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THE IMPACT OF MUSIC ENSEMBLE PARTICIPATION ON STEM STUDENTS

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THE IMPACT OF MUSIC ENSEMBLE PARTICIPATION ON STEM STUDENTS

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A capstone project submitted for Graduation with University Honors

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University Honors

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ABSTRACT

This study examines the relationship between music ensemble participation and academic performance, time management, and cognitive well-being among STEM students at the University of California, Riverside. Recent research has highlighted the benefits of music participation, yet limited research has examined its impact on the academic experiences and well-being of STEM students. Using a mixed-methods approach, survey data were collected from undergraduate STEM students: 235 enrolled in an introductory organic chemistry course and 58 students participating in university music ensembles, of whom 70.7% were STEM majors. Structured interviews were conducted with a subset of STEM music participants and music faculty, including ensemble directors. Results indicate that participation in music ensembles is associated with positive self-reported outcomes in time management and cognitive well-being. Many STEM students involved in music reported effective time management abilities, suggesting that engagement in structured musical activities may support organizational skills. Students also indicated that music participation provided a mental and emotional outlet, reducing stress and improving focus. Interview data from both students and faculty supported these findings, highlighting themes of discipline, balance, and personal growth. Despite these positive reported benefits, no significant difference in GPA distribution was observed between music and non-music students, suggesting that music participation does not measurably impact academic performance. While students involved in music reported occasional scheduling conflicts, these were generally infrequent and did not significantly hinder academic responsibilities. Overall, music ensemble participation is associated with improved well-being and organizational skills without negatively affecting academic outcomes in STEM students.

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INTRODUCTION

Science, Technology, Engineering, and Mathematics (STEM) students are consistently exposed to demanding academic environments characterized by high workloads, complex problem-solving tasks, and sustained cognitive pressure. Prior research has shown that such academic demands are associated with increased stress and cognitive strain among college students (Wang et al., 2022). These conditions often require advanced time management skills and can lead to increased stress and burnout. At the same time, many STEM students engage in extracurricular activities that require equally significant commitment. Participation in structured activities, such as music ensembles, has been shown to support cognitive, emotional, and social development (Dingle et al., 2021; Intolubbe-Chmil, 2019). As a STEM student who also participates in music ensembles, I have personally experienced the challenges of balancing academic and musical commitments. This raises an important question: whether involvement in music serves as a supportive mechanism that enhances student performance and well-being, or whether it introduces additional demands that may interfere with academic success.

Existing research has widely documented the cognitive and psychological benefits of music participation. Musical training has been associated with improvements in memory, attention, and problem-solving abilities, as well as increased discipline and persistence (Jing, 2023). In addition, engagement in music has been shown to positively influence psychological well-being through mechanisms such as stress reduction, emotional regulation, and social connection (Dingle et al., 2021). A comprehensive review found that participation in music activities can enhance mood, cognitive functioning, and interpersonal bonding across diverse populations (Dingle et al., 2021). Similarly, research in higher education contexts indicates that

music involvement contributes to improved psychological well-being and academic performance through mediating factors such as self-efficacy and self-esteem (Jiang, 2024).

Despite these findings, the relationship between music participation and academic performance remains contested. Some studies report positive associations between music involvement and academic achievement; however, more rigorous analyses suggest that these relationships may be influenced by selection bias rather than causal effects. For instance, research comparing statistical models has shown that while simple analyses indicate a positive relationship between music participation and GPA, this effect often disappears when controlling for unobserved variables such as prior ability and socioeconomic background (Intolubbe-Chmil, 2015). This suggests that students who choose to participate in music may already possess characteristics associated with higher academic performance, complicating interpretations of direct impact.

A further limitation in the existing literature is the lack of focus on STEM-specific populations. Much of the research on music participation examines general student populations without accounting for the uniquely demanding nature of STEM coursework. Additionally, few studies directly compare STEM students who participate in music with those who do not, limiting the ability to evaluate how music participation interacts with academic demands in a controlled context.

This study addresses these gaps by examining the relationships among music ensemble participation, academic performance, time management, and cognitive well-being among students at the University of California, Riverside. Using a mixed-methods approach, the study compares STEM students who participate in music ensembles with those who do not, and incorporates qualitative perspectives from interviews to provide additional context. By focusing

specifically on STEM students and incorporating both quantitative and qualitative data, this research aims to provide a more nuanced understanding of how music participation functions within academically rigorous environments.

The central research question guiding this study is: how does music ensemble participation relate to academic performance, time management, and cognitive well-being among STEM students? It is hypothesized that participation in music ensembles is associated with improved time management and well-being, while having no significant effect on academic performance as measured by GPA. Through this analysis, the study contributes to ongoing discussions regarding the role of interdisciplinary engagement in higher education and the potential value of integrating artistic practices within STEM-focused academic pathways.

LITERATURE REVIEW

Music Participation and Cognitive Development

A substantial body of research has examined the relationship between music participation and cognitive development, with findings suggesting that musical training enhances a range of cognitive functions relevant to academic success. Students engaged in music demonstrate improved memory retention, attention, and problem-solving abilities, which are essential skills in STEM disciplines (Jing, 2023). Musical engagement has also been linked to increased discipline and sustained focus, reinforcing its relevance in academically rigorous environments (Jing, 2023).

Neuroscientific and interdisciplinary research further supports the role of music in cognitive development. Musical training has been associated with enhanced brain plasticity, executive functioning, and multitasking ability, all of which contribute to improved academic performance (Sun, 2022). Additionally, integrating music into STEM education through STEAM

(Science, Technology, Engineering, Arts, and Mathematics) frameworks highlights its role in fostering creativity and innovation, as music-based learning environments promote discovery-based thinking and deepen conceptual understanding by bridging artistic and technical disciplines (Dignam, 2024).

Music and Academic Performance

The relationship between music participation and academic achievement has been widely studied, though findings remain mixed. Several studies report a positive association between music involvement and academic performance. For example, population-level research has found that students participating in instrumental music programs tend to achieve higher academic outcomes across multiple subjects (Guhn et al., 2020). Similarly, longitudinal findings indicate that sustained engagement in music is associated with improved performance in mathematics and related academic areas (Boyd, 2013). Musical engagement has also been linked to modest but measurable improvements in cognitive functioning, as structured music training involves sustained attention, practice, and skill development that can contribute to broader intellectual growth (Schellenberg, 2004).

However, these findings are not universally supported when more rigorous methodologies are applied. Intolubbe-Chmil (2015) demonstrates that although simple statistical analyses suggest a positive relationship between music participation and GPA, this effect often disappears when controlling for individual differences, such as prior academic ability and socioeconomic background. This suggests that selection bias and underlying cultural or socioeconomic factors may play a significant role, as students who participate in music often come from backgrounds associated with stronger academic support and achievement (Intolubbe-Chmil, 2015). Additional research indicates that while music can enhance

concentration and engagement, its direct impact on academic performance may depend on contextual factors such as workload and time allocation (Kumar et al., 2016).

Psychological Well-Being and Emotional Outcomes

Beyond cognitive and academic outcomes, music participation has been consistently associated with improvements in psychological well-being. A comprehensive review by Dingle et al. (2021) found that music activities positively influence mood, emotional regulation, and social connection, contributing to overall mental health. These effects are particularly significant in higher education settings, where students frequently experience stress and academic pressure (Jiang, 2024).

Empirical studies further highlight the mechanisms underlying these benefits. Jiang (2024) found that music learning significantly improves students' psychological well-being, with self-efficacy and self-esteem acting as mediating factors that also contribute to academic performance. Similarly, Wang et al. (2022) report that music education improves mental health outcomes among university students, with emotional intelligence moderating the relationship between stress and well-being. These findings suggest that music participation enhances not only immediate emotional states but also long-term psychological resilience.

