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The Role of AP & Concurrent Courses on Student Postsecondary Outcomes, Out-of-state Choice, and College Selectivity

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Abstract:

Literature on Advanced Placement (AP) and dual or concurrent enrollment (CE) courses shows that entry to and completion of these rigorous courses can increase students' cognitive and non-cognitive outcomes. Issues of equity remain as White students and students from more affluent backgrounds tend to enroll in these courses at much higher rates than minoritized students and low-income students. Arkansas implemented a universal policy mandating all school districts provide access to AP and CE courses. Within this context, we investigate the relationship between enrollment in these courses and student postsecondary outcomes. Despite universal access, we find that enrollment in AP or CE courses still varies across students' demographic backgrounds. However, the findings also highlight improved postsecondary outcomes for many students across multiple demographic groups, especially students with high prior achievement.

Keywords:

Advanced Placement; dual and concurrent enrollment; college attendance; college and career readiness; selective colleges

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I. Executive Summary

Advanced Placement (AP) and dual or Concurrent Enrollment (CE) courses provide high school students with an opportunity to take rigorous coursework in multiple subject areas. The general goal of AP & CE courses is to introduce learners to college-level learning opportunities that support student college readiness. Issues of equity remain as White students and students from more affluent backgrounds tend to enroll in these courses at much higher rates than minoritized students and low-income students.

Arkansas implemented a universal policy mandating all school districts provide access to AP and CE courses. Within this context, we investigate the relationship between enrollment in these courses and student postsecondary outcomes and find several important findings. First enrollment in either AP or CE was determined by students' educational status, gender, race/ethnicity, rurality of the schools as well as their past achievements in ELA, math, and science. Second, enrollment in any AP or CE during high school was associated with greater college attendance by about 20 *pp* and 22 *pp*, respectively ($p <.01$). Enrollment in any AP courses increased the likelihood of being a STEM major by about 7 *pp* ($p <.01$). We did not observe similar significant results for CE. Third, high school students who took at least one AP course had a higher likelihood of attending a four-year institution by about 21 *pp* ($p <.01$) than those without AP. This relationship was slightly higher for CE, 22 *pp* ($p <.01$). We did not observe any significant results for two-year institutions for either AP or CE. Fourth, for types of postsecondary institutions, all else equal, enrolling in at least one AP course in high school was associated with a higher likelihood of attending in-state institutions by about 17 *pp* ($p < .01$) than high schoolers with no AP and it was even higher for those who took at least one CE, 21 *pp* ($p < .01$) but these estimates differed by racial/ethnic groups. Moreover, students who took at least one AP course in high school had a higher likelihood of attending out-of-state institutions than those who did not take any AP by about 4 *pp* ($p < .01$) but it was only about 1 *pp* higher ($p < .1$) for those who took at least one CE course. We also found that only AP courses and not CE courses were associated with an increase in enrollment in selective schools. Lastly, despite having a universal access policy in Arkansas, enrollment in AP and CE varied by student groups. For instance, by comparing G/T or academically advanced students across socioeconomic status level, we found that despite being academically advanced, low-income G/T students were less likely to attend both any postsecondary institutions and 4-year institutions by 13 *pp* ($p < .01$), 6 *pp* ($p < .05$) for top schools, and 10 *pp* ($p < .05$) for in-state institutions. We provide policy implications based on these results.

II. Literature Review

Advanced Placement (AP) and dual or concurrent enrollment (CE) courses

AP and dual or CE courses provide high school students with an opportunity to take rigorous coursework in multiple subject areas. The general goal of AP courses is to introduce learners to college-level learning opportunities that support student college readiness. After completion of AP coursework, students who take the AP examination and obtain a score three or above can typically be awarded college credit (College Board, n.d.). Similarly, CE enrollment allows students to experience college coursework and obtain college credit (National Alliance of Concurrent Enrollment Partnerships, NACEP, n.d.). AP and CE courses cover challenging subject content in the social sciences, humanities, as well as science, technology, engineering, and math (STEM).

There is evidence supporting the effectiveness of AP and CE courses on improving student outcomes. For example, several studies have documented that enrollment and completion of AP and CE courses was associated with student academic success and career aspirations (Conger et al., 2023; Ebrahiminejad et al., 2021; Jackson, 2010). However, course availability, instruction quality, AP exam participation, equity, and inclusion remain obstacles to fully understanding the effectiveness of these courses in the transition from high school to college (Graefe & Ritchotte, 2019; Meyer et al., 2023; Ricciardi & Winsler, 2021; Ritchotte et al., 2016; Sparks, 2023; Xu et al., 2021).

AP, CE and academic outcomes

AP and CE courses are recognized for the potential to enhance students' academic outcomes (Jones, 2014; Warne, 2017; Warne et al., 2015). AP and CE curriculum often requires learners to engage with greater content complexity than the typical high school curriculum. Advanced content may challenge learners to use higher order thinking skills such as analytical or general reasoning, critical thinking, and creative problem solving (Conger et al., 2021, 2023). Besides achievement outcomes, these courses may also enhance student motivation, self-efficacy, self-concept, and self-regulation (Bryan et al., 2011). The confidence gained from successfully completing challenging coursework can lead to increased motivation and a greater willingness to pursue new and difficult subjects. For example, Malpass et al. (1999) found that students in AP classes developed positive ability beliefs and personal interest in response to the challenging content. Since one goal of AP courses is to prepare learners for the demands of college academics, these courses also enhance student persistence (Jones, 2014) and self-regulatory skills such as planning, goal setting, and time management (DiBenedetto, 2018; DiBenedetto & Zimmerman, 2013). These skills are essential preparation for the complex and demanding higher education academic environments.

Results on the positive effects of participating in AP and CE courses on academic achievement are consistent (Sadler, 2010). Multiple sources of observational and experimental evidence suggest that AP and CE have a positive association with higher academic performance as demonstrated by GPA, class rank (Jones, 2014; Wehde-Roddiger et al., 2012), and academic growth among high achieving students (Wai & Allen, 2019). Moreover, research shows enrollment in AP and CE courses supports post-secondary outcomes (Bleske-Rechek et al., 2004; Conger et al., 2023; Warne et al., 2015; Xu et al., 2021). In one study, AP and CE participation predicted elevated participation performance on the ACT and SAT (Kettler & Hurst, 2017). In an experimental design, learners in AP courses took college admission tests at higher rates than their counterparts (Jackson, 2010). In turn, higher ACT and SAT scores are associated with the type of college students enroll in and indicators of college success such as first semester GPA, retention, and on time graduation (Kuncel et al., 2004; Scott et al., 2010) as well as longer-term outcomes (Makel et al., 2016; Park et al., 2007). Students who participate in AP and CE courses can potentially graduate earlier from college. By earning college credits through these courses, they can reduce the number of courses needed to complete college, saving both time and money (Curry et al., 1999). This can be particularly beneficial for students who wish to pursue advanced degrees or enter the workforce sooner (Henneberger et al., 2022).

Debates about the effectiveness of AP courses beyond high school graduation note that enhanced outcomes are not necessarily related to AP enrollment alone, but in fact, related to taking and passing AP examinations (Finn & Scanlan, 2019; Graefe & Ritchotte, 2019; Warne, 2017), or related to the dosage of AP along with other experiences (Wai et al., 2010; Wai & Allen, 2019). Chajewski and colleagues (2011) examined a nationally representative sample of 1.5 million students and found AP and CE participants were more likely to attend college and graduate on time compared to their counterparts. Warne and colleagues (2015) also found that students with AP course participation (but not sitting for the test) had lower raw score gains on the ACT English subtest compared with students who took the AP exam. Taking the test and passing may better reflect competence or achievement, thus increasing students' chances of being admitted to competitive colleges and universities and providing them with even more opportunities to excel academically.

AP, CE courses and STEM interest

Fostering enrollment and retention of students in college Science, Technology, Engineering and Mathematics (STEM) disciplines is a common policy goal as educating more students in STEM areas can have individual and societal benefits (Buxton, 2001; National Science Board, 2010). Promoting STEM education has held consistent global and historical interest (Wai, 2023). The progress of countries depends on technical knowledge and information, which is often achieved through the development of STEM areas (Kärkkäinen & Vincent-Lancrin, 2013; Kier et al., 2014).

The type and number of courses students take in high school can predict their post-secondary career interests and outcomes (Bryan et al., 2011; Sadler et al., 2014; Wai et al., 2010). As the availability of STEM AP and CE courses has increased over the last decade, researchers have investigated whether AP and CE courses (and which types) might influence student career paths (Sadler, 2010; Sadler et al., 2014; Warne et al., 2019). Research by Bryan and colleagues (2011) showed that learners taking AP science courses exhibited deep personal interest to major in science compared to students who did not take AP courses at all. Results from a quasi-experimental design by Corin and colleagues (2020) indicated that simultaneous AP and CE enrollment is an effective intervention to increase STEM career interests in students of all demographic backgrounds above and beyond the effect of AP enrollment alone.

