Dual Enrollment Students' Perspectives on College-Level Mathematics Instruction

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Dual enrollment (DE) students have simultaneous roles as both high school and college students. DE programs have been utilized to enhance students' access to higher education and post-secondary success. While many studies have focused on the effects of DE programs through quantitative, outcome-oriented frameworks, few studies utilized sociocultural, qualitative approaches to examine DE students' perspectives on their experiences by centering their own voices. Our qualitative case study addresses this need by exploring how three high school students taking a DE Calculus course describe their experiences with college calculus instruction. Student views about the affordances and limitations of college instruction emerged as themes in our study, which have critical implications for undergraduate mathematics education.

Keywords: dual enrollment, college-level instruction, student perspectives, calculus

In the US, dual enrollment (DE) programs, which allow high school students to take college courses, have drawn attention as an educational and policy issue with the goals of enhancing students' college readiness, access to higher education, and interest in pursuing STEM degrees (Cevallos et al., 2016; Hoffman, 2003; Jamieson et al., 2022; Kremers, 2010). Many studies involving DE students focus on the potential benefits of DE programs in relation to these goals through outcome-based approaches (e.g., undergraduate enrollment, matriculation, degree completion, and grade point average measures), often using quantitative perspectives. (e.g., Allen & Dadgar, 2012; An & Taylor, 2019; Blankenberger et al., 2017; Henneberger et al., 2022). While several researchers explored general experiences of US students taking DE college courses such as their adaptation to college environment or self-perceptions as college students (e.g., Cevallos et al., 2016; Kanny, 2015; Karp 2012; Lile et al., 2018), there are relatively few studies examining DE students' experiences with instruction while taking college-level mathematics courses (e.g., Cevallos et al., 2016), particularly through sociocultural and qualitative approaches that bring students' own voices and perspectives to the fore (Ramsey-White, 2012; Williams, 2015). Our research addresses these areas needing more attention by exploring the following research question: How do three high school DE students describe their experiences while taking a college-level calculus course with respect to mathematics instruction?

Theoretical Framework

We use a sociocultural perspective to purposefully frame our work through students' *descriptions* of their experiences rather than framing it via beliefs. While *belief* has been dominantly used as a construct to examine students' views about their experiences and themselves, researchers often treat beliefs as internal, individual, as well as stable cognitive "entities" and predictors of behavior that are detached from social context (Cobb, 2007; Lerman, 2002; Sfard, 2008). Treating beliefs as internal constructs fails to capture the social, discursive, and situated nature of students' practices and experiences (Cobb, 2007; Lerman, 2002). We argue that students' meanings, views, and positions about mathematics, learning, instruction, and themselves always occur within social contexts and are dynamic, contextual, discursive, and participatory rather than merely cognitive (Lave & Wenger, 1991; Lerman, 2002; Sfard et al.,

2001). By privileging student *descriptions* over *beliefs*, we treat talk as a unit of analysis in itself (Edwards, 1993) and align with the sociocultural perspectives that consider what students say not as a window to their inner states but as their evolving discourses and narratives through which they construct meaning (Sfard, 2008). We view students' descriptions and narrations as situated accounts, which are also influenced by students' interactions with us during the interviews, rather than as providing direct access to their internal beliefs about instruction. Consistently, we focus on how three DE students describe and narrate their experiences with their college-level calculus instruction.

Methodology

To examine the students' descriptions of their experiences, we used an exploratory qualitative approach through a case study design (Merriam, 1998). While there are different DE models through which high school students can take college coursework (An & Taylor, 2019; Andrews, 2001), our study focuses on the case in which students take a DE Calculus course (Calculus I) at a college simultaneously with an Advanced Placement (AP) Calculus course at their high school. Focusing our case study on this group of students allowed us to examine their perspectives on college-level instruction while having some prior experiences with calculus.