Extracurricular Engagement, Time Management, and Student Development

Participation in structured extracurricular activities has been associated with improved academic and personal outcomes, particularly in the development of time management and organizational skills. Music ensembles, as structured and collaborative environments, require consistent commitment and discipline, which may translate into improved academic behaviors. Research suggests that involvement in such activities promotes responsibility, goal-setting, and sustained engagement, all of which support student success (Jing, 2023).

At the same time, the time demands of music participation may pose challenges. Students must balance rehearsals, practice, and performances with academic responsibilities, which can lead to scheduling conflicts and increased stress. While some studies suggest that these challenges may hinder academic performance, others indicate that structured activities can enhance students' ability to manage competing demands effectively (Kumar et al., 2016). This dual effect highlights the complexity of music participation as both a potential support system and a competing obligation.

Gaps in the Literature and Study Contribution

Despite extensive research on music participation, several important gaps remain. First, much of the existing literature focuses on general student populations rather than examining specific academic groups such as STEM students. This is a significant limitation, as STEM students face uniquely demanding academic environments that may alter the effects of extracurricular involvement.

Second, prior research often relies on single-method approaches, limiting the ability to capture both measurable outcomes and subjective experiences. Additionally, selection bias complicates interpretations of existing findings, as demonstrated by Intolubbe-Chmil (2015), underscoring the need for more nuanced research designs.

The present study addresses these gaps by examining the relationships among music ensemble participation, academic performance, time management, and cognitive well-being, specifically among STEM students. By incorporating both survey data and qualitative interviews, and by comparing students with and without music involvement, this research provides a more comprehensive and context-specific understanding of how music participation functions within academically rigorous environments.

METHODOLOGY

Research Design

This study employed a mixed-methods research design to examine the relationship between music ensemble participation and academic performance, time management, and cognitive well-being among STEM students. A mixed-methods approach was selected to integrate quantitative survey data with qualitative interview responses, enabling both statistical comparisons and deeper interpretation of student and ensemble director perspectives. The quantitative component focused on identifying patterns and differences between students involved in music ensembles and those who were not, while the qualitative component provided additional context regarding how music participation is experienced and evaluated within academic settings.

Participants

Participants were recruited from two primary sources at the University of California, Riverside: students enrolled in an introductory organic chemistry course (CHEM 008A) and students involved in university music ensembles, including orchestra, wind ensemble, jazz ensemble, choir, chamber music groups, and related performance ensembles.

The CHEM 008A group ($n = 235$, 82% response rate) served as the primary non-music comparison sample and consisted predominantly of STEM majors, particularly in life science disciplines such as Biology, Neuroscience, Biochemistry, and Cell, Molecular, and Developmental Biology (CMDB), with additional representation from engineering and related fields.

The music ensemble group consisted of 58 participants actively involved in university ensembles, including Wind Ensemble, Jazz Ensembles, Choirs, Orchestra, and World Music

ensembles. Among these participants, approximately 70.7% identified as STEM majors. In addition to student ensemble members, a small number of music faculty members, including ensemble directors, were recruited for structured interviews. These participants were selected to provide instructional and observational perspectives on student engagement, discipline, and the academic impact of music participation.

Because participants were recruited through university-affiliated music ensembles, the primary comparison in this study was between STEM students actively participating in organized ensemble programs and STEM students enrolled in CHEM 008A who were not actively involved in music participation during college.

Some participants did not respond to all survey questions, particularly demographic items. As a result, the number of valid responses varies across survey items, and analyses were conducted using available responses for each question.

Data Collection

Data were collected through online surveys via Qualtrics and structured interviews. This study was conducted under UCR IRB protocol #30733. Separate, but parallel, survey instruments were administered to music participants and non-music participants (Appendix A-C). The music participant survey included sections on demographic information, music background, ensemble participation, rehearsal and practice hours, time management, academic performance, cognitive well-being, and perceived benefits and challenges of balancing music with academic responsibilities. The non-music survey included comparable measures related to academic workload, extracurricular involvement, time management, GPA, stress levels, and perceptions of structured activities, including the arts, in supporting academic success.

Survey questions consisted of multiple-choice items, Likert-scale responses, and open-ended questions. Likert-scale items were used to assess perceptions of time management ability, stress, and cognitive outcomes, while categorical questions captured GPA ranges, time commitments, and academic behaviors.

Structured interviews were conducted with both STEM student participants involved in music ensembles and music faculty members, including ensemble directors. All participants were asked a consistent set of predetermined questions. Student interviews focused on time management, academic balance, stress management, and personal development, while faculty interviews focused on observations of student discipline, workload management, and the broader role of music participation in academic and personal development (Appendix D).

Variables and Measures

The primary independent variable in this study was music ensemble participation. This variable was operationalized using self-reported participation status, years of involvement, ensemble type, and time commitment to rehearsals and practice.

Dependent variables included academic performance, time management, and cognitive well-being. Academic performance was measured through self-reported GPA ranges and participant perceptions of academic impact. Time management was assessed through self-reported planning strategies, perceived effectiveness, and frequency of scheduling conflicts between academic and extracurricular responsibilities. Cognitive well-being was measured through self-reported stress levels, perceived focus, emotional responses, and sense of accomplishment associated with music participation.

Additional measures included perceived development of academic and transferable skills, such as time management, memory retention, problem-solving, discipline, and stress management.

Data Analysis

Quantitative data were analyzed using descriptive statistical methods, including frequencies, percentages, and comparative distributions. Analyses focused on differences between STEM students involved in music ensembles and STEM students in the CHEM 008A comparison group. Survey data were organized using Microsoft Excel and statistically analyzed using RStudio. Because response counts varied across survey items due to non-response, each analysis used the valid response count for each question. No statistical imputation was performed for missing data.

Qualitative data from interviews and open-ended survey responses were analyzed using thematic analysis. Responses from both students and faculty were coded to identify recurring themes, including discipline, balance, stress management, and personal development. Faculty perspectives were used to complement and contextualize student-reported experiences.

Ethical Considerations

This study was conducted in accordance with institutional guidelines for research involving human subjects and received approval from the Institutional Review Board at the University of California, Riverside as an exempt study. Participation was voluntary, and informed consent was obtained from all participants prior to data collection.

Survey responses were collected anonymously, and interview data were de-identified to protect participant confidentiality. Participants were informed that they could withdraw from the study at any time without penalty. Students enrolled in CHEM 008A who completed the survey

received a small amount of extra credit for their participation, while interview participants received gift cards for their time.

RESULTS

Demographics and Ensemble Involvement

Participants were recruited from two primary sources at the University of California, Riverside: students enrolled in an introductory organic chemistry course (CHEM 008A) and students participating in university music ensembles. The CHEM 008A group ($n = 235$) served as the primary non-music comparison sample and consisted predominantly of STEM majors, particularly in life science disciplines such as Biology, Neuroscience, Biochemistry, and Cell, Molecular, and Developmental Biology (CMDB), with additional representation from engineering and related fields.