Despite positive findings supporting the link between precollegiate STEM coursework and STEM careers, the mechanism and consistency of the role of AP and CE in this relationship remains unclear. For example, Warne et al. (2019) found negligible effects of enrollment in AP calculus on learners' desire to major in STEM after controlling for student characteristics and prior interest in STEM. Rather than promoting interest, it seems AP enrollment might be due to preexisting levels of high STEM interest. AP and CE courses may also increase existing interest in a domain. Taking a broader longitudinal view, the quality and quantity of STEM experiences or the dosage of STEM AP, CE, or a variety of other academic challenges on post-secondary and career outcomes may matter more than any individual intervention (Wai et al., 2010). Wai and colleagues (2010) showed that an increased dosage of rich STEM learning opportunities predicted sustained interest and performance in STEM majors, doctoral degrees, occupational outcomes, patents, and beyond. This early exposure can help students make more informed decisions about their academic and career paths, ensuring that they are better prepared for the challenges they will face in college and their careers.

AP and CE courses may provide the challenge and scaffolding necessary for success in STEM majors (Turner & Lapan, 2005). Findings from Henneberg et al. (2020) show that CE courses can sustain learner motivation and self-efficacy, often facilitating the transition to post-secondary institutions, which may in turn increase perseverance and retention in STEM programs. This persistence is particularly important in STEM fields, where students may encounter complex concepts and problems that require significant effort and dedication to master. Students who engage in AP and CE courses often demonstrate persistence and resilience, which are crucial for success in challenging STEM disciplines. These qualities can help students overcome setbacks, maintain their motivation, and continue working towards their goals, even in the face of difficulty.

AP, CE courses and gifted education

Although AP and CE courses are offered to a wide variety of learners, AP and CE can play an important role in talent development for gifted and talented students (Bleske-Rechek et al., 2004; Finn & Scanlan, 2019; Wai & Allen, 2019). AP and CE courses provide this population of students with intellectually challenging content and structured instruction matched to their learning rates. Researchers in gifted education recommended AP and CE courses as a suitable program accommodation for students identified as gifted and talented (Assouline et al., 2015; Curry et al., 1999; Graefe & Ritchotte, 2019; Van Tassel-Baska, 2001; Wai et al., 2010). These courses can complement and enrich the offerings of gifted education programs by expanding access and opportunity to advanced coursework, college credit, and exposure to a broader academic community. In a survey of representative school districts across the U.S., 90.7% of respondents identified AP programs as the most common program type offered to gifted and talented high school students (Callahan et al., 2017). More importantly, in these courses gifted and talented high schoolers can engage with intellectual peers enhancing their academic, aspirational, and socioemotional development and explore college-level coursework while still in high school (Almarode et al., 2014; Olszewski-Kubilius, 2009), which ultimately can lead to greater achievement (Subotnik et al., 2011). Given the range of learning needs among the gifted, however, some scholars have noted that the rigor of AP coursework and performance on AP tests has likely decreased over time (Lichten, 2000; Warne, 2017).

Equity and fairness

Although AP and CE courses can be beneficial, these interventions, like many others, receive criticism regarding issues of equity and inclusion (Klopfenstein, 2004; Moreno et al., 2021; Museus et al., 2007; Ricciardi & Winsler, 2021). According to Ebrahiminejad and colleagues (2021), AP courses favor mostly White, urban, affluent students, and male students compared to rural, low income, students of color, English language learners (ELL), and females. A nationally representative study linking data from the Office of Civil Rights, Common Core Data, and the Integrated Postsecondary Education Data System revealed persistent racial/ethnic gaps in student participation in CE and AP enrollment (Xu et al., 2021). The researchers found that across the U.S., White students were more likely to participate in AP courses than African Americans (9.8%) and Hispanics (6.9%). These gaps were nearly twice as large as existing gaps in CE courses (Xu et al., 2021). Although AP and CE enrollment may enhance college aspirations, an experimental design applied in 23 schools and with 1,809 students enrolled in AP science courses showed that learners from underserved groups were still less likely than more affluent and White students to pass AP exams and to enroll in selective colleges (Conger et al., 2023).

AP and CE prerequisites are commonly cited as factors reducing access to enrollment. Requirements for enrollment vary across schools including minimum test-scores, teacher recommendation, and GPA prerequisites, which may be barriers for marginalized students to participate in AP or CE courses (Ricciardi & Winsler, 2021). In a longitudinal analysis of AP gaps, Kettler and Hurst (2017) showed prior achievement was the core individual factor affecting marginalized student enrollment. Moreover, the question of access has been expanded to a question of access plus selection. In schools with open AP and CE enrollment, even after controlling for prior achievement, elementary school performance, and income, African American students were less likely to enroll in AP coursework (Ricciardi & Winsler, 2021).

Contextual factors related to inequity depend on the degree of diversity within school districts, age, and quality of the AP program. Schools with a majority enrollment of White students report higher intent to take the AP exam and offer a broader range of AP courses than schools that have larger proportions of minority students (Cisneros et al., 2014). Conversely, Xu and colleagues (2021) found reduced gaps in intent to take AP exam in schools with higher student diversity, greater offerings of AP courses, and proximity to higher education institutions. Despite the reduced AP enrollment and outcomes for marginalized students broadly, Graefe and Ritchotte (2019) found that positive environmental support and an open access policy jointly reduced disparities for enrollment and AP exam success for Hispanic students. Similarly, programs emphasizing culturally responsive pedagogies and care for minority learners can enhance AP course participants' motivation and confidence for success while exposing students to interest-based enrichment and accelerated coursework (Swanson & Nagy, 2014).

AP and CE in Arkansas

According to Arkansas Code (005.22.04 Ark. Code R. § 002), all school districts are required to offer at least one AP course in math, science, English, and social studies (McKenzie

& Ritter, 2005, 2016). The Act 102 mandate introduced in 2003 increased AP and CE enrollment of students from traditionally underrepresented and underserved populations. Additionally, the state covers the entire AP test cost for home-schooled and public-school students enrolled in an AP course and who wish to take the AP test ranging from $50 - $80 per AP exam depending on the subject. For comparison, few states provide financial aid for AP exams for students eligible for free and reduced-price lunch, and only two other states, North and South Carolina, provide total financial aid to public-school students taking the AP examination. In Arkansas, about one quarter of all high school students enroll in an AP course. Nearly 90% of these students take the corresponding AP examination (McKenzie & Ritter, 2016). One study argued the universal access policy has resulted in significant performance gains for Arkansan students (McKenzie et al., 2020). AP examination pass rates have increased since 2003 for underserved students, specifically Hispanic (from 2% to 9%) and low-income learners (8% to 24%). Moreover, all demographics, with the exception of Black students, had significant performance gains on the ACT compared to students who did not enroll in AP coursework (McKenzie et al., 2020).

The overall landscape for state equity has improved since all high school in Arkansas are required to offer four AP classes, one in each core area – English, math, science and social studies. College Board (2022) provided detailed AP courses availability scale by dividing the number of schools offering AP courses with total number of schools and present them by students' demographics groups. Based on this report, in 2022, 81% of all Arkansas public high schools offered at least one AP STEM class compared to the 60% national average (College

Board, 2022). Arkansas policy encourages equity in AP participation through covering the cost and providing universal access, but further improvement remains gradual. In 2022, 22% of all Arkansas students in grades 10-12 took an AP examination (College Board, 2022), with overall growth of 2% over the last decade. On average, Arkansas students' AP scores have had a moderate increase, (2.1 points in 2012 to 2.4 in 2022). In the same period, there was positive average growth in mean scores for Asian students (2.6 points in 2012 to 3.0 in 2022), and White students (2.2 points in 2012 to 2.5 in 2022). Gains for traditionally underrepresented populations were modest: Hispanic students (2.0 points in 2012 to 2.2 in 2022), and African American students (1.5 points in 2012 to 1.7 in 2022). Other demographics such Native American students and multiracial students did not show change in the average AP scores between 2012 and 2022. Thus, continued efforts may be needed to address equity gaps in AP participation and performance, particularly among underserved students.

Two studies have examined the impact of the 2003 Arkansas policy mandate on graduation and college enrollment rates (Arce-Trigatti, 2014; Taylor & Yan, 2018). By the 2008-09 school year, the policy had increased the likelihood of high school completion for all Arkansas student groups (Arce-Trigatti, 2014). However, the average gains on ACT and SAT scores were negligible. Arce-Trigatti (2014) reported benefits for White and Hispanic students; increased enrollment but lower college retention rates for African American students; and a positive impact for female learners of all ethnic groups. Taylor and Yan (2018) found in a sample of 37,302 Arkansas students that enrolling in AP or CE courses significantly predicted college enrollment and retention especially the first year after high school graduation. Moreover, students enrolled in both AP and CE courses were more likely to remain enrolled than students who only took AP courses.

With 22% of high schoolers taking AP examinations in 2022, Arkansas ranks among the top 10 states with the largest AP participation—with similar proportions to Illinois, Connecticut, New Jersey, and Maryland (College Board, 2022). Additionally, Arkansas's universal access to AP courses and test fee waiver offers a unique opportunity to examine policy effects on long-term student outcomes. Thus, research on a variety of outcomes is needed to continually measure the longitudinal effects of AP and CE enrollment, as well as AP examination scores and passing rates, as well as the variability in student outcomes due to AP and CE program quality (Zinth & Taylor, 2019).

III. Research Questions and Hypothesis

The present study seeks to understand the impact of AP and CE courses in Arkansas, particularly in relation to equity and post-secondary outcomes. Our research questions are as follows:

1. What are the demographics and factors associated with enrollment in AP and CE high school courses?
    a. Are there any differences between students enrolled in STEM courses and in non-STEM courses?