The three participants, who had dual roles as both high school and college students, were taking a DE Calculus course at a 4-year university called Tech College (pseudonym) located in northeastern US. The DE Calculus course was taught at the Tech College campus and was composed of seven DE students from two local high schools and three traditional college-aged students. All three participants were high school seniors, who had taken DE coursework since 10th grade. Our participants were Billy, Richard, and Catherine (pseudonyms), who all self-identified as Black/African American and attended a high school where 68% of the students were designated as low-income and consisted primarily of students of color. The high school the students were enrolled in offered several advanced coursework options including honors, AP, and DE coursework. The high school utilized DE to provide career-oriented coursework in computer science, engineering, and health sciences. All participants were taking part in the engineering pathway and had previously taken DE mathematics and engineering coursework.

The data we report here is based on two semi-structured interviews conducted with the students individually. The questions in the first interview elicited general information about students' DE program, courses, and overall experiences. The second interview followed up on the student responses to the first interview and provided more information about the experiences they previously mentioned, which resulted in questions related more specifically to mathematics instruction depending on each student's response. For example, if a student mentioned they liked or disliked the instruction in their DE Calculus course during the first interview, we asked the student to elaborate more on this issue during the second interview. Data analysis occurred simultaneously with data collection so that future interview questions could be informed by the prior collected data (Merriam & Tisdell, 2015). Data analysis involved coding the data both deductively and inductively to examine the themes in students' descriptions and narratives (Guest et al., 2012). Due to space constraints, this paper only focuses on the emerging themes about the affordances of and limitations of/barriers associated with DE Calculus instruction because how DE students describe their college-level instructional experiences has critical implications for undergraduate mathematics education.

Findings

Affordances of DE Mathematics Instruction

Learning about applications of mathematical concepts. Participants viewed seeing and learning more about the applications of mathematical concepts as a positive aspect of their DE Calculus instruction.

> *Catherine*: (In) Calculus I, we actually do projects with the stuff that we learn. So, I think the college part of it definitely has more of the aspects of like applying the math, rather than high school, where it's just learning and then seeing if you remember the information to take the tests.

Catherine provided further details about how the inclusion of real-life applications in her DE Calculus instruction helped her appreciate the usefulness and utility of mathematics.

> *Catherine:* The examples and the problems that we're made to solve in Calculus…they were…dealing with like planes and bridges and we were calculating different things that people, especially engineers, use a lot. So, it was good to see math in a practical way and see that it actually is used pretty often.

Similarly, Billy said that taking the DE Calculus course allowed him to "better understand" part of the "fundamentals" of mathematics, an aspect of which was "not knowing just how to solve an equation but knowing how to apply it to the real world." Billy further stated that calculus involved the study of mathematical applications as "calculus ties into basically everything related to engineering." It seemed that, through his exposure to the applications of mathematical concepts during the instruction of his DE Calculus course, Billy started making connections between different disciplines, such as mathematics and engineering. While Richard did not explicitly mention applications of mathematical concepts as a specific affordance of his DE Calculus instruction, he stated that "math is everywhere. I think a lot of people say that but it's just the truth. You need math for everything…math is pretty big in society." We interpret Richard's statement to suggest that he would likely respond positively to instructional approaches that showcased the real-life applications of mathematical concepts in the context of his DE mathematics courses. All participants directly or indirectly indicated that they viewed the focus on applications of mathematical concepts as an affordance of their experiences in the context of DE mathematics instruction, which appeared to have helped them develop a greater appreciation for the usefulness of mathematics, make connections between different disciplines, and learn more about how mathematics can be utilized in real life.

Deeper conceptual understanding of mathematics. Two students' instructional experiences taking DE Calculus seemed to assist them in developing deeper conceptional understanding of mathematics.

> *Billy*: I started to understand how to do math and …(how) a certain concept is the way it is, and not just how to do it…I just understood the fundamentals way more and how to get from A to B and why I'm getting from A to B in this certain way.

Billy elaborated further by stating that taking the DE Calculus course allowed him to go "beyond the world of (routine) problem solving and really seeing why math is that way it is. Like why you do things specifically this way and why and how, if you do it another way, then you know it's not gonna work."