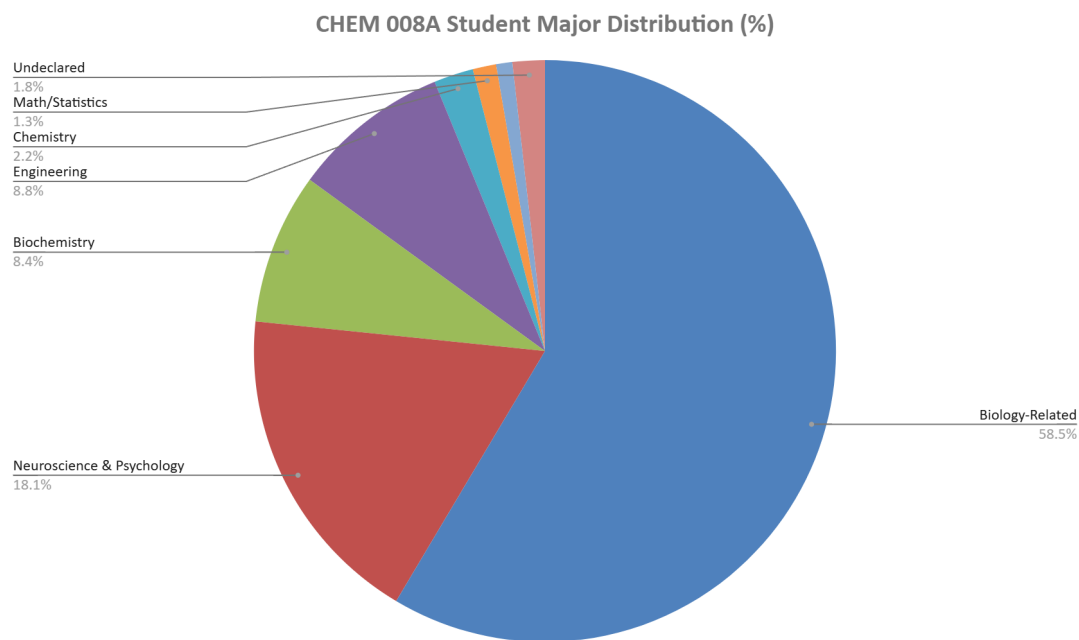


Figure 1. Major distribution of students enrolled in CHEM 008A, showing the predominance of biology-related and other STEM disciplines among survey participants.

Demographic data from the CHEM 008A sample indicate that most respondents were second-year students (71.1%), followed by third-year students (26.4%), with minimal representation from fourth-year students (2.1%). Most students reported enrolling in 12–15 units (68.5%), while 28.5% enrolled in 16–18 units, and 2.1% enrolled in more than 18 units. These findings indicate that the non-music comparison group consisted primarily of students in the early stages of their academic programs who were managing standard to moderately heavy course loads.

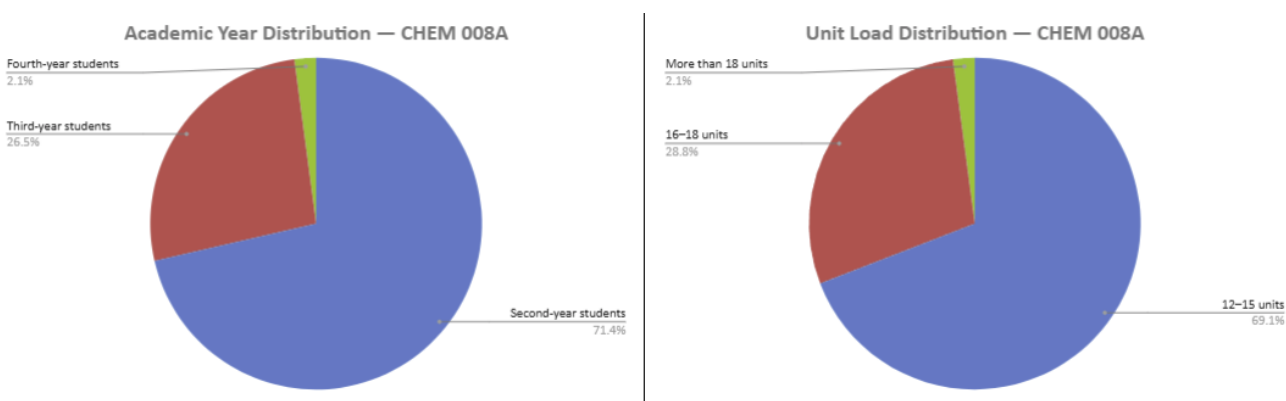
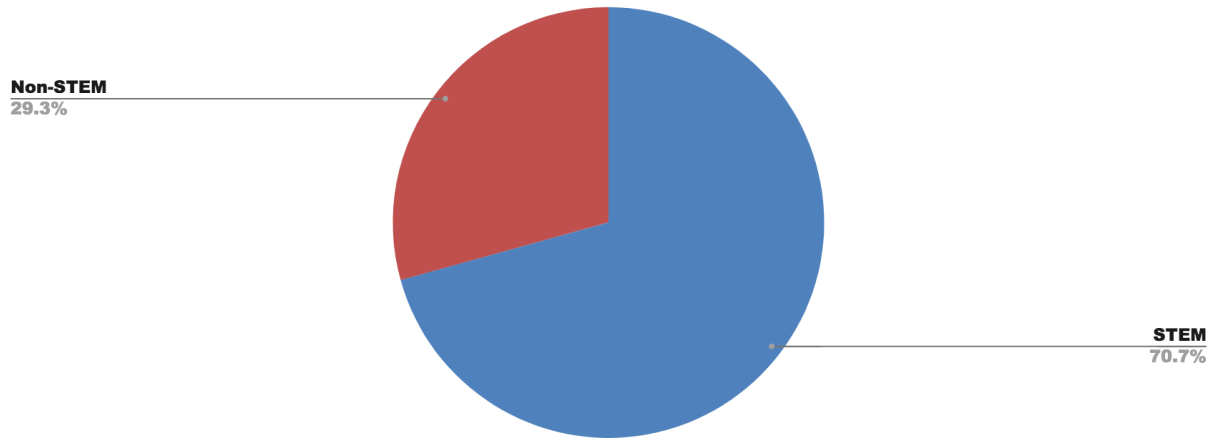


Figure 2. *Academic year and unit load distributions for students enrolled in CHEM 008A. The left panel shows participants' year in school, while the right panel displays current unit enrollment.*

The music ensemble group consisted of 58 participants. Of these, 41 participants identified as STEM majors, representing 70.7% of the music sample, while 17 participants identified as non-STEM majors, representing 29.3%. Academic standing within the music group was more evenly distributed than in the CHEM 008A sample: 16.7% were first-year students, 27.8% were second-year students, 22.2% were third-year students, 25.0% were fourth-year students, and 8.3% were fifth-year or graduate-level students. Participants in music also reported substantial academic workloads, with 50.0% enrolled in 12–15 units, 36.1% in 16–18 units, and 13.9% in more than 18 units. Within the music ensemble sample, reported majors were

distributed across several academic fields. The largest categories included Neuroscience/Psychology, Biology-related fields, Engineering, Biochemistry/Chemistry, Music, Business, Math/Computer Science, Political Science/Law, Economics, Languages, and Dance. Because these percentages are based on the full music sample rather than only the STEM subset, they are used descriptively rather than as a basis for formal STEM-versus-non-STEM comparison.