2. How does enrollment in AP or CE courses impact student enrollment in any post-secondary institution and the type of major students choose (i.e., STEM, non-STEM)?
    a. Does it differ by the number of STEM courses (dosage) taken?
3. How does enrollment in AP or CE courses associate with student enrollment in different types of postsecondary institutions (4-year vs. 2-year; in-state vs out-of-state) as well as selective post-secondary institutions?
    a. Does the dosage of these courses modify these relationships?
4. Are there any heterogeneous effects across groups on postsecondary enrollment, college selectivity, and types of postsecondary institutions attended?

Hypotheses:

Hypothesis I: Demographic characteristics shape the likelihood of a student enrolling in AP or CE high school courses, especially those in STEM.

Hypothesis II: Students enrolled in AP or CE courses are more likely to go to college and major in STEM, with this relationship being influenced by type of course taken.

Hypothesis III: Access to AP or CE courses influences the type of postsecondary institution chosen and is driven by the number of (or dosage of) AP and CE courses taken.

Hypothesis IV: Moderating factors such as socioeconomic status, race/ethnicity, and gender significantly alter the effects of enrollment in and dosage of AP and CE courses on students' postsecondary attendance and major choice.

IV. Methods

Data and Sample

To empirically test our hypotheses, we utilized several data sources from the Arkansas Department of Education (ADE), the National Student Clearinghouse (NSC), and the U.S. Census Tract. All data sources were restricted to 2014-2019, where data was systematically available. ADE data contained anonymized individual details on students' demographics such as gender, race/ethnicity, gifted and talented status (G/T), English Language Learner status (ELLs), and participation in the free or reduced-priced lunch program (FRL), a proxy for students from low-income backgrounds. This data also contained information about students' prior achievement from several sources of state-required standardized assessments such as the ACT Aspire (used from 2015-2019) and the Partnership for Assessment of Readiness for College and Careers (PARCC), a state-issued standardized test in Arkansas (used only in 2014). Scores were available on English Language Arts (ELA), mathematics, and science subtests. All scores were standardized for comparison purposes across assessments. We also used students' transcript information which included high school courses students took from grades 9 through 12. For this study, we focused only on AP and CE courses for which students could receive college credit. We also identified whether the courses taken were STEM or non-STEM courses given the prior literature focused on STEM AP or CE courses. Prior STEM focused literature makes the distinction between pSTEM (physical science, technology, engineering and math) and STEM, which also includes social sciences and life sciences in the categorization (Ceci et al., 2014;

Miller & Wai, 2015). In this study, we define pSTEM as any course under physical and life sciences, technology, engineering and mathematics disciplines and excluding social science disciplines due to missing data. The National Student Clearinghouse (NSC) data was also merged with ADE data. NSC data is a national student-level college-going dataset that provides information about postsecondary institutions attended by high school graduate, including their types and majors. We used the U.S. Census Tract data as an identifier for the urbanicity of school districts. By merging all these data sources, we developed a relatively comprehensive student-level database with information on demographics, achievement, high school courses, and postsecondary outcomes. We obtained over 900,000 observations in our complete dataset.

Descriptive Statistics

Table 1 contains information about student descriptive statistics. Table 1 shows about 7% of students were identified as ELLs from 2014 to 2019 (equal numbers of males and females). Most students (56%) participated in Free or reduced Lunch (FRL) program. About 12% were G/T and 10% as ELL students. Most students were White (63%), with 21% Black, 11% Hispanic, 2% Asian, 2% more than one race, and 1% Native American/Native Hawaiian or Pacific Islander. Fifty seven of students attended urban school districts. Table 1 shows student baseline scores in ELA, math, and science as well as more complete demographic data.

Table 1 Student demographic characteristics (2014-2019)

Variable	Observations	Percent
Educational characterization	966,161	
ELL status		7
Female		50
Free or Reduced Lunch (FRL) status		56
Gifted and Talented (G/T) status		12
Multilingual students		10
Race and Ethnicity	966,161	
Asian		2
Black		21
Hispanic		11
White		63
More than one race		2
Native American/ Hawaiian, Pacific Islander (Other)		1
School district urbanicity	959,876	
Rural		43
Urban		57

Note: We have missing data for G/T indicator in one of the cohorts. Multilingual students refer to students who speak one or more languages than English.

Table 2 provides descriptives of explanatory variables. Table 3 shows enrollment in AP or CE by demographic characteristics and Table 4 provides descriptives of outcomes. Table 2 shows 30% of students took at least one AP course at some point in grades 9 through 12, and 3% took four or more AP courses. By AP course type, 3% of all Arkansas students from 2014-2019 took at least one pSTEM AP course. About 24% of students took CE or dual enrollment courses and earned college credits. Two percent of high school students took five or more CE courses. Three percent took at least one STEM CE course. As seen in Table 3, the enrollment rates of AP and CE varied across groups with female, non-FRL, urban and White students having higher participation.

Table 2 Descriptive statistics: Explanatory variables

Variable	Observations	Percent
Advanced Placement (AP) courses	966,161	
At least take one		30
Take four or more (Top 1% of total AP taken)		3
AP Science, Technology, Engineering & Math (STEM)		3
Concurrent Enrollment (CE) courses	966,161	
At least take one		24
Take five or more (Top 1% of total concurrent courses)		2
CE STEM		3
Simultaneous AP and CE courses	966,161	
Took both at least one AP and CE courses		10
Took either at least one AP or one CE course		34
Took no AP or CE courses at all		60
Took both at least one AP and CE courses STEM		3

Table 3 Percent of enrollment in AP or CE by demographic characteristics

Variable	**≥ 1 AP**	**≥ 1 CE**	**AP & CE**	**≥ 1 AP STEM**	**≥ 1 CE STEM**	**AP & CE STEM**	**No AP or CE**
Educational characterization							
ELL students	6	3	2	4	3	2	9
Non-ELL students	94	97	98	96	97	98	91
Female	59	57	62	55	58	61	44
Male	41	43	38	45	42	39	56
FRL students	42	40	34	38	39	35	66
Non FRL students	58	60	66	62	61	65	34
G/T students	26	23	32	33	23	34	04
Non-G/T students	74	77	68	67	77	66	96
Race and Ethnicity							
Asian	3	1	2	4	1	2	1
Black	15	9	9	13	9	8	27
Hispanic	12	8	8	10	8	8	12
White	67	79	78	70	79	80	57
More than one race	2	2	2	2	2	2	2
Other(PI, NA, Hawaiian)	1	1	1	1	1	1	1
School district urbanicity							
Rural	38	50	45	40	50	49	44
Urban	62	50	55	60	50	51	56
Number of observation (n)	292,112	230,968	97,966	150,050	145,243	30,855	541,047

*Note: * AP & CE* indicate that students took at least one AP and one CE course in high school while *AP & CE STEM* means the student took at least one STEM AP and at least one CE STEM course in any point in high school.

For outcome variables (see Table 4), about 59% of high school graduates in Arkansas enrolled in college between 2014-2019, and 30% of students in our analyses majored in STEM. Of those who attended postsecondary institutions, the vast majority of students attended 4-year colleges (84%) compared to 2-year (16%) and attended in-state (89%) versus out-of-state (11%) institutions.

Table 4 Descriptive statistics: Outcome variables (N = 966,161)

Variable	Observations	Percent
Postsecondary institution type		
2-year	90,807	16
4-year	476,731	84
In-state	505,109	89
Out-of-state	62,429	11
College going and major		
Attend any postsecondary institution	567,538	59
pSTEM major in 4-year institution	170,261	30
Selective college		
Attended most competitive college	5,678	1
Attended top schools	137.532	24
Attended Ivy league schools	353	0

We followed Barron Index (2015) for college selectivity. *Top college or university* are post-secondary institutions rated 1 (most competitive), 2 (highly competitive) and 3 (very competitive) in Baron Index (2015) while *Most competitive college/university* only includes the highest rating (1) in Barron's Index (2015). We exclude schools that are designated as "competitive" (4), "less competitive" (5) and "noncompetitive" (6) from the index. The percentage of students attending Ivy League schools are less than 1% but not entirely 0.

Methodology

We employed both logit and multinomial logit models for research questions 1, 2 and 4 and multinomial logit models for research question 3. The simplified logit model is as follows:

$$\Pr(Y_{it}) = \wedge\ (\beta_0 + X_{it} + \gamma_{it} + \mu_t + \varepsilon_{it})$$

The subscript *i* represents each student in Arkansas in year *t* from 2014-2019. For the first research question, our outcome variables Y_{it} were binary and took the value 1 if student *i* in year *t* took at least one AP or CE / AP STEM or CE STEM course in high school and 0 if otherwise. X_{it} represents a matrix containing students' demographic classifications, including

ELL, G/T, FRL, gender, race/ethnicity, and school urbanicity. Since ELL status for individual *i* might change due to reclassification, we defined student *i* as ELL if they were identified at some point as an ELL student in grades 6-12 and 0 if otherwise. The term γ_{it} represents individual student *i's* standardized lagged achievement scores in ELA, math, and science in year *t* (2014-2019). The term μ_t describes the year-fixed effects accounting for differences observed in each academic year, and ε_{it} captures the unobserved differences in the model.