Catherine acknowledged that the instruction in her DE Calculus course made her realize and utilize two types of mathematical skills: the procedural skills "when you see just like an integration sign and a function it's automatic about what you have to do", and the more conceptual mathematical skills, where "they don't just give you these numbers, they give you…a

situation and you have different variables to it…(in) optimization and related rates…you have to paint a literal picture and consider this and this…and you actually have to think about what you have to do." Catherine said she struggled more with the problems involving conceptual skills, jokingly noting that she was "a little traumatized from optimization and related rates", but also noted that she appreciated being exposed to such problems in her DE calculus course, which enhanced her overall understanding of calculus.

Both Billy and Catherine mentioned that the instructional approaches in their DE Calculus course helped them learn how to get from A to B (Billy), why mathematics is the way it is (Billy), paint a larger picture (Catherine), and actually think about what one has to do (Catherine), which are all components of deep and conceptual mathematical understanding (Rittle-Johnson & Siegler, 1998; Skemp, 1987). In addition, these experiences also seemed to help these students distinguish situations involving routine problems (Billy) and automatic applications (Catherine) from those that involve deeper effort and thought, indicating that they were also starting to differentiate between procedural and conceptual understanding.

Although Richard did not directly indicate deeper conceptual understanding through DE Calculus instruction, he noted that his second exposure to calculus concepts in his DE Calculus course (in addition to the AP Calculus course) helped him realize which calculus ideas and topics were important and where he needed to close the gaps in his understanding.

> *Richard*: There would be…this topic we went over in AP Calc and I kind of did not do so good on it. So, the fact that we went over (it) in the dual enrollment class, it kind of made me realize, wow I really need to go over this a ton more.

For Richard, although his DE Calculus instruction might not have led to deeper conceptual understanding, it helped him understand which calculus topics, concepts, and ideas occur again, are important, and where he needs to put more effort to enhance his conceptual understanding.

Limitations of and Barriers Associated with DE Mathematics Instruction

Negative assumptions about and experiences with college instructors. While some of the limitations and barriers mentioned by the students in relation to their DE Calculus instruction were based on their presuppositions, others were related to their actual experiences. All participants entered the DE Calculus course having some negative assumptions about college instructors. Catherine stated she was initially hesitant to enroll in the DE Calculus course until other classmates assured her that the instructor was "nice".

> *Catherine*: (Before taking DE Calculus) I thought if I take this calculus, they're probably not going to be as nice as my AP Calculus teacher but then my two friends that decided to take calculus…I was talking to them, and they were like…the teacher is so nice.

Billy related his viewpoint that his DE calculus instructor was not as lenient and approachable as his high school teachers by saying "it's not like the professor offers a lot of extra credit and a lot of second chances that teachers in high school do. You definitely have to be more careful of how you go about approaching the college calculus." Billy then noted that his perceived need to be more cautious with college instructors prevented him from seeking help from his instructors and said "I'd say, taking college courses, I haven't always asked for help too much."

Richard also stated that he was initially hesitant to ask his DE Calculus instructor for help as college instructors were not nice: "It would just be like me not knowing whether I can ask my college professor for help, because I would feel like college professors aren't really that nice." Richard said his assumption primarily came from the stories he heard from other students when they had negative experiences with their college instructors. In addition to what he heard from

his peers about college professors, Richard further revealed that he enrolled in the DE Calculus course because he was denied from enrolling in a different course he originally wanted to take: "the person who was running the class said they don't want dual enrollment students…. how can you just do that to a whole (group) of kids?" This personal experience, together with the experiences of his peers, likely reinforced Richard's negative views of college instructors. Despite viewing professors as uncaring or unempathetic towards their students, Richard stated that he ultimately became comfortable interacting with his DE Calculus instructor.

> *Richard:* I asked her this one question, she was actually pretty good, nice about it. I just kept asking her more questions and my learning was never stunted…because I felt like I was afraid to ask for help from my professor.

While all participants indicated that they ultimately interacted with their DE Calculus instructor, especially when they needed to ask questions, their assumptions about college instructors based on their own as well as their peers' experiences were initial barriers they had to work through in order to fully participate in the DE Calculus course.

