and methods

This study analyzes discourse from twenty incoming undergraduate majors in STEM disciplines at a large, Northeastern comprehensive institution that participated in a two-week summer experience designed to foster metacognitive practice. Of the twenty students studied, all were drawn from at-risk populations: fourteen were FG and six were DHH, of whom three communicated primarily through American Sign Language. (Multiple interpreters were present to facilitate communication, and DHH students' statements are taken from the interpreters' communications.) Immediately prior to the large group discussion analyzed, students worked in small groups (3-4) on an activity in which they compared two documents describing climate change and global warming. Documents were distilled from prior student writing as well as professional articles intended for non-scientists.

Students were told that an "expert" wrote one document and a "novice" wrote the other and their task was to determine which was which. Little instruction or guidance was given; in particular students were not given criteria by which to make this determination. After working in their small groups for an hour, the students gathered in a large circle for a more general discussion about expertise. The instructor started the conversation by asking students how they decided which papers were written by experts or novices. The students' conversation later shifted organically into a broader discussion about expertise and what makes someone an expert. All activities were videotaped and transcribed and discussion elements (fragments of conversation consisting of 1-5 sentences) codified according to an emergent rubric adapted from Chi (1981). Sample fragments include the following, coded to indicate communication as a marker of expertise:

> Also the tone of how it is written…I think if you can read it, you can hear it in the voice.

and the following, coded to indicate teaching as a maker:

> One of the main differences [between the papers] was that one was telling you the definition while also teaching, while the other, I don't know if it was right or not 'cause I don't know the definition, it just seemed like 'alright here is the definition.' It seemed that the the other one said, this is the definition and you can see what happened. He puts it in perspective for you.

Video discussion elements were reviewed and entered as source data into NVIVO (NVIVO, 2012). From this, it emerged that the student discourse could be parsed into coherent fragments, 1-5 sentences in length, that articulated a single idea. Ideas were sorted into ten rubric codes, shown in Table 1, that emerged from comparing the video data with categories identified by Chi (1981). Two researchers independently coded half of the discussion elements and established an inter-rater reliability of >85% for each code. A single researcher then coded the remaining elements, and a third researcher reviewed the emergent themes.

Table 1: Coding rubric used to categorize student comments

Rubric Code	Qualities contained in
Communication	Comments about syntax, diction, vocabulary, and confidence shown in communication.
Teaching	Comments that cite the ability to teach as evidence of expert understanding.
Self-Awareness	The ability to self-monitor one's understanding and accurately assess one's expertise.
Relative Scale	Acknowledging that expertise is relative to the understanding of others in the field.
Domain Specific	Statements that acknowledge the domain-specific nature of expertise.
Resourcefulness	Comments that cite the ability to access relevant information with relative ease.
Gradual Scale	Statements that recognize the gradual progression from novice to expert understanding and the amount of time spent working in a domain as evidence of expertise.
Deeper Understanding	Ability to see patterns and qualities within the domain. Includes ability to apply knowledge to new contexts and focus on why something happens, rather than just how.
Interest	Comments about one's dedication and curiosity about the topic.
Counter Argument	Statements that argue against one of the criteria described by the codes above.

Findings

Students argued both for and against individual elements as evidence for expertise. The relative frequency (fraction of coded statements) of elements over the forty minute discussion is shown in Figure 1. Positive values indicate supporting statements; negative values (shaded red) argue against the trait as representative of expertise.

The first part of students' expertise discussion was in response to the instructor's question on how they decided on whether a paper was written by an expert. The primary evidence cited was terminology: using words correctly and straightforwardly was seen as a sign of expertise, as was perceived confidence. Some students reversed these criteria, suggesting that simpler terms indicated an expert who could explain content clearly. Some disagreed with written communication as a criterion for expertise, suggesting that some experts could simply not be skilled at expressing their understanding. Others felt that this skill was a part of expertise, and knowing how to express ideas reflected one's understanding. While there were disagreements in whether written communication was indicative of someone's expertise in the topic of the writing, the discussion prompted students to consider other qualities of experts beyond their initial task of determining expertise through writing.

Throughout the discussion, students often debated about the ability to teach as a marker of expertise. Some students felt that the ability to teach a topic was a necessary marker of expertise. While a novice might be able to explain or define something, an expert would also offer perspective. One student placed teaching at the highest level of expertise (e.g. teaching a topic leads to true understanding). This same student then immediately questioned this by wondering aloud if "creating" was a higher level. Another student offered a personal experience of teaching a class for a week and yet still not being an expert. Students used the example of knowing how to speak, but not teach, a language, and cited Einstein as an expert, regardless of his teaching ability. Interestingly, as students continued their discussion, they began to separate teaching from expertise.