The second research question employed similar logit models, and is as follows:

$$\Pr(Y_{it}) = \wedge\,(\beta_0 + \beta_1 APConcur_{it} + X_{it} + \gamma_{it} + \mu_t + \varepsilon_{it})$$

The only difference between this and the previous logit model are the outcomes (Y_{it}) and the primary explanatory variable ($APConcur_{it}$). In this model, Y_{it} are binary variables that take the value 1 if student *i* in year *t* attended any postsecondary school after high school graduation / majored in STEM and 0 if otherwise. Moreover, $APConcur_{it}$ represents a binary variable that takes the value 1 if student *i* in year *t* enroll to at least one AP or CE course in high school and 0 if otherwise. The remaining components of the model remain the same as the logit model for research question 1. For research question 3, we used a multinomial logit model since our outcome variables are no longer binary. The simplified form of the multinomial logit model is as follows:

$$P(Y_{it} = j | X_{it}) = \frac{\exp(\beta_j' X_{it})}{\sum_{l=1}^{4} \exp(\beta_l' X_{it})} \quad j = \begin{cases} 4-year \\ 2-year \\ In-state \\ Out-of-state \end{cases}$$

In this multinomial model, we controlled for the same sets of X_{it}, γ_{it}, or μ_t as in the previous models with the same primary explanatory variable of $APConcur_{it}$ as in the second research question. The four outcome variables in this model were four binary variables of types of postsecondary institutions: *4-year, 2-year, in-state,* and *out-of-state.* Each binary variable took the value 1 if student *i* in year *t* attended any of these postsecondary institution types and the value 0 if otherwise. We also ran two multinomial logit models: 1) 4-year vs. 2-year and 2) in-state vs. out-of-state. The baseline category for each model was students who graduated high school but did not enroll in college. For our last research questions, we ran separate logit and multinomial logit models that were identical to the second and third research questions by interacting significant predictors that we uncovered from the first research question. The reported estimates from these logit and multinomial logit models were presented as marginal effects for more accessible interpretation.

V. Results

Who enrolls in AP and CE courses?

We found enrollment in AP or CE courses was largely determined by students' educational status (ELL, FRL, G/T, multilingual status), gender, race/ethnicity, rurality of the schools as well as their past achievements in ELA, math, and science (Table 5). Some characteristics negatively predicted students' likelihood of enrolling in AP and CE courses, including ELL and FRL statuses and other race/ethnicity, including being Pacific Islander or Marshallese. From Table 5, all else equal, on average, being ELL was associated with a lower likelihood of enrolling in at least one AP course (column 1) and at least one CE course (column 2) by about 6 and 10 percentage points (*pp*), respectively. Similar lower likelihoods were observed among FRL students (10 and 8 *pp*, respectively) as well as students who come from the other race/ethnicity category (7 and 24 *pp*, respectively). These estimates were statistically significant at the 99.9% confidence level (p <.001).

Students with a higher likelihood of enrolling in AP or CE courses were categorized as G/T students (18 and 10 *pp*, respectively) and female students (8 and 6 *pp*, respectively). Students' past achievements in ELA, math, and science also positively predicted students' likelihood of having access to AP and CE courses. For instance, each standard deviation (SD) increase in students' ELA score was associated with a 15% SD and 10% SD increase in their likelihood of enrolling in AP and CE courses, respectively. Though still positive, the increases were slightly smaller for math and science than for ELA.

Table 5 Who enrolls in at least one AP and CE (N=219,115)

	(1) AP	**(2)** CE	**(3)** AP STEM	**(4)** CE STEM
ELL	-0.06**	-0.10***	-0.06**	-0.06**
	(0.02)	(0.03)	(0.02)	(0.02)
Female	0.08***	0.06***	0.02***	0.05***
	(0.01)	(0.01)	(0.00)	(0.01)
FRL	-0.10***	-0.08***	-0.06***	-0.06***
	(0.01)	(0.01)	(0.01)	(0.01)
G/T	0.18***	0.10***	0.12***	0.05***
	(0.01)	(0.02)	(0.01)	(0.01)

Table 5 Continued

	(1) AP	**(2)** CE	**(3)** AP STEM	**(4)** CE STEM
Multilingual	0.09***	0.05	0.06**	0.02
	(0.03)	(0.03)	(0.02)	(0.02)
Asian	0.18***	-0.00	0.13***	0.00
	(0.03)	(0.03)	(0.01)	(0.02)
Black	0.05**	-0.11***	0.01	-0.08***
	(0.02)	(0.03)	(0.01)	(0.02)
Hispanic	0.06***	-0.03	0.03**	-0.01
	(0.01)	(0.02)	(0.01)	(0.01)
Two or more races	0.05**	-0.01	0.04***	-0.01
	(0.02)	(0.02)	(0.01)	(0.02)
Other races	-0.07***	-0.24***	0.03	-0.12*
	(0.02)	(0.08)	(0.02)	(0.06)
Rural school district	-0.03	0.08***	-0.01	-0.05**
	(0.02)	(0.02)	(0.01)	(0.02)
ELA standard. score	0.15***	0.10***	0.08***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)
Math standard. score	0.01	0.03**	0.02**	0.02**
	(0.01)	(0.01)	(0.00)	(0.01)
Science standard. score	0.11***	0.06***	0.06***	0.04***
	(0.01)	(0.01)	(0.01)	(0.00)
Pseudo R2	0.15	0.10	0.14	0.08

*Standard errors in parentheses. All models include district fixed effects. *** p<0.001,** p<.01,* p<0.05.*

We also found some student characteristics were only significant in predicting either AP or CE courses but not both. Although they differ in magnitude, higher likelihoods for enrollment to AP was observed among multilingual students or those who spoke more than one language

(9 *pp*), Asian students (18 *pp*), Hispanic students (6 *pp*), or students who identified with two or more races (5 *pp*). All these estimates were statistically significant at p<.001. We did not see the same trends regarding CE courses. For instance, Black students were more likely to enroll in AP by about 5 *pp (p<.01), but* they were less likely to enroll in CE courses by about 11 *pp (p<.001).* Students from rural schools enrolled in CE courses by about 8 *pp* more than students from urban schools (p<.001), but we didn't find the same pattern for AP courses. As seen in Table 5, we found similar patterns for AP STEM and CE STEM courses (columns 3-4). ELL and FRL statuses remained significant predictors associated with students' lower likelihood of enrolling in either AP STEM or CE STEM courses by about 6 *pp* (p<.001). On the other hand, being female, a G/T student, or having increases in past academic achievements in ELA, math, and science was associated with a higher likelihood of students enrolling in AP STEM and CE STEM courses in high school. The likelihood of students enrolling in AP STEM or CE STEM courses also differed across racial/ethnic groups. The remaining details about these results are found in Table 5.

Postsecondary enrollment

We examined the overall relationship between enrollment in AP or CE courses and postsecondary school major, and whether it varied by enrollment in any AP and CE courses (see Table 6) and by STEM dosage for both types of courses (Table 7). Table 6 shows that enrollment in any AP and CE courses during high school was associated with greater college attendance by about 20 *pp* (column 1) and 22 *pp (*column 3*)*, respectively (p <.001), after controlling for student demographic characteristics and prior achievement. In column 2 we see that AP course enrollment increased the likelihood of being a STEM major by about 7 *pp* ($p < .001$). However, we did not observe similar significant results for CE courses (column 4). ELL, FRL, G/T, gender, rurality of school, and student prior achievement were significant moderators that predicted students' likelihood of attending any college and majoring in STEM (with variation of the magnitude of estimates across student characteristics). For instance, on average, being a G/T student, an Asian student, or a Black student was associated with a higher likelihood of attending college and majoring in STEM. In contrast, the opposite applied to ELL students, students who identified with two or more races, and students from FRL backgrounds. Further details can be seen in Table 6.

Table 6 AP and concurrent courses and postsecondary outcomes (N=219,115)

	(1) AP: Any postsecondary attendance	**(2)** AP: STEM major	**(3)** CE: Any postsecondary attendance	**(4)** CE: STEM major
At least one AP	0.20***	0.07***		
	(0.01)	(0.01)		
At least one CE			0.22***	0.01
			(0.01)	(0.01)
ELL	-0.07***	0.00	-0.06**	-0.00
	(0.02)	(0.02)	(0.03)	(0.02)
Female	0.10***	-0.05***	0.11***	-0.04***
	(0.01)	(0.01)	(0.01)	(0.01)
FRL	-0.16***	-0.01	-0.16***	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
G/T	0.14***	0.03**	0.16***	0.05***
	(0.01)	(0.01)	(0.01)	(0.01)
Multilingual	0.02	0.03	0.03	0.03
	(0.03)	(0.03)	(0.03)	(0.03)
Asian	0.17***	0.10***	0.20***	0.11***
	(0.02)	(0.03)	(0.02)	(0.03)
Black	0.06***	0.05***	0.09***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)
Hispanic	0.02	-0.01	0.04***	-0.01
	(0.01)	(0.02)	(0.01)	(0.02)
Two or more races	-0.01	0.01	0.01	0.02
	(0.03)	(0.03)	(0.03)	(0.03)
Other races	-0.19***	0.04	-0.17***	0.04
	(0.04)	(0.06)	(0.04)	(0.05)
Pseudo R2	0.12	0.02	0.13	0.02

*Standard errors in parentheses. We control for achievement data and rural indicator. All models include district fixed effects.*** p<.001,** p<.01,* p<.05.*

Table 7 provides results on the dosage of STEM AP and STEM CE courses on postsecondary attendance and STEM major. Dosage represents each additional AP or CE course taken at some point in high school. We found that each additional STEM AP course taken was associated with a higher likelihood of attending any college by about 16 *pp* (p <.001) (column 1) and nine *pp* (p <.001) for each additional STEM CE course (column 3). Second, each additional STEM AP enrollment was associated with a higher likelihood of majoring in STEM in college by about 10 *pp* (p < .001) (column 2) and two *pp* (p < .05) for each additional STEM CE course (column 4). Third, similar to previous results from Table 6, we found that some student characteristics were significant moderators. Being G/T, Asian, and Black were associated with a higher likelihood of postsecondary attendance or participation in STEM areas. On the other hand, being ELL (7 *pp*, p<.05), FRL (17 *pp,* p<.001), or another race/ethnicity (20 *pp,* p<.001) was associated with a much lower likelihood of college attendance.