Inability to attend office hours. All students brought up the issue of not being able to attend their DE Calculus instructor's office hours due to the scheduling of their high school courses. Billy and Catherine explicitly stated how scheduling prevented them from attending office hours.

> *Billy*: …office hours, we can't even attend those because it's during high school.
>
> *Catherine*: A difficult aspect of it, though is office hours. Because they're always at 11 am on a Thursday and I'm in (high) school then.

Richard also acknowledged his inability to attend the instructor's office hours and stated that he would work around this limitation by completing his DE Calculus assignments early so that he could ask any questions he had in a class meeting before the assignment was due.

> *Richard*: I would just wait until I had class again and then asked my teacher about it in class to get the additional help. Because I would always prioritize early college work over everything…So I'd always start on (the assignment) early so I had time to ask (the instructor) in class about the work.

Billy said he would utilize outside resources, like online math videos, to get help with calculus since he did not have the opportunity to get assistance from his instructor during office hours.

> *Billy*: I didn't ask for help too much. I think self-studying did help me a lot. Like taking time to use resources outside of class to understand (the course material) and maybe watch some math videos.

Catherine revealed that on the school days in which students did not have the DE Calculus course, the DE students would meet in their high school's library and assist one another as peers.

> *Catherine*: When we don't have class that day, we have like a free hour, which is supposed to be our last block of school, where we're in the library altogether and we take that time to do the homework and also projects (together)…we definitely use each other a lot for support.

While the DE students devised strategies to get around the challenge of not being able to attend their professor's office hours and find ways to get assistance with the DE Calculus material, they were unable to interact with their instructor regularly, which was a barrier to clarifying their questions, getting assistance from, and establishing a rapport with their instructor.

Time- and expectation-related challenges of DE students. During the interviews, the students did not directly attribute this challenge to DE Calculus instruction but mentioned it as a time commitment challenge. However, college instructors might be unaware of time- and

expectation-related challenges often faced by DE students. College instructors' potential unawareness of and lack of accommodation for DE students who operate in two spaces (high school and college) and work with at least two different sets of requirements at once (high school and college mathematics) can hinder their learning opportunities and success. So, we interpret this issue also as a potential pedagogical barrier.

During the interviews, all students expressed their difficulties in meeting the time and effort requirements for their DE studies in addition to their existing high school coursework. Richard said DE coursework was a time commitment as students would need to be transported to the college campus, which resulted in their DE coursework ending in the evening hours.

> *Richard*: You have to take the bus to go to Tech College…(and it's a) time commitment because at the start we literally got at Tech College at like two (p.m.), and then (class) would end at five (p.m.)…It was kind of crazy, honestly… We don't have that much time as high school students, because we have a whole day's worth of work we have to do.

Since the DE students finished their school days late, they had limited time in the evenings to then complete the homework required for all their courses. Billy stated: "Be prepared to set a lot of time aside after school and when you get home to do your college work and do your high school work." While Billy and Richard spoke more generally about the issue of not having enough time after school to do their studies for their coursework, Catherine was more explicit about her struggles:

> *Catherine*: I would get home at six (p.m), I had three AP (classes), and two regular (high school) classes, and (the DE) class, and to get all the homework done from six (p.m) to the time I have to sleep and eat and take a shower and do everything else in the middle of it…I was getting like five hours of sleep.

As expressed by Billy, these time limitations and different requirements of the courses impacted how much time the DE students could dedicate towards their DE Calculus studies and improving their understanding of the mathematics content.

> *Billy*: I was putting in so much work and putting a lot of time outside of class…to understand what's actually going on…It was something that was new to me so I didn't know how to exactly go about approaching the class and the material.

In the context of this theme, Richard mentioned an additional challenge regarding the faster pace of instruction in their DE Calculus course compared to the AP Calculus course, which further complicated catching up with the DE Calculus instruction, content, and assignments: "AP Calculus…they teach at a slower pace than college. So, I think there's more time to get the material." Richard's sentiment about the fast-paced nature of DE Calculus instruction was echoed also by Billy and Catherine, who said the DE Calculus course "is definitely faster, and it covers a lot more". The pacing of the DE Calculus instruction added another layer of complexity regarding students' time commitments as they needed to understand more material faster to meet the requirements of their DE Calculus course.