STEM vs. Non-STEM Representation in UCR Music Ensemble Participants (n=58)



Composition of Majors Among Music Ensemble Participants (n=58)

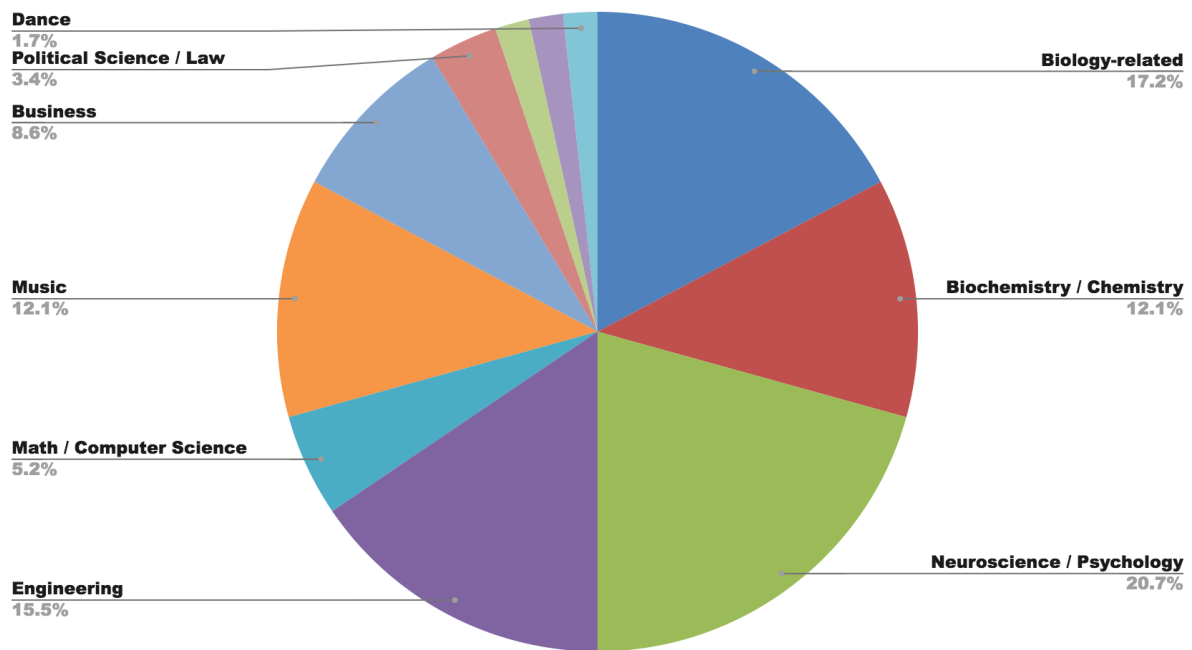


Figure 3. *Distribution of academic backgrounds among music ensemble participants at the University of California, Riverside (n = 58). The top chart shows that 70.7% of participants are STEM majors, while 29.3% are non-STEM majors. The bottom chart further breaks down participants by specific fields of study.*

Music participants also reported varying levels of ensemble experience. Approximately 33.3% reported 0–1 years of ensemble participation during their STEM studies, 36.1% reported 2–3 years, and 30.6% reported 4 or more years. Participants were involved in a range of ensembles, including Concert Band/Wind Ensemble (n = 22), Orchestra (n = 15), Chamber Music (n = 12), Jazz Ensemble/Big Band (n = 11), Choir/Choral ensembles (n = 10), Wind Group (n = 9), Pit Orchestra (n = 6), Jazz Combo (n = 4), Brass Band (n = 3), Mariachi (n = 2), and Rock Band (n = 1). Because students could report involvement in more than one ensemble, these counts are not mutually exclusive and therefore do not sum to 58.

Among CHEM 008A respondents, 70.6% reported prior participation in music but not current involvement, while 24.3% reported no prior music experience. Only a small proportion reported current or recent involvement in college music. This suggests that the CHEM 008A group functioned primarily as a non-active-music comparison group, even though many participants had some earlier exposure to music.

Academic Impacts

Academic performance was assessed using self-reported GPA ranges across participant groups. To account for differences in group size, GPA distributions were converted into percentages within each group: STEM students not participating in music (n = 230), non-STEM students participating in music (n = 22), and STEM students participating in music (n = 35).

Among STEM students not participating in music, the majority reported GPAs in the 3.5–3.9 range (57.8%), followed by 3.0–3.4 (25.2%). Smaller proportions reported GPAs of 4.0 or higher (8.3%), 2.5–2.9 (7.4%), and below 2.5 (1.3%). A similar distribution was observed among STEM students participating in music ensembles. Within this group, 48.6% reported GPAs in the 3.5–3.9 range, followed by 28.6% in the 3.0–3.4 range. A higher proportion reported

GPA of 4.0 or higher (14.3%), while smaller proportions reported 2.5–2.9 (5.7%) and below 2.5 (2.9%).

Non-STEM students participating in music exhibited a more variable distribution. Within this group, 36.4% reported GPAs in the 3.0–3.4 range and 31.8% in the 3.5–3.9 range, while 27.3% reported GPAs in the 2.5–2.9 range. No participants in this group reported GPAs of 4.0 or higher. Due to the smaller sample size, these results are interpreted descriptively.

Table 1. *Distribution of self-reported GPA ranges among STEM students not participating in music, STEM students participating in music ensembles, and non-STEM students participating in music at the University of California, Riverside. Percentages are reported within each participant group.*

GPA Range	STEM Students Not Participating in Music (%)	STEM Students Participating in Music (%)	Non-STEM Students Participating in Music (%)
4.0 or higher	8.3	14.3	0.0
3.5–3.9	57.8	48.6	31.8
3.0–3.4	25.2	28.6	36.4
2.5–2.9	7.4	5.7	27.3
Below 2.5	1.3	2.9	0.0

Across all groups, GPA distributions were concentrated in the 3.0–3.9 range, indicating generally strong academic performance. While minor differences in percentage distributions were observed, these variations did not indicate a consistent advantage or disadvantage associated with music participation. A chi-square test of independence was conducted to examine the relationship between group membership and GPA distribution. The results indicated

no statistically significant association, $\chi^2(8) = 4.01$, $p \approx 0.993$. This suggests that GPA distribution is independent of music participation status within this sample.

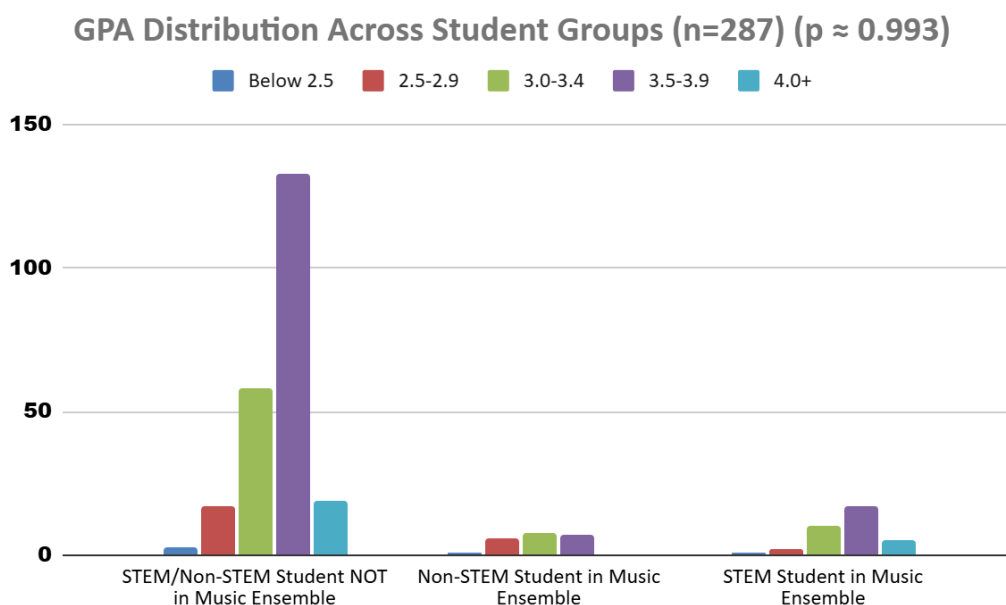


Figure 4. *Distribution of self-reported GPA ranges across student groups ($n = 287$). The chart compares STEM/non-STEM students who do not participate in music, non-STEM students in music ensembles, and STEM students in music ensembles.*

Because GPA data were self-reported and survey participation was voluntary, responses may be subject to reporting bias. However, the consistency of GPA distributions across groups supports the conclusion that music ensemble participation does not negatively impact academic performance among STEM students.

Social and Experiential Aspects of Music Participation

Students in music ensembles identified multiple aspects of musicianship that contributed to stress relief. The most frequently reported responses included: performing (71.4%), socializing

with other musicians (68.6%), rehearsals (62.9%), and personal practice (54.3%). A small proportion selected “other” (5.7%), while 2.9% reported no benefit.