Table 7 AP and concurrent STEM courses and STEM major (N=219,115)

	(1) AP: Postsecondary attendance	**(2)** AP: Majoring in STEM	**(3)** CE: Postsecondary attendance	**(4)** CE: Majoring in STEM
STEM AP Dosage	0.16***	0.10***		
	(0.01)	0.01)		
STEM CE Dosage			0.09***	0.02*
			(0.01)	(0.01)
ELL	-0.07*	0.01	-0.08**	0.00
	(0.03)	(0.02)	(0.03)	(0.02)
Female	0.11***	-0.04***	0.11***	-0.04***
	(0.01)	(0.01)	(0.01)	(0.01)

Table 7 Continued

	(1) AP: Postsecondary attendance	**(2)** AP: Majoring in STEM	**(3)** CE: Postsecondary Attendance	**(4)** CE: Majoring in STEM
FRL	-0.17***	-0.00	-0.17***	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
G/T	0.15***	0.02*	0.18***	0.05***
	(0.01)	(0.01)	(0.01)	(0.01)
Multilingual	0.03	0.02	0.04	0.03
	(0.02)	(0.03)	(0.03)	(0.03)
Asian	0.17***	0.07*	0.20***	0.11***
	(0.03)	(0.03)	(0.02)	(0.03)
Black	0.07***	0.05***	0.08***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)
Hispanic	0.03**	-0.01	0.03**	-0.01
	(0.01)	(0.02)	(0.02)	(0.02)
Two or more races	-0.00	0.01	0.01	0.02
	(0.02)	(0.03)	(0.03)	(0.03)
Other races	-0.21***	0.03	-0.20***	0.04
	(0.04)	(0.05)	(0.04)	(0.06)
Rural school district	0.03**	-0.01	0.03**	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)
ELA standard. score	0.10***	-0.01	0.11***	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Math standard. score	0.00	0.03**	0.00	0.03**
	(0.00)	(0.01)	(0.00)	(0.01)
Science standard. score	0.05***	0.05***	0.06***	0.08***
	(0.00)	(0.01)	(0.01)	(0.01)
Pseudo R2	0.12	0.02	0.11	0.02

*Standard errors in parentheses. All models include district fixed effects. *** p<.001, ** p<.01, * p<.05.*

Types of postsecondary institutions

Next, we examined the relationship between AP (Table 8) or CE (Table 9) and whether students attended 2-year, 4-year, in-state, or out-of-state institutions. From Table 8 column 1, all else equal, on average, students who took at least one AP course had a higher likelihood of attending a 4-year institution by about 21 *pp* ($p < .001$). This relationship was slightly higher for CE courses at 22 *pp* ($p < .001$) (see Table 9, column 1). We did not observe any significant results for two-year institutions for either AP (Table 8 column 2) or CE courses (Table 9 column 2). Second, consistent with previous findings, all else equal, enrolling in at least one AP course was associated with a higher likelihood of attending in-state institutions by about 17 *pp* ($p<.001$) than students with no AP (Table 8, column 3) and it was even higher for those who took at least one CE course, at 21 *pp* ($p<.001$) (Table 9, column 3). Third, results from Table 8 column 4 show that students who took at least one AP course had a higher likelihood of attending out-of-state institutions than those who did not take any AP by about 4 *pp* ($p< .001$) but it was only about 1 *pp* higher for those who took at least one CE course (see Table 9, column 4). This may be because CE courses are designed for Arkansas transfer only. Similarly, these estimates differed significantly by racial/ethnic group.

Table 8 AP courses and postsecondary institution types (N=219,115)

	(1)	**(2)**	**(3)**	**(4)**
	4-year	2-year	In-state	Out-of -state
At least one AP	0.21***	-0.01	0.17***	0.04***
	(0.01)	(0.01)	(0.01)	(0.00)
ELL	-0.08***	0.00	-0.07*	0.01
	(0.02)	(0.01)	(0.03)	(0.01)
Female	0.08***	0.02*	0.09***	0.01
	(0.01)	(0.00)	(0.01)	(0.00)
FRL	-0.14***	-0.02*	-0.13***	-0.03**
	(0.01)	(0.01)	(0.01)	(0.01)
G/T	0.16***	-0.04***	0.11***	0.02*
	(0.01)	(0.01)	(0.01)	(0.00)
Multilingual	-0.02	-0.04*	0.05**	-0.03**
	(0.03)	(0.02)	(0.02)	(0.01)
Asian	0.18***	-0.01	0.12***	0.05***
	(0.03)	(0.03)	(0.02)	(0.01)
Black	0.07***	-0.01	0.02*	0.04***
	(0.01)	(0.03)	(0.01)	(0.00)
Hispanic	-0.02	0.04**	0.01	0.01
	(0.02)	(0.01)	(0.01)	(0.00)
Two or more races	0.01	-0.02	-0.03	0.02*
	(0.03)	(0.02)	(0.03)	(0.01)
Other races	-0.19***	-0.01	-0.33***	0.09***
	(0.05)	(0.02)	(0.03)	(0.02)
Rural school district	0.04*	0.00	0.07**	-0.03**
	(0.02)	(0.01)	(0.01)	(0.01)
ELA standard. score	0.08***	0.00	0.08***	0.01
	(0.01)	(0.00)	(0.01)	(0.00)
Math standard. score	0.01	-0.01	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Science standard. score	0.05***	-0.01	0.03**	0.01*
	(0.01)	(0.00)	(0.01)	(0.00)
Pseudo R2	0.11	0.02	0.10	0.10

*Standard errors in parentheses. All models include district fixed effects. *** p<0.001, ** p<0.01, * p<0.05.*

Table 9 CE and postsecondary institution types (N=219,115)

	(1) 4-year	(2) 2-year	(3) In-state	(4) Out-of -state
At least one Concurrent	0.22***	-0.00	0.21***	0.01*
	(0.01)	(0.01)	(0.01)	(0.00)
ELL	-0.08***	0.00	-0.07*	0.01
	(0.02)	(0.01)	(0.03)	(0.01)
Female	0.08***	0.02*	0.09***	0.01*
	(0.01)	(0.00)	(0.01)	(0.00)
FRL	-0.14***	-0.02*	-0.13***	-0.03**
	(0.01)	(0.01)	(0.01)	(0.01)
G/T	0.18***	-0.04***	0.12***	0.03***
	(0.02)	(0.01)	(0.01)	(0.00)
Multilingual	-0.01	0.04	0.06**	-0.02*
	(0.02)	(0.02)	(0.02)	(0.01)
Asian	0.22***	-0.01	0.15***	0.05***
	(0.02)	(0.02)	(0.02)	(0.01)
Black	0.10***	-0.01	0.05***	0.04***
	(0.01)	(0.01)	(0.01)	(0.00)
Hispanic	-0.00	0.03**	0.03**	0.01
	(0.02)	(0.01)	(0.01)	(0.01)
Two or more races	0.03	-0.02	-0.02	0.03***
	(0.03)	(0.02)	(0.03)	(0.01)
Other races	-0.17***	-0.01	-0.31***	0.09***
	(0.04)	(0.02)	(0.03)	(0.02)
Rural school district	0.01	0.00	0.05***	-0.03**
	(0.01)	(0.02)	(0.01)	(0.01)
Pseudo R2	0.11	0.11	0.11	0.11

*Standard errors in parentheses. We control for achievement data. All models include district fixed effects. *** p<.001, ** p<.01, * p<.05.*

Selectivity

Next, we explored the relationship between enrolling in at least one AP or CE course and the likelihood of selective school enrollment. We categorized selective schools into three groups following Barron's index for admission selectivity (2015): *top schools, the most competitive schools, and Ivy League schools.* A full description is in the Table 10 footnote. As seen in Table 10, we found that AP courses but not CE courses were associated with an increase in selective school enrollment. If students took at least one AP course at any point, they had a higher likelihood of enrolling in the top schools by 11 *pp* (p <.001) and 1 *pp* (p<.001) for the most competitive schools than those students who did not take any AP.

As seen in results reported in Tables 11 and 12, we investigated the relationship between each additional AP/CE course taken in high school (dosage) with types of postsecondary institutions students enrolled in. As seen in Table 11, all else equal, each additional AP course taken was associated with a higher likelihood of students enrolling in 4-year institutions by 10 *pp* (p<.001), in-state institutions by eight *pp* (p<.001) and out-of-state institutions by two *pp* (p<.05) (see Table 11, columns 1, 3 and 4). For CE courses, each additional course taken increased students' likelihood of enrolling in 4-year institutions and in-state institutions, both by six *pp* (p<.001) (see Table 11, columns 5 and 7). For results found in Table 12, we looked at this relationship among selective schools, finding that each additional AP course taken was associated with an additional 5 *pp* increase in top school enrollment (p<.001) (Table 12, column 1).

