Utilizing an Asset-Based Model to Understand Historically Marginalized Students' Experiences in a General Chemistry Course

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Introduction

Background
Success in introductory STEM courses is a key determinant in students' persistence on STEM paths. Students from historically marginalized groups (HMGs) are disproportionately harmed by this dependency. Therefore, introductory courses, like General Chemistry, are a major factor that contributes to a significant underrepresentation of HMGs in STEM careers.

Constrasting Approaches
Previous research has addressed this disparity through a focus on compensating for the systemic barriers that leave HMGs underprepared and disadvantaged in STEM classrooms, such as with supplemental interventions. However, focusing solely on the insufficiencies of historically marginalized students overlooks their strengths. Moreover, these deficit-based approaches forfeit the opportunity to design resources and components of STEM courses that would emphasize these strengths. This study shifts from a deficit-based perspective to an asset-based approach by analyzing HMGs' experiences to capture what strengths they utilize most in a General Chemistry course. Additionally, this study collected student opinions on existing course resources and how they relate to students' own perceived assets to more directly tie student strengths to course components.

Theoretical Model
Tara Yosso's 2005 Community Cultural Wealth (CCW) model categorizes six strengths that historically marginalized students commonly use to succeed in education. We utilize five of these strengths that are applicable in the context of introductory chemistry instruction to analyze how historically marginalized students are able to find success in the course through their assets.

Research Questions
- What assets do HMGs utilize to succeed in General Chemistry?
- What course structures are beneficial to student success?
- What course aspects should be restructured to better attend to HMGs' needs?

Methods
We conducted 26 semi-structured interviews with historically marginalized students. Questions encouraged students to share strengths and how they relate to the course, as well as suggestions for course improvements. For example:

- Reflecting back on the semester, what strengths did you realize you have that empowered you to succeed in schoolwork when it's challenging?
- Imagine next semester, you're invited to come back as a student panelist for CH101. What kind of advice would you give to the students about how to succeed as a student?

Students were split into four cohorts (A, B, C, D) based on course outcome:

A (n=7)	Sucessful: A, A-, B+
B (n=11)	Passing: B, B-, C+, C
C (n=8)	Unsuccessful: C-, D, F, W

Three researchers analyzed each transcript, identifying student assets described in Tara Yosso's Community Cultural Wealth model of HMGs' strengths in the context of education (see Fig. at right). We inductively coded any clear student strength that fell outside of Yosso's model (one thus far: Persistant). We also identified course resources or aspects that students mentioned helped or hindered them. Each unique skill or resource a student exhibited or described was classified as one instance of the corresponding asset. Students self-assigned code names for confidentiality.

Asset Classification

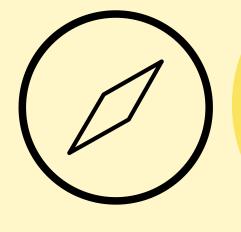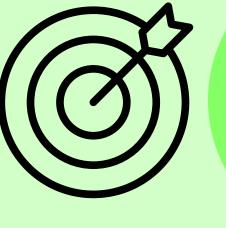| Capital (Asset)		Student Example
Resistant — Motivation and skills acquired through **overcoming challenging systems**, especially inequitable systems in the status quo		**Noodle, Cohort B** — "I guess a strength would be like **my ability to just like keep going, no matter how hard or how many times I failed at a problem.**"
Familial — Support and knowledge gathered from **family and communities** connected through identity		**Chem, Cohort C** — "Strength?...Like making a lot of friends who were also in Chem...like, **it's just a group of Black people. So like, I gravitated more towards them.**"
Navigational — Skills of **exploiting available resources**, especially those derived in self-motivation for success		**Wolf, Cohort C** — "I guess my **ability to utilize like all the resources** that professors gave me, and resources I found on my own."
Aspirational — Motivation for success sourced from **hopes and dreams** for the future, both short-term (e.g. course grade), and long-term (e.g. career)		**Pink Dino, Cohort A** — "But I feel like I've kind of like **idolized my dream life in the future** and stuff and that kind of keeps me focused on school."
Social — Ability to create and utilize social networks, often for both direct support with the course and more broad emotional support		**Carnation, Cohort B** — Okay, I think that something that really helped me was that I was able to **reach out to like friends** that were also taking Chem 101.
Persistant (inductive) — Internal motivation for success from determination, originating from one's own expectations for themselves		**Piano Man, Cohort A** — "I would also say...my **determination and will to just keep working through it**...You can't just like settle for, like, 'good enough,' I guess, right."