Table 2. *Self-reported aspects of music participation identified by STEM students as contributing to stress relief include performing, rehearsals, personal practice, and social interaction with other musicians. Percentages reflect the proportion of participants selecting each response.*

Aspect of Musicianship	Percentage (%)
Performing	71.4
Socializing with other musicians	68.6
Rehearsals	62.9
Personal practice	54.3
Other	5.7
No benefit	2.9

Personal and Cognitive Development

Students reported strong personal and cognitive benefits associated with music participation. A majority reported experiencing a sense of accomplishment “most of the time” (45.7%) or “always” (28.6%), with smaller proportions indicating “sometimes” (14.3%) or “about half the time” (11.4%). When asked about mood and cognitive focus, 54.3% reported a significant positive impact, and 42.9% reported a moderate positive impact. Music was also widely perceived as a stress-reducing activity, with 51.4% strongly agreeing and 42.9% somewhat agreeing that participation provides a mental break from academic stress. Students reported that music had either a positive (45.7%) or neutral (51.4%) impact on academic performance, with only 2.9% reporting a negative impact.

Table 3. *Self-reported perceptions of fulfillment, cognitive well-being, stress reduction, and academic impact associated with music participation among STEM students involved in university music ensembles. Percentages are reported within the STEM music participant group.*

Category	Response	Percentage (%)
Sense of Accomplishment or Fulfillment After Musical Activities	Never	0
	Sometimes	14.3
	About half the time	11.4
	Most of the time	45.7
	Always	28.6
Impact of Music on Overall Mood or Cognitive Focus	Yes, Significantly	54.3
	Yes, Somewhat	42.9
	No Impact	0
Music as a Mental Break or Stress Reduction From STEM Coursework	Strongly disagree	0
	Somewhat disagree	0
	Neither agree nor disagree	0
	Somewhat agree	42.9
	Strongly agree	51.4
Perceived Impact of Music Participation on Academic Performance	Positively	45.7
	Negatively	2.9
	No noticeable impact	51.4

Academic and Professional Skill Development

Students identified multiple academic skills that improved through participation in music. The most frequently reported were memory retention (77.1%), time management (74.3%), and stress management (68.6%), followed by critical thinking (60.0%) and problem-solving (45.7%). A smaller proportion selected “other” (14.3%). These findings indicate that music participation is associated with perceived improvements in cognitive processing, organization, and stress

regulation.

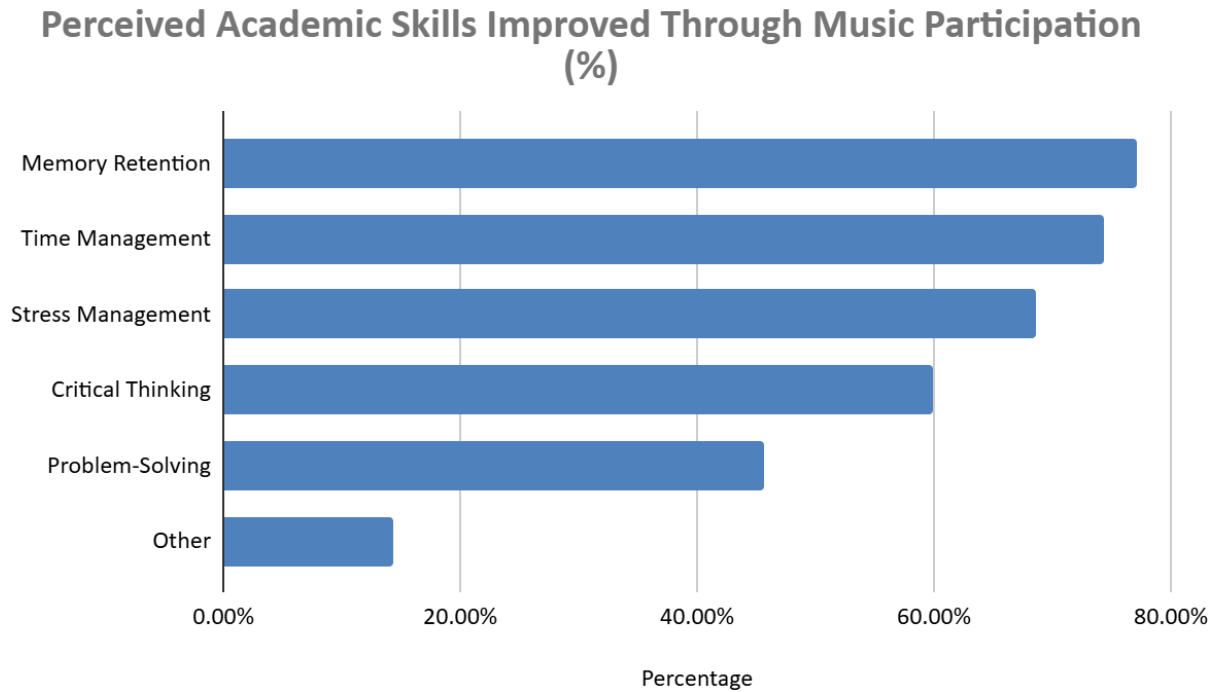


Figure 5. *Self-reported academic skills improved through music participation among STEM students involved in music ensembles, including memory retention, time management, stress management, critical thinking, and problem-solving.*

Time Management and Academic Balance

Among STEM students participating in music, 51.4% rated their time management ability as “good” and 20.0% as “excellent,” while 22.9% reported “neutral” and 5.7% reported “poor.” In comparison, students not participating in music reported lower perceived time management: 31.2% rated “good,” 40.7% “neutral,” and 21.2% “poor,” with fewer reporting “excellent.” Regarding missed academic obligations, music students reported 37.1% never, 34.3% rarely, and 28.6% occasionally, with no respondents indicating frequent occurrences.

Non-music students reported similar patterns, with 40.7% never, 37.7% rarely, and 18.2% occasionally.

Table 4. *Self-reported time management ability among STEM students participating and not participating in music.*

Rating	STEM Students Participating in Music (n=35)	STEM Students Not Participating in Music (n=235)
Excellent	20	3.9
Good	51.4	31.2
Neutral	22.9	40.7
Poor	5.7	21.2
Very Poor	0	3

Table 5. *Frequency of missed academic obligations among STEM students participating and not participating in music.*

Frequency	STEM Students Participating in Music (n=35)	STEM Students Not Participating in Music (n=235)
Never	37.1	40.7
Rarely	34.3	37.7
Occasionally	28.6	18.2
Often	0	3.5

Perceptions of Extracurricular Activities (Non-Music Students)

Among STEM students not participating in music, 38.3% reported feeling stressed “sometimes,” 36.5% “often,” and 16.5% “always.” Despite this, 46.5% reported feeling a sense of accomplishment from personal activities “most of the time.” When asked about non-academic interests, 45.7% somewhat agreed and 16.5% strongly agreed that such activities positively affect academic success. Similarly, 42.4% somewhat agreed, and 13.5% strongly agreed that structured activities improve academic skills. However, willingness to participate in music was low, with 40.9% “probably not” and 36.1% “definitely not” considering joining. Despite this, 48.3% believed arts participation would benefit STEM students, with 20.4% responding “definitely yes.” Students also identified perceived benefits of music, including stress management (n =

158), memory retention (n = 119), critical thinking (n = 65), time management (n = 62), and problem-solving (n = 59).

Challenges Noted by Music Ensemble Members

Students identified multiple overlapping challenges in balancing music and STEM coursework. The most frequently reported challenge was time constraints (n = 31), followed by scheduling conflicts (n = 26) and stress levels (n = 12). A smaller number of students reported a lack of faculty support (n = 4), while a limited number selected “other” challenges (n = 2). Because responses were multi-select, these categories are not mutually exclusive and reflect overlapping areas of difficulty rather than independent variables.