Table 10 AP and CE and their relationship with selective school's enrollment (N=127,162)

	(1) AP: Top schools	(2) AP: Most competitive schools	(3) AP: Ivy League schools	(4) CE: Top schools	(5) CE: Most competitive schools	(6) CE: Ivy League schools
Took at least one AP	0.11***	0.01***	0.00*			
	(0.02)	(0.00)	(0.00)			
Took at least one concurrent				-0.00	-0.00**	-0.00**
				(0.00)	(0.00)	(0.00)
ELL	-0.06**	-0.01*	-0.00	-0.06**	-0.01*	-0.00
	(0.02)	(0.00)	(0.00)	(0.03)	(0.01)	(0.00)
Female	0.00	0.00	-0.00	0.01	0.00	-0.00
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FRL	-0.08***	-0.00*	-0.00	-0.08***	-0.01**	-0.00
	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)
G/T	0.03***	0.00*	0.00	0.05***	0.01**	0.00*
	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)
Multilingual	0.02	0.00	-0.00	0.02	0.00	-0.00
	(0.02)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)
Asian	0.11***	0.01**	0.00**	0.13***	0.01**	0.00**
	(0.02)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)
Black	0.01	0.00	-0.00	0.02	0.00	-0.00
	(0.02)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)

Table 10 Continued

	(1) AP: Top schools	(2) AP: Most competitive schools	(3) AP: Ivy League schools	(4) CE: Top schools	(5) CE: Most competitive schools	(6) CE: Ivy League schools
Hispanic	0.01	0.00	0.00	0.02	0.00	0.00
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Two or more races	0.03	0.00	0.00	0.04**	0.00	0.00
	(0.02)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)
Rural school district	-0.13***	-0.01**	-0.00	0.14***	-0.01**	-0.00
	(0.02)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)
ELA standard. score	0.05***	-0.00	-0.00	0.07***	0.00	-0.00
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Math standard. score	0.02	0.00	0.00	0.02*	0.00	0.00
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Science standard. score	0.13***	0.00*	0.00*	0.16***	0.01**	0.00*
	(0.02)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)
Pseudo R2	0.13	0.12	0.18	0.12	0.11	0.15

*Standard errors in parentheses. All models include district fixed effects. *** p<0.001, ** p<0.01, * p<0.05.*

Note: We followed Barron Index (2015) for college selectivity. *Top college or university* are postsecondary institutions rated 1 (most competitive), 2 (highly competitive) and 3 (very competitive) in Baron Index (2015) while *Most competitive college/university* only includes the highest rating (1) in Barron's Index (2015). We exclude schools that are designated as "competitive" (4), "less competitive" (5) and "noncompetitive" (6) from the index.

Table 11 Dosage of AP and CE and their relationship with types of postsecondary enrollment (N=219,115)

	(1) 4-year	**(2)** 2-year	**(3)** In-state	**(4)** Out-of-state	**(5)** 4-year	**(6)** 2-year	**(7)** In-state	**(8)** Out-of-state
AP dosage (each additional AP taken)	0.10***	-0.01	0.08***	0.02*				
	(0.01)	(0.00)	(0.00)	(0.00)				
Concurrent dosage (each additional concurrent taken)					0.06***	0.00	0.06***	0.00
					(0.00)	(0.00)	(0.00)	(0.00)
ELL	-0.08***	-0.00	-0.08***	0.02	-0.09***	0.00	-0.08**	0.01
	(0.02)	(0.00)	(0.00)	(0.01)	(0.02)	(0.01)	(0.03)	(0.01)
Female	0.08***	0.02*	0.10***	0.01*	0.09***	0.02*	0.10***	0.01
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
FRL	-0.14***	-0.02*	-0.14***	-0.02*	-0.15***	-0.02*	-0.14***	-0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
G/T	0.15***	-0.03***	0.12***	0.02*	0.19***	-0.04***	0.13***	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
Multilingual	-0.04	0.03	0.03	-0.03*	-0.02	0.03	0.03	-0.02
	(0.04)	(0.02)	(0.03)	(0.01)	(0.03)	(0.02)	(0.03)	(0.01)
Asian	0.18***	0.00	0.15***	0.03**	0.23***	-0.01	0.17***	0.05***
	(0.03)	(0.03)	(0.03)	(0.01)	(0.02)	(0.03)	(0.02)	(0.01)

Table 11 Continued

	(1) 4-year	**(2)** 2-year	**(3)** In-state	**(4)** Out-of-state	**(5)** 4-year	**(6)** 2-year	**(7)** In-state	**(8)** Out-of-state
Black	0.07***	-0.00	0.03**	0.04***	0.10***	-0.01	0.05***	0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Hispanic	-0.00	0.04***	0.04	-0.00	0.01	0.04***	0.05***	0.00
	(0.01)	(0.01)	(0.02)	(0.00)	(0.01)	(0.01)	(0.02)	(0.01)
Two or more races	0.02	-0.02	-0.03	0.02**	0.03	-0.02	-0.02	0.03**
	(0.03)	(0.02)	(0.03)	(0.01)	(0.03)	(0.02)	(0.03)	(0.01)
Rural school district	0.04*	0.00	0.07***	-0.03***	0.02	0.00	0.05***	-0.03**
	(0.02)	(0.00)	(0.01)	(0.00)	(0.02)	(0.01)	(0.01)	(0.01)
ELA standard. score	0.09***	0.00	0.09***	0.00	0.10***	0.00	0.09***	0.01***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Math standard. score	0.01**	-0.00	0.00	0.00	0.01	-0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Science standard. score	0.05***	-0.00	0.03***	0.00***	0.06***	-0.01**	0.04***	0.01***
	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
Pseudo R2	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10

*Standard errors in parentheses. All models include district fixed effects. *** p<0.001, ** p<0.01, * p<0.05.*

Table 12 Dosage of AP and CE and their relationship with selective school's enrollment *(N=127,162)*

	(1) Top schools	**(2)** Most competitive schools	**(3)** Ivy League schools	**(4)** Top schools	**(5)** Most competitive schools	**(6)** Ivy League schools
AP dosage (each additional AP taken)	0.05***	0.00**	0.00**			
	(0.00)	(0.00)	(0.00)			
Concurrent dosage (each additional concurrent taken)				-0.00	-0.00**	-0.00
				(0.00)	(0.00)	(0.00)
ELL	-0.05***	-0.01*	-0.00	-0.06***	-0.01*	-0.00
	(0.02)	(0.00)	(0.00)	(0.03)	(0.01)	(0.00)
	0.01	0.00	-0.00	0.01	0.00	-0.00
Female	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FRL	-0.08***	-0.00	-0.00	-0.08***	-0.01*	-0.00
	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)
G/T	0.02	0.00	0.00	0.05***	0.01*	0.00*
	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)
Multilingual	0.00	0.00	-0.00	0.02	0.00	-0.00
	(0.02)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)

Table 12 Continued

	(1) Top	(2) Most competitive	(3) Ivy League	(4) Top	(5) Most competitive	(6) Ivy League
Asian	0.08***	0.01***	0.00*	0.13***	0.01**	0.00**
	(0.02)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)
Black	0.01	0.00	-0.00	0.02	0.00	-0.00
	(0.02)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)
Hispanic	0.01	0.00	0.00	0.02	0.00	0.00
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Two or more races	0.03*	0.00	0.00	0.04*	0.00	0.00
	(0.02)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)
Rural school district	-0.13***	-0.00*	-0.00	0.14***	-0.01**	-0.00
	(0.02)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)
ELA standard. score	0.05***	-0.00	-0.00	0.07***	0.00	-0.00
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Math standard. score	0.01	0.00	0.00	0.02**	0.00	0.00
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Science standard. score	0.11***	0.00**	0.00*	0.16***	0.01**	0.00*
	(0.02)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)
Pseudo R2	0.14	0.18	0.27	0.12	0.11	0.15

*Standard errors in parentheses. All models include district fixed effects. *** p<0.001, ** p<0.01, * p<0.05.*

Table 13 G/T and ELL Postsecondary outcomes *(N=219,115)*

	(1) Any postsecondary	**(2)** Top schools only	**(3)** 4-year	**(4)** 2-year	**(5)** In-state	**(6)** Out-of -state
G/T	0.11***	0.04*	0.13**	-0.03**	0.10***	0.00
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)
ELL	-0.04	-0.02	-0.03	-0.03	-0.07*	0.03**
	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.01)
Female	0.09***	0.00	0.07***	0.02**	0.08***	0.01*
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
FRL	-0.14***	-0.08***	-0.12***	-0.02**	-0.12***	-0.02**
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
G/T *ELL	-0.06*	-0.01	-0.03	-0.00	-0.03	-0.04
	(0.03)	(0.06)	(0.03)	(0.02)	(0.05)	(0.03)
ELL*Female	0.02	-0.03	-0.01	0.02*	0.02	-0.00
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)
G/T*FRL	0.01	0.02	-0.01	0.03**	0.02	-0.01
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.00)
At least one AP	0.12***	0.04***	0.11***	0.02***	0.13***	-0.01
	(0.02)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)
At least one Concurrent	0.18***	0.01	0.19***	-0.01	0.17***	0.02**
	(0.03)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
G/T*At least one AP	-0.02	-0.03	-0.01	-0.04**	-0.03	0.01

