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Core Academic Offerings in Michigan Agriculture, Food, and Natural Resources Education Programs

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Abstract

Offering core academic credits (e.g., math, science) for completing agriculture, food, and natural resources (AFNR) coursework at the secondary school level has the potential to increase the strength of the AFNR program as well as student interdisciplinary learning. Informed by the Career and Technical Education Student Typology, we explored the scope of core academic offerings in Michigan AFNR programs, including the frequency of core academic offerings, AFNR course types in which core academics are offered, and types of core academic credit obtained. Findings indicate 95.00% of Michigan teachers responding to the survey offered some form of core academic credit through their AFNR coursework. Additionally, findings suggest science is the most obtained core academic credit and the predominance of core academic credit is being offered in introductory course types within AFNR programs. These findings, among others, were synthesized into three conclusions which focus on the frequency of core academic offerings, strength of science as an integrated discipline, and identified opportunities to expand core academic offerings. The paper concludes with a roadmap for continued efforts to enhance core academic offerings and AFNR programs via a combination of research and practice.

Keywords: academic credit; English Language Arts; foreign language; interdisciplinary; math; science

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Introduction

Strong organizations rely on a sustained pipeline of motivated and engaged members (Winston, 2011). Therefore, the strength of a secondary school agriculture, food, and natural resources (AFNR) program is determined, in part, by the recruitment and retention of students (Myers et al., 2003). The programmatic feature perceived by teachers to be most effective and, thus, most

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frequently implemented to recruit students into AFNR programs is providing academic credit (e.g., science, math) for completing AFNR coursework (Nowakowski & McKim, 2021). Providing academic credit via elective coursework allows students to explore and strengthen their interests in AFNR, for example, while also meeting graduation requirements which are increasingly weighted toward core academics (Aliaga et al., 2012).

The benefits of offering core academic credit within AFNR coursework, however, are not reserved to student recruitment. Providing a learning space where core academic content and AFNR can be learned in congruence draws student attention to the overlap between multiple systems of knowledge (Scherer et al., 2019). Making connections between AFNR and core academic areas is an effective strategy for helping students learn areas like science by making abstract concepts "real" through the context of AFNR (Gonzalez & Kuenzi, 2012; McKim et al., 2017a; Stubbs & Myers, 2015). The opportunity to strengthen core academic learning through AFNR education is particularly salient given continued evidence of student underperformance in core academics in the United States (National Academy of Engineering & National Research Council, 2014).

The relationship between offering core academic credits in AFNR education, student recruitment, and student learning make research into this topic important. Therefore, we explored the academic offerings available in Michigan AFNR programs. Results from this research provide a foundation of knowledge regarding the current scope and future opportunities associated with core academic credit offerings in AFNR education. Further, results provide a pragmatic roadmap for school districts to expand core academic offerings in alignment with norms across the state.

Literature Review

The literature pertaining to core academic offerings was organized into three themes for our literature review. The three themes are (a) academic overlap, (b) role of the teacher, and (c) academic credit offerings.

Academic Overlap

Scholars in AFNR education have consistently identified overlap between AFNR concepts and core academic content (McKim et al., 2017a; Scherer et al., 2019). This overlap has led to calls for curriculum integration or illumination, in which core academic content is intentionally embedded or highlighted in secondary school AFNR curriculum (McKim et al., 2017a). The impetus for these calls includes the value of crafting interdisciplinary learning experiences in which learners simultaneously engage multiple disciplines of knowledge (Boix Mansilla et al., 2000; Nikitina, 2006; Pauley et al., 2019). Most notably, interdisciplinary learning experiences more adequately mirror authentic problems occurring in socio-ecological systems; therefore, learning experiences which are interdisciplinary better prepare students to address complex problems during and after their time in an AFNR program (McKim et al., 2019; Scherer et al., 2019).