Qualitative Student Interview Findings

Structured interviews with STEM students participating in music ensembles revealed consistent patterns in how students balance academic and musical commitments, as well as the perceived benefits and challenges of participation.

Students overwhelmingly indicated that STEM coursework takes priority, with music structured around academic demands. As one student explained, “exams come first... no questions asked,” while another noted that “school takes priority,” reflecting a consistent hierarchy in decision-making. This prioritization helps explain why music participation does not appear to negatively impact academic performance.

At the same time, students described music as providing a critical mental and emotional outlet. Many emphasized that music offers a contrast to the technical nature of STEM coursework, with one student describing it as “a form of stress relief... a contrast from academics,” and another noting that it “gives brain a break”. This framing highlights music’s role as a cognitive reset rather than an additional burden.

Students also reported gaining transferable skills through music participation, particularly in communication, leadership, and adaptability. For example, one participant explained that music fosters “communication and leadership,” while another highlighted the importance of “thinking on the spot” and attention to detail. These skills were frequently described as transferable to academic and professional contexts.

Despite these benefits, students consistently identified time constraints and scheduling conflicts as the primary challenges they experienced as music ensemble members. Conflicts between rehearsals, labs, and exams were common, with one student noting that “lab and music both can be at night,” while another described concerts near finals week as particularly difficult because music time commitments increased substantially during performance periods. These challenges were often situational, depending on workload and course structure.

A notable theme across interviews was the perception of limited institutional support, particularly from STEM faculty and the structural demands of STEM coursework. Several students described difficulty navigating overlapping expectations between rehearsals, labs, exams, and assignment deadlines, often feeling that academic commitments were treated as inherently more important than musical participation. One student explained that “professors often think their course should be the priority,” while others described feeling caught between competing responsibilities from both academics and ensemble commitments. Students also noted that rigid lab schedules and evening course requirements frequently conflicted with rehearsals and performances, leaving little flexibility during high-demand academic periods such as midterms and finals. Collectively, these responses reflected a broader perception that institutional structures were not designed to accommodate students balancing intensive STEM coursework with sustained participation in university music ensembles.

Finally, students emphasized the importance of community and personal motivation in sustaining their involvement in music. Many described music as a social and meaningful activity, with one student stating that it “comes back to the people,” while others highlighted enjoyment, passion, and a sense of belonging as key motivators. Overall, while students acknowledged challenges related to time and scheduling, interview responses consistently indicated that music participation provides meaningful personal, cognitive, and social benefits.

Music Faculty Perspectives

Interviews with ensemble faculty highlighted structural and institutional factors that influence STEM students’ participation in music, particularly in relation to scheduling, time demands, and expectations of commitment.

Faculty consistently identified scheduling conflicts as a primary challenge, especially between rehearsals and laboratory courses. One director emphasized that ensembles are often “fighting all these labs that happen at this time of day,” noting that students frequently arrive late or leave early due to overlapping academic obligations. These conflicts were described as having both individual and ensemble-level impacts. Faculty also emphasized the time constraints faced by STEM students, often observing students managing multiple demanding commitments simultaneously. Students were described as “slipping in and out of rehearsal” while balancing extensive academic workloads. This aligns with students’ reported challenges in time management and scheduling.

A key theme across faculty interviews was commitment and realistic expectations. One director noted that the expectation for participation in ensembles requires students to “honor that commitment,” framing it as part of learning “adult choices.” At the same time, faculty acknowledged that STEM students cannot be expected to meet the same practice demands as

music majors, emphasizing that “you can’t ask somebody to put in that time,” given their academic workload. This reflects an awareness of the need to adjust expectations based on students’ academic priorities. Music faculty also highlighted the role of music in fostering discipline, accountability, and collaboration. Ensemble participation was described as requiring students to be “accountable to a group,” in which individual preparation directly impacts collective performance. Additionally, music ensembles were characterized as highly collaborative environments.

Finally, faculty described music as providing opportunities for communal engagement and personal expression, in contrast to the structured, technical demands of STEM fields. Ensemble participation was viewed as a “communal effort... very unlike most of what they do in their academics”, reinforcing its role as a distinct and complementary experience. Overall, faculty perspectives reinforce student-reported experiences, particularly regarding time constraints, scheduling conflicts, and the balance between commitment and academic priorities.

DISCUSSION

This study examined how music ensemble participation relates to academic performance, time management, and cognitive well-being among STEM students. The findings indicate that music participation does not negatively affect academic outcomes, while providing measurable benefits in time management, stress relief, and personal development. Together, the quantitative and qualitative results suggest that music functions as a supportive and complementary activity within STEM education rather than a competing demand.

A central finding of this study is the absence of a significant difference in GPA between students who participate in music and those who do not. Despite the additional time commitment required for rehearsals and performances, STEM students involved in music maintained

academic outcomes comparable to their peers. This aligns with prior research indicating that music participation does not hinder academic achievement and may coexist with strong academic performance (Guhn et al. 308). Interview data helped explain this pattern, as students consistently reported that academics have a higher priority and that they structure their musical involvement around coursework demands. This prioritization allows students to engage in music without compromising academic responsibilities.

While GPA outcomes were similar, differences emerged in perceived time management ability. Students involved in music were more likely to report strong time management skills than those not involved in music. This supports existing research suggesting that structured extracurricular activities promote organizational skills and self-regulation (Jing, 2023). Interview responses further reinforce this finding, as students described actively prioritizing tasks, managing competing deadlines, and adapting their schedules around both academic and musical commitments. These results suggest that music participation may contribute to the development of time management strategies, even if it does not directly improve academic performance.

Another key finding is the role of music in supporting cognitive well-being and stress management. A majority of students reported that music provides a mental break from academic work and improves mood and focus. This aligns with prior studies demonstrating the psychological benefits of music engagement, including reduced stress and improved emotional resilience (Wang et al.). Interview data provide additional context, with students describing music as a “mental reset” and a contrast to the technical nature of STEM coursework. These findings suggest that the benefits of music participation may stem not from direct academic enhancement but from its role in maintaining cognitive balance and reducing burnout.

The results also highlight the development of transferable skills through music participation. Students reported improvements in memory retention, problem-solving, communication, and teamwork. These findings are consistent with research linking music training to cognitive development and enhanced executive function (Intolubbe-Chmil). Faculty interviews further emphasize the importance of accountability and collaboration in ensemble settings, suggesting that music provides a structured environment in which students develop interpersonal and organizational skills relevant to academic and professional contexts.

Despite these benefits, the study identifies several challenges associated with balancing music and STEM coursework. Time constraints and scheduling conflicts were the most frequently reported barriers, particularly conflicts between rehearsals and laboratory courses. Both student and faculty interviews emphasize that these challenges are largely structural rather than individual, arising from competing institutional demands. Faculty perspectives also highlight the tension between maintaining ensemble commitment and recognizing STEM students' academic priorities. This suggests that the difficulty of balancing music and STEM is not due to a lack of ability, but rather the absence of coordinated support between disciplines.

An important theme emerging from both quantitative and qualitative data is the role of community and personal motivation in sustaining music participation. Students frequently cited social connections, enjoyment, and personal fulfillment as key reasons for continuing in music, even amid academic pressures. This aligns with research indicating that extracurricular engagement fosters a sense of belonging and motivation, thereby contributing to overall student success (Dingle et al.). Music ensembles, therefore, function not only as skill-building environments but also as important social and emotional support systems.

Overall, the findings of this study support the argument that music participation enhances aspects of student experience that are not captured by traditional academic metrics. While it does not produce measurable gains in GPA, it contributes to improved time management, reduced stress, and the development of transferable skills. At the same time, structural barriers such as scheduling conflicts limit accessibility and create additional challenges for students. These results suggest that music should be viewed as a valuable complementary component of STEM education, with potential benefits that extend beyond academic performance alone.