Table 13 G/T and ELL Postsecondary outcomes *(continued)*

	(1) Any postsecondary	**(2)** Top schools only	**(3)** 4-year	**(4)** 2-year	**(5)** In-state	**(6)** Out-of -state
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.00)
G/T*At least one Concurrent	-0.03	-0.01	-0.04**	0.01	-0.03	-0.00
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)
ELL*At least one AP	-0.02	-0.04	-0.07**	0.05***	-0.01	-0.01
	(0.02)	(0.03)	(0.03)	(0.01)	(0.02)	(0.01)
ELL*At least one Concurrent	-0.01	0.04	0.02	-0.00	0.03	-0.05**
	(0.01)	(0.04)	(0.03)	(0.01)	(0.03)	(0.02)
AP count	0.05***	0.04***	0.06***	-0.02**	0.02**	0.02*
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)
Concurrent count	0.01	0.00	0.01*	0.00	0.01	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Pseudo R2	0.15	0.14	0.14	0.14	0.13	0.13

*Standard errors in parentheses. All models include district fixed effects. *** p<0.001, ** p<0.01, * p<0.05. We include demographic controls in all of specifications here*

Heterogeneity in college enrollment

Tables 5-12 show that G/T, ELL, and FRL statuses, as well as gender were significant moderating factors between AP and CE courses and postsecondary attendance, STEM major and college selectivity. Therefore, in these analyses (see Table 13), we included those factors' interaction terms to learn about their relationship with postsecondary attendance (column 1) as well as type of institution attended (columns 3-6). We utilized the logit model for columns 1-2 and two separate multinomial logit models for columns 3-4 and 5-6.

First, all else equal, on average, when we compared G/T and ELL students, being G/T was associated with a higher likelihood of college attendance by about 15 *pp*. This estimate came from subtracting the *G/T* coefficient from the *ELL* coefficient (both coefficients were jointly significant at p<.05). G/T students also had a higher likelihood of attending 4-year institutions by 16 *pp* (p<.05, column 3) and in-state institutions by 17 *pp* (p<.05, column 5). Second, examining ELLs as a function of G/T status, on average, ELL identified G/T had a higher likelihood of attending any postsecondary institutions by 5 *pp* (p <.05), attending 4-year institutions by 10 *pp* (p <.05), and in-state institutions by 7 *pp* (p <.05). These estimates were obtained by adding the *G/T* coefficient and the interaction term coefficient of *G/T*ELL*. Third, all else equal, on average, we found consistent results across all types of postsecondary institutions that female ELLs were more likely to attend any college by 11 *pp* (p <.05), 4-year institutions by 6 *pp* (p <.05), 2-year institutions by four *pp* (p <.05), and in-state institutions by 10 *pp* (p <.05). All these estimates were obtained by adding the *Female* and *ELL * Female* coefficients. Fourth, FRL status also significantly predicted G/T students' likelihood of postsecondary enrollment. We found that despite being gifted and talented, FRL G/T students were less likely to attend both any postsecondary institution and 4-year institution by 13 *pp* ($p < .01$), top schools by 6 *pp* ($p < .05$), and in-state schools by 10 *pp* ($p < .05$). These estimates were jointly significant at the reported confidence level and obtained by adding the *FRL* and *G/T * FRL* coefficients. Overall, ELL and FRL status were key barriers that lowered students' likelihood of going to college, however it was the opposite for G/T and female students.

Furthermore, as seen in the bottom panel of Table 13, we examined heterogenous effects of AP or CE course enrollment across subgroups. We interacted AP enrollment (at least one course) and CE (at least one course) with G/T and ELL (see bottom panel of Table 13 columns 1-6). First, G/T students with at least one AP course had a higher likelihood of attending college by 10 *pp* ($p < .05$), for top schools 1 *pp* ($p < .05$), for 4-year schools 10 *pp* ($p < .05$), and for in-state schools 10 *pp* ($p < .05$). Conversely, G/T students who took AP in high school had a lower likelihood of attending 2-year institutions than G/T students who did not take any AP by 2 *pp* ($p < .05$). Second, the likelihood of continuing postsecondary education for G/T students who had access to CE courses was even higher if they attended any college (15 *pp*, $p < .05$), 4-year institution (15 *pp*, $p < .05$), in-state institution (14 *pp*, $p < .05$), and out-of-state institution (2 *pp*, $p < .05$). All estimates were jointly significant at reported significance level. Third, for ELLs we found that enrolling in AP and CE courses can boost the likelihood of general college attendance by about 10 *pp* ($p < .01$), 4-year institutions by four *pp*, ($p < .05$), 2-year institutions by 7 *pp*, ($p < .01$), and in-state institutions by 12 *pp*, ($p < .01$). The trends were even higher for ELLs who took

CE courses. Specifically, ELLs who enrolled in at least one CE course had a much higher likelihood of attending any college by 17 *pp* ($p<.01$), 4-year institutions by 21 *pp*, ($p<.01$), and in-state institutions by 20 *pp*, ($p<.05$). Access to AP and CE appear important for ELLs. All remaining results about heterogeneous effects across subgroups and the relationship with access to AP and CE courses on postsecondary outcomes can be seen in Table 13.

VI. Discussion

The goal of this paper was to examine the role of AP and CE courses on post-secondary enrollment and types of college attended. This study is contextualized within the Arkansas universal access policy to AP courses enacted in 2003 to enhance college readiness and achievement. Our results overall show elevated rates of AP and CE enrollment and evidence that both AP and CE courses have a positive association with going to college (Bleske-Rechek et al., 2004; Conger et al., 2023; Warne et al., 2015; Xu et al., 2021). We consistently found a higher likelihood of postsecondary enrollment for students who took either AP or CE, even though the magnitude of the likelihood differed by type of course, the number of courses taken (dosage), or across subpopulations.

Who enrolled in AP and CE courses in Arkansas?

Participation in AP and CE remains consistent with prior reports on student enrollment rates (McKenzie et al., 2020; Taylor & Yan, 2018) where more than half of the high-school population in Arkansas enrolls in at least one advanced course. These high enrollment rates are coherent with the Arkansas universal access policy (McKenzie & Ritter, 2016). Without barriers to advanced courses, greater student participation is expected compared to other states (College Board, 2022).

Addressing equity questions of enrollment in AP and CE, our results are consistent with previous findings. Low participation rates for traditionally underrepresented populations such as ELL, low-income, and rural students (Ebrahiminejad et al., 2021) were consistently found. Following Ricciardi and Winsler (2015), it is possible that even when controlling for prior achievement, learners from these marginalized populations are less likely to "enroll in AP courses than their similarly skilled white peers" (p. 311). It is also possible that lower participation might be influenced by policies around advanced coursework. According to Xu et al., (2021) access may not be enough to warrant minority enrollment. Contextual factors such as the type of advanced courses offered to students, teacher preparation, level of guidance and support, and school level of diversity might help explain why traditionally underserved students do not take advantage of the universal enrollment. Similarly, especially among states with no universal policies around AP and CE like in Arkansas, remote, small, rural districts are less likely to offer AP and CE courses, further undermining student opportunities (Gagnon & Mattingly, 2016). However, rural districts may offer online AP and CE courses, but lack of reliable technology and connectivity might also hinder student access.

Contrasted with other studies (Moreno et al., 2021; Walker & Pearsall, 2012; Xu et al., 2021), African American and Hispanic status was associated with a higher likelihood of participating in an AP course in our sample. Whereas this result indicates a benefit from universal access to AP coursework, the association did not replicate in CE or AP STEM course enrollment. We speculate that increased information about the universal access policy is one catalyzer of minority student enrollment in AP courses. According to a qualitative study on the experiences of African American males in AP programs, widespread information, vicarious experiences, and teacher encouragement to take on challenging work can be effective strategies to attract more students of color into AP programs (Flowers & Banda, 2019).

College enrollment

Enrollment in advanced courses in Arkansas had an overall positive association with college enrollment. Consistent with prior literature, AP courses strongly predict 4-year college enrollment even after controlling for demographic and school characteristics (Chajewski et al., 2011). Our results support this finding across different types of schools including 2-year and 4-year colleges as well as non-STEM and STEM programs. Moreover, this relationship seems strengthened when the dosage of AP and CE courses is increased (Wai et al., 2010). We observed consistent results that at a higher dosage, students enrolling in rigorous AP and CE STEM courses showed a higher likelihood of continuing their education and having a STEM major. Wai and colleagues (2010) found that, retrospectively, successful graduates who took advanced coursework felt intellectually and motivationally engaged with activities that further enhanced their interest in pursuing similarly stimulating opportunities through post-secondary education. AP and CE course enrollment may be one important type of intervention among the many other interventions that students experience in the pre-college years.

Motivational and cognitive factors may play an important role in maintaining the pipeline from advanced courses to college (Bryan et al., 2011). Similarly, the rigorous curriculum may also hone higher-order and critical-thinking skills, general or analytical reasoning, and problem-solving skills that are essential for college success (Conger et al., 2021, 2023; Jackson, 2010). In addition, by taking these rigorous courses and successfully finishing them, students can build up their motivation to learn and perseverance to not only pursue harder tasks but also to finish them, developing better self-regulatory and self-efficacy skills, which also have been shown as key factors in navigating the complexity of higher education (Bryan et al., 2011; DiBenedetto, 2018; DiBenedetto & Zimmerman, 2013; Jones, 2014; Malpass et al., 1999).