Discussion

Our findings help illuminate some affordances of college DE Calculus instruction when students have concurrent calculus instruction in their high schools. In particular, by taking the DE Calculus course, our participants stated that they enhanced their conceptual understanding of mathematics, studied calculus concepts more deeply, and targeted their studies to the topics with which they still struggled. Moreover, since the DE Calculus course included the study of mathematical applications, the students viewed calculus as useful in everyday life and made connections to other fields such as engineering. On one hand, this type of DE model (where

students take a calculus course at a high school and college concurrently), might be seen as wasteful in terms of institutional resources and students' time since students are essentially taking the same coursework twice. On the other hand, our findings indicate that there might also be some benefits to this type of DE model in terms of improving mathematical understanding of calculus, making connections, and appreciating the utility of mathematics.

Our participants also highlighted certain barriers impacting how they carried out their college mathematics coursework and limited their opportunities to seek assistance from their DE Calculus instructor. Typical systems utilized to support college students, such as office hours, were completely inaccessible to the DE students due to the time periods in which they were scheduled to be on the college campus. Our findings have implications with respect to the instructional practices utilized in DE mathematics courses offered at universities. Colleges and instructors offering DE coursework need to devise solutions and find ways to accommodate the needs of DE students to provide equitable access to course assistance and content support services. For instance, post-secondary institutions could develop agreements with their high school partners that DE students must have regularly scheduled time on the college campus to utilize college support services like tutoring centers. College instructors teaching DE students could structure their office hours so that they are more accessible to DE students such as offering evening or weekend office hours via video conferencing technologies.

Our findings also reveal the importance of college instructors' roles in building positive rapport with DE students to help students overcome any negative presuppositions they may hold towards college instructors and assist students in feeling more comfortable interacting with their college professors. One way college instructors can help build positive student rapport would be to acknowledge the time limitations that DE students face and work with them to help minimize any challenges in relation to DE coursework. For instance, college instructors might restructure assignment due dates so that they occur on weekends or some other day that is more accommodating of their DE students' schedules.

It is also important for college instructors to acknowledge that DE students have to balance various demands of high school and college courses. If college instructors do not recognize this challenge, are not willing to accommodate the students, and are inflexible, they might unintentionally create barriers for DE students' mathematical learning and success. This, together with potential emotional and physical burnout DE students can experience in the process, would negate the intended goals of DE programs and mathematics courses to provide students with enhanced access to higher education.

While some findings of this study align with the results from prior research such as DE students reporting difficulties in balancing their DE coursework and their high school courses (Lile et al., 2018) and taking DE coursework supporting students' time management and other study skills (Felder, 2020; Karp, 2007; Ramsey-White, 2012), some findings require more examination. Further questions to think about include: what specific aspects of DE Calculus instruction assist students in developing conceptual understanding of mathematics? How can college mathematics instructors develop instructional practices that would make DE students feel more welcome and feel a sense of belonging in their college courses? What are the additional needs of DE students taking college mathematics courses to feel emotionally and academically supported to achieve the aims of their DE programs in terms of access to higher education and interest in pursuing STEM degrees? A key issue our study underlines is the need to examine such questions through more studies that prioritize students' own voices and perspectives.

References

Allen, D., & Dadgar, M. (2012). Does dual enrollment increase students' success in college? Evidence from a quasi-experimental analysis of dual enrollment in New York City. *New Directions for Higher Education*, *2012*(158), 11-19.

An, B. P., & Taylor, J. L. (2019). A review of empirical studies on dual enrollment: Assessing educational outcomes. *Higher Education: Handbook of Theory and Research, 34*, 99-151.

Andrews, H. A. (2001). *The dual-credit phenomenon! Challenging secondary school students across 50 states*. New Forums Press, Inc.

Blankenberger, B., Lichtenberger, E., & Witt, M. A. (2017). Dual credit, college type, and enhanced degree attainment. *Educational Researcher*, *46*(5), 259-263.