Several limitations should be considered when interpreting the findings of this study. First, the study relied heavily on self-reported survey data, including GPA, stress levels, time management ability, and perceived academic benefits of music participation. As a result, responses may be influenced by recall bias, self-perception, or social desirability bias. Second, the study was conducted at a single institution, the University of California, Riverside, which may limit the generalizability of the findings to other universities with different student populations, academic structures, or music programs.

Additionally, the sample sizes between participant groups were uneven, with the largest group consisting of STEM students enrolled in CHEM 008A and smaller samples drawn from music ensemble participants. While the study identified meaningful trends and perceptions, the cross-sectional design prevents causal conclusions regarding whether music participation directly improves academic performance or well-being. It is also possible that students who choose to participate in music already possess characteristics associated with stronger academic engagement, discipline, or institutional support.

Future expansions of this project could benefit from larger and more diverse participant samples across multiple universities. Collecting longitudinal data would allow for stronger

analysis of how sustained music participation influences academic performance, stress management, and well-being over time. Additional objective academic measures, such as verified GPA, retention rates, or graduation outcomes, could strengthen comparisons between groups. Future research could also further examine institutional factors, including faculty attitudes, scheduling conflicts, and availability of academic accommodations for student musicians. Finally, expanding qualitative interviews with both students and faculty across a wider range of ensembles and academic disciplines would provide deeper insight into how students navigate the balance between music participation and rigorous academic environments.

CONCLUSIONS

This study examined how participation in music ensembles influences academic performance, time management, and cognitive well-being among STEM students. The findings indicate that participation in music does not negatively impact academic performance, as GPA distributions were comparable between students involved in music and those who were not. At the same time, students participating in music reported stronger time management skills and significant benefits in stress reduction, mood, and overall well-being.

These results suggest that music functions as a complementary support system within STEM education rather than a competing demand. While music participation does not appear to directly enhance academic performance as measured by GPA, it contributes to important aspects of student success that are not captured by traditional academic metrics. In particular, music supports the development of transferable skills such as time management, communication, and collaboration, while also providing a structured outlet for stress relief and personal expression.

The findings also highlight the importance of community and engagement in sustaining student participation. Students consistently emphasized the social and motivational aspects of

music ensembles, indicating that these environments provide a sense of connection and fulfillment that complements the technical and often individual nature of STEM coursework. As a result, music participation may play a broader role in supporting student persistence and overall academic experience.

However, the study also identifies structural challenges, particularly related to time constraints and scheduling conflicts between academic and musical commitments. Both student and faculty perspectives indicate that these challenges are not due to a lack of ability or motivation, but rather the absence of coordinated support across disciplines. These findings suggest that institutions could better support STEM students by increasing scheduling flexibility, improving communication between departments, and maintaining accessible music opportunities for non-majors.

Overall, this study contributes to ongoing discussions about interdisciplinary engagement in higher education by demonstrating that music participation provides meaningful cognitive, social, and personal benefits without compromising academic outcomes. These findings support the continued inclusion and expansion of music programs within STEM-focused institutions, particularly to promote student well-being and holistic development.

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APPENDIX A

Survey Instrument — STEM/Non-STEM Students Not Participating in Music

This appendix contains the survey instrument administered to students enrolled in CHEM 008A who were not actively participating in university music ensembles.

1. What demographic do you fall under?

STEM/Non-STEM Student NOT in Music Ensemble

2. What is your major?
3. What is your year in school?

1st Year

2nd Year

3rd Year

4th Year

5th Year + Graduate Student

4. How many units are you enrolled in?

Less than 12

12–15

16–18

More than 18

5. Have you ever participated in music activities or ensembles at any point in your life?

Never

Yes, in the past (not during college)

Yes, in the past (in college)

Yes, in college

Currently Active

6. On average, how many hours per week do you spend on extracurricular activities?

0–2

3–5

6–8

9–12

13+

7. How do you typically manage your time between STEM coursework and extracurriculars or personal obligations?

I Schedule Everything Ahead of Time

I Prioritize Based on Deadlines

I Often Struggle with Time Management

I Just Do What I Can Without Planning

8. Have you ever had to miss a class, lab, or academic obligation due to extracurricular commitments?

Yes, Often

Yes, Occasionally

Rarely

Never

9. How would you rate your overall time management ability?

Very Poor

Poor

Neutral

Good

Excellent

10. What is your current cumulative GPA?

Below 2.5

2.5–2.9

3.0–3.4

3.5–3.9

4.0+

11. Have your extracurricular activities or other non-academic responsibilities impacted your academic performance?

Positively

Negatively

No noticeable impact

12. I believe involvement in structured activities (e.g., clubs, sports, volunteer work) has enhanced my academic skills.

Strongly Disagree

Somewhat Disagree

Neither Agree nor Disagree

Somewhat Agree

Strongly Agree

13. Which of the following academic skills do you think music has helped improve? (Select all that apply)

Time Management

Memory Retention

Problem-Solving

Stress Management

Critical Thinking

Other

14. I feel stressed about balancing school with my other responsibilities.

Never

Rarely

Sometimes

Often

Always

15. I feel that engaging in non-academic interests positively affects my academic success or mindset.

Strongly Disagree

Somewhat Disagree

Neither Agree nor Disagree

Somewhat Agree

Strongly Agree

16. I experience a sense of accomplishment or fulfillment from my extracurricular or personal activities.

Never

Sometimes

About half the time

Most of the time

Always

17. Have you ever considered joining a music ensemble in college?

Definitely Not

Probably Not

Might or Might Not

Probably Yes

Definitely Yes

18. Why or why not?

19. Do you believe that participating in the arts (e.g., music, dance, theater) could benefit

STEM students?

Definitely Not

Probably Not

Might or Might Not

Probably Yes

Definitely Yes

APPENDIX B

Survey Instrument — STEM Students Participating in Music Ensembles

This appendix contains the survey instrument administered to STEM students participating in university-affiliated music ensembles at the University of California, Riverside.

1. What is your major?
2. What is your year in school?
 - 1st Year
 - 2nd Year
 - 3rd Year
 - 4th Year
 - 5th Year + Graduate Student
3. How many units are you enrolled in?
 - Less than 12
 - 12–15
 - 16–18
 - More than 18
4. How long have you been involved in music (as a musician or in an ensemble)?
 - Less than 1 Year
 - 1–2 Years
 - 3–4 Years
 - 5+ Years
5. What type of musical involvement do you have? (Select all that apply)
 - Ensemble Member

Solo Musician

Private Lessons

Composer

Other

6. What type of ensemble(s) are you or have you been a part of? (Select all that apply)

Orchestra

Jazz Ensemble (Big Band)