Noted by Scherer et al. (2019) in their comprehensive review of STEM education research within AFNR education, there exists a dearth of scholarship detailing *how* core academic areas are actually incorporated within AFNR curriculum. Noting the value of these investigations for educators, scholars call for research exploring pragmatic approaches teachers are using to fuse core academic and AFNR learning. Heeding this call, we pinpoint the courses in which Michigan AFNR teachers are offering core academic credit to illuminate the *where* and *when* core academic learning is occurring within AFNR programs.

Role of the Teacher

Incorporating content from other disciplines into AFNR courses requires the AFNR teacher be both motivated to do so and knowledgeable of the incorporated content (McKim et al., 2017a). Research conducted by McKim et al. (2017a) suggested AFNR teachers fall into one of three categories detailing their ability to illuminate science concepts present within AFNR content: science illuminators (i.e., high motivation, high competence), illumination attempters (i.e., high motivation, low competence), and vocational purists (i.e., low motivation). Shifting from science to math, an investigation of teacher characteristics found perceived behavioral control to be the only statistically significant predictor of math integration within AFNR coursework (McKim et al., 2017b). Regarding English Language Arts (ELA), a 2015 study by McKim et al. found teachers valued the integration of reading and writing within their coursework, but perceived ELA integration as an area of potential professional growth.

Existing research positions educators as the gatekeepers to core academic learning in AFNR education. To increase the prevalence of core academic learning within the discipline, teachers need to be motivated, knowledgeable, and empowered to incorporate core academics within their curriculum. Identifying the distribution of core academic credits being earned in Michigan AFNR classrooms provides teachers with a broadened perspective of the opportunities and importance of core academic learning within AFNR education which may lead to more teachers incorporating core academic credits and interdisciplinary learning within their program.

Academic Credit Offerings

In response to consistent evidence of academic underperformance among students in the United States, policies (e.g., No Child Left Behind) have been implemented to increase core academic credit requirements for high school graduation (Fletcher Jr., 2006). Increasing core academic requirements has a negative impact on elective areas, like AFNR education, due to reduced availability in course schedules (Martin et al., 2006). To address this challenge, disciplines like AFNR education have evolved to illuminate the core academic standards inherent within their curriculum, justifying their elective coursework to meet core academic learning requirements (Martin et al., 2006; McKim et al., 2017a). Research on specific courses teachers leverage for core academic credit and specific types of academic credit obtained is, however, scant. This gap in the literature misses an opportunity to inform educators on *how* to align core academic integration efforts with others based on empirical evidence. Therefore, the work being detailed in this study seizes an important opportunity to empower educators, school districts, and the AFNR education discipline to meet the goals of learners within core academics and AFNR.

Theoretical Framework

Our study is framed by the Career and Technical Education (CTE) Student Typology (Aliaga et al., 2012, 2014). This typology supplants categorizing students as either *academic* or *vocational*, a categorization system which fails to acknowledge evolving graduation requirements mandating all students, including those traditionally classified as vocational, engage in increased core academic credits (Aliaga et al., 2012, 2014). Alternatively, the CTE Student Typology suggests most secondary school students experience a combination of CTE and core academic coursework and, consequently, authors proposed a continuum of eight categories (i.e., ranging from “zero CTE credits” to “high intensity CTE”) representing varying levels of academic and vocational engagement (Aliaga et al., 2012, 2014). Our research builds on this foundation by

exploring the combination of academic and CTE learning at the course level, analyzing academic credit obtained by completing Michigan AFNR coursework.

Purpose and Objectives

Through this research, we sought to understand the scope of core academic credits being offered in Michigan AFNR programs. In addition, we found utility in understanding the AFNR course types aligned to core academic credits as well as the type of core academic credit being offered. Achieving these aims yields insights for current teachers, school administrators, and the AFNR education profession to understand *what* academic credit is being offered *where* in the Michigan AFNR education curriculum. In so doing, local programs can compare their suite of core academic offerings to state norms to identify opportunities to expand core academic offerings to come into alignment with state norms as well as innovate by finding new opportunities to align AFNR coursework with core academic areas underrepresented throughout the state.