Cevallos, L., Cevallos, P., & Webster, K. (2016). College readiness through an innovative concurrent enrollment program for underrepresented college bound students. *Journal for Leadership, Equity, and Research*, *3*(1), 1-13.

Cobb, P. (2007). Putting philosophy to work: Coping with multiple theoretical perspectives. In F. K. Lester, Jr. (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 3–38). Information Age Publishing.

Edwards, D. (1993). But what do children really think?: Discourse analysis and conceptual content in children's talk. *Cognition and Instruction, 11*(3/4), 207-225.

Felder, K. (2020). *An analysis of dual enrollment program experiences from the perspective of high school students in central & southwest Ohio* [Doctoral dissertation, Concordia University Chicago]. ERIC.

Guest, G., MacQueen, K. M., & Namey, E. E. (2012). *Applied thematic analysis*. Sage publications.

Henneberger, A. K., Witzen, H., & Preston, A. M. (2022). A longitudinal study examining dual enrollment as a strategy for easing the transition to college and career for emerging adults. *Emerging Adulthood*, *10*(1), 225-236.

Hoffman, N. (2003). College credit in high school: Increasing college attainment rates for underrepresented students. *Change: The Magazine of Higher Learning*, *35*(4), 42–48. https://doi.org/10.1080/00091380309604110

Jamieson, C., Duncombe, C., Bloomquist, L., Mann, D., & Keily, T. (2022, June 21). *50-State comparison: Dual/Concurrent enrollment policies*. Education Commission of the States. Retrieved August 22, 2025, from https://www.ecs.org/50-state-comparison-dual-concurrent-enrollment-policies/

Kanny, M. A. (2015). Dual enrollment participation from the student perspective. *New Directions for Community Colleges*, 169, 59-70.

Karp, M. M. (2007). *Learning about the role of college student through dual enrollment participation*. (Working Paper No. 7). Community College Research Center. https://academiccommons.columbia.edu/doi/10.7916/D8TF05G9/download

Karp, M. M. (2012). "I don't know, I've never been to college!" Dual enrollment as a college readiness strategy. *New Directions for Higher Education*, *2012*(158), 21-28.

Kremers, A. L. (2010). *The effect of advanced placement and concurrent enrollment on postsecondary math achievement* [Doctoral dissertation, University of Arkansas at Little Rock]. ProQuest.

Lave, J. and Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.

Lerman, S. (2002). Situating research on mathematics teachers' beliefs and on change. In G. C. Leder, E. Pehkonen, & G. Törner (Eds.), *Beliefs: A hidden variable in mathematics education?* (pp. 233–243). Kluwer Academic Publishers.

Lile, J.R., Ottusch, T.M., Jones, T., & Richards, L.N. (2018). Understanding college-student roles: Perspectives of participants in a high school/community college dual-enrollment program. *Community College Journal of Research and Practice, 42(2)*, 95-111.

Merriam, S. B. (1998). *Qualitative research and case study applications in education. Revised and expanded from "case study research in education".* Jossey-Bass Publishers.

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation* (Revised and expanded Edition). Wiley.

Ramsey-White, K. (2012). *Exploring college readiness: Self-perceptions of early college students* [Doctoral dissertation, Georgia State University]. Scholarworks. https://doi.org/10.57709/2764752

Rittle-Johnson, B., & Siegler, R. S. (1998). The relation between conceptual and procedural knowledge in learning mathematics: A review. In C. Donlan (Ed.), *The development of mathematical skills* (pp. 75-110). Psychology Press.

Sfard, A. (2008). *Thinking as communicating: Human development, the growth of discourses, and mathematizing*. Cambridge University Press.

Sfard, A., Forman, E., & Kieran, C. (2001). Learning discourse: Sociocultural approaches to research in mathematics education. *Educational Studies in Mathematics, 46*(1/3), 1-12.

Skemp, R. R. (1987). *The psychology of learning mathematics*. Lawrence Erlbaum.

Williams, M. (2015). *An early taste of college: A closer look at dual enrollment at Shasta College among students at Anderson Union High School District* [Doctoral Dissertation, University of California, Davis]. ProQuest.