Jazz Combo

Concert Band/Wind Ensemble

Chamber Music

Choir/Choral

Latin American Music Ensemble

Taiko

Gamelan

Mariachi

Rondalla

Rock Band

Pit Orchestra

Wind Group

Brass Band

Other

7. How many years have you participated in a music ensemble while being a STEM student?

0–1

2–3

4+

8. Do you plan to continue participating in music after graduation?

Definitely Not

Probably Not

Might or Might Not

Probably Yes

Definitely Yes

9. How many hours per week do you spend in ensemble rehearsals?

0–2

3–5

6–8

9–12

13+

10. How many hours per week do you spend practicing your instrument outside of rehearsals?

0–2

3–5

6–8

9–12

13+

11. How do you manage time between STEM coursework and music activities?

I Schedule Everything Ahead of Time

I Prioritize Based on Deadlines

I Often Struggle with Time Management

I Just Do What I Can Without Planning

12. Have you ever had to miss a rehearsal due to STEM coursework?

Yes, Often

Yes, Occasionally

Rarely

Never

13. Have you ever had to miss a class, lab, or academic obligation due to music commitments?

Yes, Often

Yes, Occasionally

Rarely

Never

14. How would you rate your ability to manage your time between STEM and music?

Very Poor

Poor

Neutral

Good

Excellent

15. What is your current cumulative GPA?

Below 2.5

2.5–2.9

3.0–3.4

3.5–3.9

4.0+

16. How has your participation in music affected your academic performance?

Positively

Negatively

No noticeable impact

17. Have you ever had to adjust academic deadlines due to music commitments?

Yes, Often

Yes, Occasionally

Rarely

Never

18. I believe my musicianship has enhanced my academic skills (e.g., focus, problem-solving, discipline).

Strongly Disagree

Somewhat Disagree

Neither Agree nor Disagree

Somewhat Agree

Strongly Agree

19. Have you ever received academic support or accommodations due to your music involvement?

Yes

No

I Didn't Know This Was an Option

20. Which of the following academic skills do you think music has helped improve? (Select all that apply)

Time Management

Memory Retention

Problem-Solving

Stress Management

Critical Thinking

Other

21. How often do you feel stressed about balancing STEM coursework and music?

Never

Rarely

Sometimes

Often

Always

22. Participating in music provides a mental break or reduces stress from STEM coursework.

Strongly Disagree

Somewhat Disagree

Neither Agree nor Disagree

Somewhat Agree

Strongly Agree

23. How often do you experience a sense of accomplishment or fulfillment after musical activities?

Never

Sometimes

About half the time

Most of the time

Always

24. Does being a musician positively impact your overall mood or cognitive focus?

Yes, Significantly

Yes, Somewhat

No Impact

25. Which aspects of musicianship do you find most helpful in relieving academic stress?

Rehearsals

Personal Practice

Performing

Socializing with Musicians

None of the Above

Other

26. Have you ever considered quitting music due to academic pressures?

No

Maybe

Yes

27. What has been the biggest challenge of balancing music and STEM studies?

Time Constraints

Stress Levels

Scheduling Conflicts

Lack of Faculty Support

Other

28. Would you recommend music participation to other STEM students?

Yes, Strongly

Yes, Somewhat

No

29. If music ensembles were to offer academic accommodations or schedule adjustments, would that help you continue participating?

Yes, Significantly

Yes, Somewhat

No Impact

30. Would you be interested in having a one-on-one interview on your personal experiences in music and STEM?

Yes

No

31. If yes, please input email.

APPENDIX C

Survey Instrument — Non-STEM Students Participating in Music Ensembles

This appendix contains the survey instrument administered to non-STEM students participating in university-affiliated music ensembles at the University of California, Riverside.

1. What is your major?
2. What is your year in school?
 - 1st Year
 - 2nd Year
 - 3rd Year
 - 4th Year
 - 5th Year + Graduate Student
3. How many units are you enrolled in?
 - Less than 12
 - 12–15
 - 16–18
 - More than 18
4. How long have you been involved in music (as a musician or in an ensemble)?
 - Less than 1 Year
 - 1–2 Years
 - 3–4 Years
 - 5+ Years
5. What type of musical involvement do you have? (Select all that apply)
 - Ensemble Member

Solo Musician

Private Lessons

Composer

Other

6. What type of ensemble(s) are you or have you been a part of? (Select all that apply)

Orchestra

Jazz Ensemble (Big Band)

Jazz Combo

Concert Band/Wind Ensemble

Chamber Music

Choir/Choral

Latin American Music Ensemble

Taiko

Gamelan

Mariachi

Rondalla

Rock Band

Pit Orchestra

Wind Group

Brass Band

Other

7. How many years have you participated in a music ensemble while being a college student?

0–1

2–3

4+

8. Do you plan to continue participating in music after graduation?

Definitely Not

Probably Not

Might or Might Not

Probably Yes

Definitely Yes

9. How many hours per week do you spend in ensemble rehearsals?

0–2

3–5

6–8

9–12

13+

10. How many hours per week do you spend practicing your instrument outside of rehearsals?

0–2

3–5

6–8

9–12

13+

11. How do you manage time between academic responsibilities and music activities?

I Schedule Everything Ahead of Time

I Prioritize Based on Deadlines

I Often Struggle with Time Management

I Just Do What I Can Without Planning

12. Have you ever had to miss a rehearsal due to academic obligations?

Yes, Often

Yes, Occasionally

Rarely

Never

13. Have you ever had to miss a class or other academic responsibility due to music commitments?

Yes, Often

Yes, Occasionally

Rarely

Never

14. How would you rate your ability to manage your time between music and academics?

Very Poor

Poor

Neutral

Good

Excellent

15. Do you feel your involvement in music affects your ability to complete assignments or study for exams on time?

Yes, Positively

Yes, Negatively

No Impact

16. What is your current cumulative GPA?

Below 2.5

2.5–2.9

3.0–3.4

3.5–3.9

4.0+

17. How has your participation in music affected your academic performance?

Positively

Negatively

No noticeable impact

18. Have you ever had to adjust academic deadlines due to music commitments?

Yes, Often

Yes, Occasionally

Rarely

Never

19. Do you believe your musicianship has enhanced your academic skills (e.g., focus, problem-solving, discipline)?

Strongly Disagree

Somewhat Disagree

Neither Agree nor Disagree

Somewhat Agree

Strongly Agree

20. Have you ever received academic support or accommodations due to your music involvement?

Yes

No

I Didn't Know This Was an Option

21. Which of the following academic skills do you think music has helped improve? (Select all that apply)

Time Management

Memory Retention

Problem-Solving

Stress Management

Critical Thinking

Other

22. How often do you feel stressed about balancing academics and music?

Never

Rarely

Sometimes

Often

Always

23. Participating in music provides a mental break or reduces stress from academic responsibilities.
- Strongly Disagree
 - Somewhat Disagree
 - Neither Agree nor Disagree
 - Somewhat Agree
 - Strongly Agree
24. How often do you experience a sense of accomplishment or fulfillment after musical activities?
- Never
 - Sometimes
 - About half the time
 - Most of the time
 - Always
25. Does being a musician positively impact your overall mood or cognitive focus?
- Yes, Significantly
 - Yes, Somewhat
 - No Impact
26. Which aspects of musicianship do you find most helpful in relieving academic stress?
- Rehearsals
 - Personal Practice
 - Performing
 - Socializing with Musicians

None of the Above

Other

27. Have you ever considered quitting music due to academic pressures?

No

Maybe

Yes

28. What has been the biggest challenge of balancing music and your academic studies?

Time Constraints

Stress Levels

Scheduling Conflicts

Lack of Faculty Support

Other

29. Would you recommend music participation to other students in your major?

Yes, Strongly

Yes, Somewhat

No

30. If music ensembles were to offer academic accommodations or schedule adjustments, would that help you continue participating?

Yes, Significantly

Yes, Somewhat

No Impact

APPENDIX D

Interview Questions for Music Faculty and Ensemble Directors

This appendix contains the semi-structured interview questions administered to university music faculty members and ensemble directors regarding their observations of students balancing music participation and STEM coursework.

1. From your perspective, what are the biggest challenges STEM students face when balancing music and academics?
2. Have you noticed any academic or cognitive benefits in students who participate in music alongside their STEM coursework?
3. Do you believe involvement in music enhances skills such as problem-solving, discipline, or creativity in STEM students? Why or why not?
4. How do you perceive the time management struggles of students who are both musicians and STEM majors?
5. What advice would you give to students trying to maintain both their STEM and musical commitments?
6. In what ways could the university better support students who are engaged in both music and STEM?
7. Do you think music participation should be encouraged among STEM students? Why or why not?