There are also some financial and time incentives involved in pursuing AP and CE enrollment. In general, students are incentivized to take advanced courses to help reduce the number of college years and higher education cost (Curry et al., 1999; Henneberger et al., 2022). Credits awarded for advanced courses may facilitate timely or even early college graduation (Finn & Scanlan, 2019), allowing students to enter the workforce sooner. However, based on the trends observed, there is still a possibility that students self-select in or out of AP or CE courses based on their developed self-perception, academic readiness, or interest in pursuing higher education in the first place (Corin et al., 2020).

Type of college attended

Our results provide evidence of a relationship between AP and CE course taking and eventual enrollment in 4-year colleges and selective colleges. Increased dosage of AP courses was linked with top college enrollment in our sample. However, the literature has shown mixed evidence regarding college selectivity and AP. For example, this finding could be indirectly associated with evidence suggesting that colleges favor admission of AP takers (Isaacs, 2001). A recent experimental study indicates that taking AP coursework is linked to student ambition to attend selective schools, there were no statistical differences in actual college selectivity enrollment between AP and non-AP takers (Conger et al., 2023). We identified different trends for CE, which makes sense because CE courses can only be transferred in Arkansas.

Since Arkansas requires access to AP and CE to support underserved students, reduce achievement gaps, and improve postsecondary outcomes (McKenzie et al., 2020), we should acknowledge that this universal policy might have unintended consequences for students and school districts in general. For instance, this policy may push students who still need to get college ready to enroll in these rigorous courses (McKenzie et al., 2020). Instead of preparing them for other alternatives where the students might be more interested in or thrive in, such as Career and Technical Education (CTE) courses, we might fall into the trap of letting students struggle not only academically but also emotionally as they navigate the demanding process of enrolling in AP or CE courses. Consequently, some of these students might have to delay their high school graduation, which also delays their workforce participation because they are failing these rigorous courses and have to take remedial courses. This situation may have negative consequences financially for the students (see Newman and Winston, 2016).

Second, according to the ADE policy, it takes special credentials and rigorous training for teachers to teach rigorous courses like AP or CE. With all school districts required to offer these courses, it raises the question as to how to prepare the school to provide the necessary rigor and quality for students to be college ready, especially in the rural parts of Arkansas that historically have struggled to recruit qualified teachers (Camp & Zamarro, 2021). Therefore, it raises an important point that we all have to address, acknowledge and support: perhaps, college is not a solution for every student's success.

Arkansas's universal policy

The relatively unique Arkansas context provides evidence on the relationship of advanced classes and various postsecondary outcomes, ranging from enrollment, college selectivity, and STEM major in college across student groups (including across racial/ethnic groups, socio-economic status, and others such as G/T and ELL). The goal of the universal policy was to reduce inequalities among demographic participation in AP courses and increase college attendance (005.22.04 Ark. Code R. § 002). This goal has been partially supported by previous work such as Taylor and Yan's (2018) study on the effect of CE and AP courses on student postsecondary outcomes in Arkansas. This study found positive effects for both CE and AP courses on postsecondary enrollment for a cohort of all high school freshmen in 2009. A difference-in-differences study in the cohorts of 2011/2012 also found positive effects on high school graduation and college enrollment, especially for female or non-Hispanic white AP takers (Arce-Trigarti, 2014).

The Arkansas findings are promising when contrasting our findings with the aggregated results of a systematic review by Kolluri (2018). Kolluri's (2018) findings highlighted the challenges most states face when promoting access and equity in AP courses. Contrasting these results, Arkansas has shown relative success in implementing its universal access when compared with states with similar open access and funding policies. For example, as reported by the College Board (2022), in states like South and North Carolina, less than 20% of the high school student population takes the AP examination, and less than 80% of the public schools offer AP courses. Additionally, only South Carolina has shown relative gains on average AP test scores from 2012 to 2022 (College Board, 2022). Our results expand the evidence on the positive effect of the universal policy, generally favoring post-secondary outcomes for several demographics.

Hypothetically, and perhaps in an ideal scenario, accessing these rigorous courses should no longer be a problem for equity. In actual practice, we still found some indicators of disparity among some student characteristics such as G/T status, being female, and student prior achievement in math, ELA, and science. These aspects were associated with a higher likelihood of students enrolling in AP or CE, whereas situational aspects surrounding ELL and low-income statuses (FRL) might still hinder students in enrolling in AP or CE. We also noticed that the likelihood of accessing (or taking advantage of) AP or CE differs across racial/ethnic groups, with Asian students enrolling in both AP in general and STEM AP at much higher rates. In contrast, Hispanic and Black students tend to favor enrolling in AP but not in CE. Other racial/ethnic groups (Pacific Islanders, Native Americans, Native Hawaiian, and others) were less likely to enroll in both AP and CE in Arkansas. In other words, although access to AP and CE courses on average increases the likelihood of students attending any postsecondary, in-state, or selective institutions, not all students enjoy this benefit. This, however, aligns with prior literature (Djita et al., 2023; McKenzie et al., 2020). Finally, it is also noteworthy that given the challenging nature of AP and CE, these courses are suitable for challenging gifted and talented students (VanTassel-Baska, 2001; Wai & Allen, 2019). One might argue that G/T students would have the upper hand in enrolling in these courses than their counterparts, consequently attending college at much higher rates. However, from our results, we found that, the interaction of student characteristics matter and disaggregation of subpopulations must be considered in statistical analysis to more fully understand the effects of the Arkansas universal policy. When we compared AP enrollment across FRL and ELL groups, we found that G/T students who came from low-income households and were also categorized as ELLs were less likely to attend postsecondary institutions than G/T students from more affluent and English-speaking homes. This again shows that strong moderating factors might be intentionally or unintentionally masked when analysis are performed on aggregated populations of students without considering risk factors such as poverty and low-English proficiency. Despite these important considerations, the universal access policy does appear to continue to help many students.

Limitations

One limitation of our study was that access to AP or CE courses was defined loosely, based on enrollment in at least one of these courses. Additionally, our data did not allow us to clearly determine whether AP course enrollment corresponded to course completion. A significant constraint was the absence of specific AP course grades, preventing us from distinguishing between merely enrolling in an AP or CE course and successfully completing and earning credit for it. This becomes significant given that prior research has underscored the importance of AP exam performance as a determinant of student success, a metric we unfortunately lacked. Similarly, the definition we employed for ELLs was broad, potentially encompassing a wide variety of student experiences without capturing specific nuances. For example, the ELL category encompassed any student designated as ELL without considering varying level of English proficiency.

Future Directions

Despite the Arkansas universal policy for enrollment in both AP and CE courses, a large proportion of high school students still do not participate in this opportunity. Understanding the role of schools in guiding student decisions about AP and CE is vital. Future studies could address school factors related to availability of information and active recruitment of students into AP or CE classes. Such studies could consider the role of school personnel such as teachers and counselors in promoting (perhaps even nudging or making it a default for G/T or other students already demonstrating academic readiness), recruiting, and supporting students of all demographics in AP and CE courses. How proactive are schools in involving parents, especially those from minoritized or underserved populations, in conversations about the potential benefits and opportunities linked with AP and CE courses for higher education aspirations? Moreover, individual factors such as student interest, student ability, and overall school experiences might illuminate why students do not participate in such courses, and more research could be targeted in this area. Given that a large proportion of Arkansas students opt for in-state postsecondary institutions, would it be more strategic to emphasize concurrent enrollment over AP courses for these populations? The answers to these questions in part are determined by educational values by policymakers, parents, and students themselves, and thus may not be readily answered.

Regarding the structure and quality of AP courses offered in Arkansas, studies may address teacher qualifications to teach AP courses, availability of specialized AP courses across rural and marginalized areas, as well as preparation for AP examinations. It is also essential to ask if the prerequisites for these courses may create barriers for marginalized and underserved populations. Lastly, an intriguing area highlighted by past studies is the variability in outcomes between students enrolled in accredited versus unaccredited AP or CE courses. Preliminary insights suggest that students from unaccredited programs may be more likely to pursue postsecondary education. Investigating this counterintuitive trend, potentially explained by factors such as program participation, could offer valuable perspectives for policymakers and educators alike.

Conclusions

Our study provides comprehensive evidence that enrollment in advanced courses within Arkansas displays a consistent, positive relationship with college enrollment, especially in four-year and selective institutions. The financial and time incentives of such courses, especially possible benefits, are important to consider. Access to several AP and CE courses offer a direct route for students to minimize college time and economic burden when navigating higher education. The Arkansas universal policy aimed to level the playing field in terms of access to these educational opportunities, however, residual disparities persist across minoritized and underserved student demographics. These disparities are nuanced; therefore, evidence suggests the need for equally nuanced policy implementation targeting the most disadvantaged populations. As the state strives for equity, more needs to be done to ensure that all students can benefit from AP and CE courses, and yet, the policy does appear to benefit many students across Arkansas, especially relative to students in the 47 other states who don't have universal access. Finally, the multifaceted nature of student characteristics and their interplay in these outcomes underscores the importance of nuanced, disaggregated analysis for fully understanding and refining policy effects.

VII. References

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