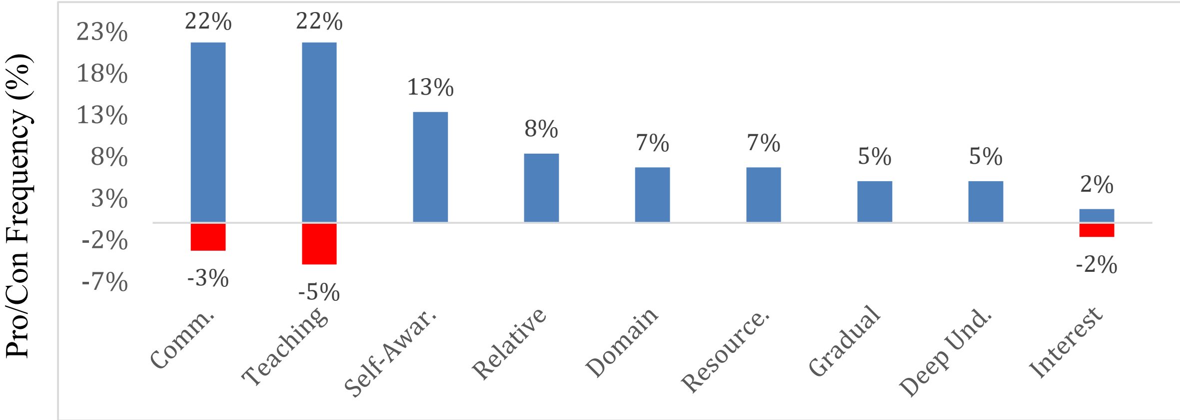

Figure 1. Expert criteria referenced during group discussion as percentage of discussion elements (fragments of conversation consisting of 1-5 sentences) over the course of a forty-minute discussion. Statements supporting the criteria as evidence of expertise are positive; those contesting are coded as negative.

Students brought up multiple criteria that relate to theories of deliberate practice. Key criteria identified in experts was self-awareness and awareness of available resources, and was often expressed in terms of an academic experience. Specifically, students expressed self-awareness in experts as "knowing when to study more", understanding the limitations of your knowledge and abilities, and correctly recognizing what remains to be learned. Students also recognized that an essential part of expertise is a metacognitive awareness of what it means to be an expert (e.g. Dunning& Kruger, 1999), with this awareness enabling a correct determination of what remains to be learned. Students also brought up the importance for experts to be aware of their cognitive resources and the ability to choose which are most relevant to the context at hand. Students recognized that experts need not know (or be able to instantly recall) all content, but rather possess the ability to marshal resources, techniques and strategies as needed. For students, being deliberate as an expert meant knowing themselves and their limitations, and being able to recognize and use available resources.

Expertise was seen as having two scales. The relative scale compared one's expertise with that of others. The other scale was gradual, with expertise gradually learned or accumulated over time. One student compared his expertise at speaking Spanish relative to his different family members, considering himself an expert compared to his mother, yet a novice compared with his grandmother. Another said that, to other students, he is considered an expert at sign language, even though he feels he is not exceptional. Students pushed the scale of expertise to perceptions at different points in history, noting that discoveries in the past might have been easier when less was known. Students also saw expertise as a function of time. Students can become experts with work, and expertise is not binary, growing over time. Some suggested that simply working over time is not enough (reminiscent of early work by Bryan & Harter 1897), arguing that excitement (or motivation) could also play a significant role in acquiring expertise. As a counter argument, though, one student suggested that interest in a topic makes you an aspiring, rather than actual, expert. For some students, reflective practice itself leads to expertise, yet for others such practice only comes about through interest.

Students recognized the importance of considering depth of expertise, and first mentioned this with regards to writing. Students argued that writing which shows a broader perspective and deeper insight into the concept is likely the writing of an expert. Additional depth occurs when considering the applications of a topic and explanations for why something worked. Students used the example of learning to speak a language versus developing fluency, which they saw as language expertise. A deeper understanding is indicative of expertise, but this deeper understanding is also domain-specific. One student talked of "being an expert in naming things in his dorm" to explain how a student could be an expert in a certain domain. Students highlighted the need to focus on a specific field within a broader subject to become an expert in, rather than a general topic or multiple fields. Students' conceptions of expertise were largely connected to a deep understanding within a specific domain.

Discussion and conclusion

We have presented analysis of a student group discussion about expertise. Their conversation centered around five characteristics: communication, teaching ability, self-awareness, relative expertise, and the domain specificity of expertise. We speculate that the first two arise due to the specific context of students and activity. As the discussion was initiated with a question about writing samples, students naturally begin by considering written expression as a marker of expertise. The external origin or motivation could also explain the presence of counter-arguments, as students did not feel strong ownership of this idea as a characteristic of expert knowledge. Similarly, students just beginning the transition from high school to college have a very limited experience with academic content experts. It is plausible that the high school experience conditions students to see their teachers as experts, and it is encouraging that upon reflection they have the ability to question this belief.

Student discussion evolved to issues that can be understood through the lens of deliberate practice. While not explicitly mentioning deliberation or intentionality, student discussions surrounding self-awareness invoked many of the hallmarks of deliberate practice. Their articulation of resources (cognitive or strategic) is insightful, and recognizes the ability of experts to identify the most promising resource from a larger set. This ability has been seen in prior research as characteristic of expertise (e.g. Chi, 1981). Interestingly, students intuitively apply this to the *process* of becoming an expert, recognizing that practice (time-on-task) alone does not bring about expertise. They recognize that an interest in the subject is needed to provide motivation and self-reflection brings about an awareness of resources that both leads to and defines expertise.

Student conceptions of expertise are a rich new area of research with potential implications for instruction. While some believed characteristics --- primarily metacognitive self-awareness --- are consistent with past research on both differentiating experts and novices and the path to expertise, other elements (teaching, communication) appear grounded in the specific experiences students bring with them. It remains to be seen as to whether students profit from insights into expertise and which, if any, interventions are most effective at helping students grow their expertise. Explicit metacognitive/reflective interventions (e.g. Dounas-Frazer & Reinholz, 2015) have been promising, but additional research is needed on the specific conception of expertise and the consequences that an improved understanding of expertise has on student learning.

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