Results
These results cover the preliminary findings across the first 9 analyzed interview transcripts.

Table 1: Unique instances of student assets across cohorts

Student	Cohort	Res.	Fam.	Asp.	Nav.	Soc.	Per.
Eagle	A	1	2	4	3	3	0
Piano Man	A	0	2	3	6	6	1
Pink Dino	A	0	2	3	6	4	1
Carnation	B	1	0	1	4	2	1
Pencil	B	1	1	2	5	1	1
Chem	C	0	3	0	3	5	0
Octopus	C	3	1	3	5	2	1
Shark	C	1	1	2	5	2	0
Wolf	C	0	2	1	6	2	1

Table 1 legend: Brighter color = high capital utilization. Darker color = low capital utilization

Table 2: Positive and negative student course feedback

Course component	# of student reviews +	# of student reviews -	Common feedback
- Mostly negative reception:			
Discussion worksheets	0	4	Wish work was shown in key
Office hours	1	5	Intimidating, overcrowded
Textbook problems	0	2	Waste of time
Pre-lab lecture	0	2	Waste of time
+ Mostly positive reception:			
Office hours for students struggling	2	0	More personal, useful
Pre-lecture concept videos	6	2	Guides are accessible, friendly
Learning Assistant/Teaching Fellow	4	2	Good topic preview, digestible
-/+ Mixed reception:			
Lab	3	4	Low intimidation / Group environment challenging
Paid review sessions	1	1	Useful, worth it / Expensive
Discussion	2	1	Practical, hands-on / Direction was poor
University tutoring	1	1	Helpful / Too busy, no time slots available

Cohort Similarities
Aside from Chem and Eagle, all students—regardless of cohort—had **navigational** capital as their most used asset. This result suggests that a lack of access to or utilization of resources is not a major factor in student success. Additionally, with such a high emphasis already placed on utilizing available resources, further access to supplemental resources, as is proposed by many deficit-based approaches, may be met with diminishing returns as students are overloaded with options. Students across cohorts tended to moderately utilize **aspirational** and **social** capitals, suggesting HMGs do not struggle to utilize peers and consistently have dreams for the future that serve as significant motivators. Since these students have strong individual drives for success, the risk of group settings unevenly distributing workload or understanding is low. Therefore, these preliminary findings suggest that altering chemistry course structures to encourage the use of social networks, perhaps instead of simply adding more resources, may prove valuable for historically marginalized students.

Cohort Differences
While few differences in the proportion of capital utilized were found between cohorts, more successful students (Cohort A) utilized more capital overall (average of 15.67 unique capitals) than less successful students (Cohorts B, C, D) (average of 11.5 unique capitals). This may imply that varying student success is less linked to individual asset utilization and more to the use of any combination of strengths at large. This only further suggests that course components should be modified to make the utilization of commonly relied-upon strengths easier, like **social** capital, so struggling students have a more direct path to course success.

Relation to Course Feedback
As seen in Table 2, many successful resources can be closely tracked to student assets, like the relationship between Learning Assistants and Teaching Fellows and **social** capital. Many students referenced this resource as helpful because these guides were personable, and conversations with them were not completely focused on chemistry, but rather felt like comfortable social interactions. The common suggestion to improve discussion worksheets, which are difficult chemistry problem sets students complete in groups, by including step-by-step answer keys is connected to student's **resistant** and **aspirational** capitals, as it suggests a willingness to analyze and grow from failures with the goal of later success in mind. The diversity of perspectives in mixed reviews suggests an overall finding that HMGs possess diverse strengths, which are emphasized by a broad array of course components. This result implies variety is a principal concern when selecting and providing course resources.

Limitations
Quantifying qualitative interviews introduces weaknesses in our insights. Primarily, the number of unique instances of a capital fails to capture to what extent that capital was used. Interviews ranged from 30 minutes to an hour, and while students were never pressured to shorten answers, this interpretation rewards longer responses that cover more strengths with less depth. Additionally, some assets are difficult to quantify at all, like the inductive persistant capital, which conceptually cannot appear in multiple instances.

References
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