Conducting this important scholarship was guided by three research objectives: (a) identify the percentage of Michigan AFNR programs in which students receive at least one core academic credit; (b) identify the types of AFNR courses in which science, math, ELA, and foreign language credits are offered; and (c) identify the type of academic credit received via AFNR courses.

Methods

Our investigation into the core academic credit offerings within Michigan AFNR programs was completed using survey research methods. Data reported in this manuscript are part of a larger research project exploring core academic integration in AFNR education.

Population and Data Collection

The population for this study included all school-based AFNR education teachers in Michigan during the 2020-2021 school year ($N = 139$). The population frame, including teacher names and email addresses, was obtained from the Michigan FFA office in accordance with accepted Institutional Review Board (IRB) policies. Given our interest in understanding the scope of core academic offerings across the state, a census of all Michigan teachers was attempted. A maximum of four emails were sent to potential respondents between March 21, 2021 and April 26, 2021 soliciting their engagement in the survey (Dillman, 2007). A total of 100 surveys were completed, yielding a 71.94% response rate. To evaluate potential non-response bias, the core academic offerings of respondents to the first two email solicitations ($n = 63$) were compared to the core academic offerings of respondents from the second two email solicitations ($n = 37$). The lack of statistically significant differences between the two groups (i.e., p-values $< .05$) suggests non-response bias was not an issue within our data (Lindner et al., 2001; Miller & Smith, 1983). Further evidence to support the lack of non-response bias comes from the similarity of current respondent demographic data and known demographic data of Michigan AFNR teachers (Nowakowski & McKim, 2021).

Instrumentation

The Qualtrics survey developed for this project included an introductory block, five response blocks for science, five response blocks for math, five response blocks for ELA, five response blocks for foreign language, and a demographic block. The introductory block narrowed

which response blocks were appropriate for respondents by asking which, if any, core academic areas were offered within the AFNR program. Introductory block responses led participants to the first block within a core academic area offered within their program. For example, if on the introductory block, Respondent A indicated science credit was offered through their AFNR program, Respondent A would be directed to the first science credit block. Within the first block of science, for example, respondents identified one science credit (e.g., life science) obtained through their AFNR program coursework. In addition, respondents indicated the AFNR course, or series of courses (i.e., coursework options described in the data analysis section), required to obtain the credit. To complete the block, respondents were asked if an additional science credit, for example, could be obtained through the AFNR program. If yes, respondents were directed to the second block within the core academic area, with questions mirroring the first block. Once the series of blocks for one academic area was complete and respondents had entered information for each credit available within their program within that academic area, respondents moved to the next core academic area block series in accordance with their responses in the introductory block (e.g., if they also offered math credit, they would then start with block one of math credit). The final block for all respondents contained demographic questions, including questions pertaining to educational background and program characteristics.

Data Analysis

Data analysis was completed using the Statistical Package for the Social Sciences. First, data were imported from Qualtrics, reviewed for completeness, and variable names were changed to assist with data interpretation. Research objective one was completed by identifying the percentage of respondents who indicated teaching science, math, ELA, or foreign language credits. Additionally, the proportion of respondents offering any academic areas was calculated by combining responses from each academic area. For research objective two, a total number of instances of academic credit being offered in AFNR courses was calculated and then concatenated by respondent-selected course type. AFNR course type options (i.e., 16 total) were developed based on course conventions in Michigan and included introductory and advanced general agriculture, plant sciences, animal sciences, agribusiness, leadership, agricultural mechanics, natural resources, and food science. For the final research objective, we categorized respondents' indication of core academic credit received by the Michigan Merit Curriculum graduation requirements (Michigan Department of Education, 2017) and counted the instances within each graduation requirement subcategory (e.g., life science, general math).

Description of respondents. The majority of respondents to the demographic section (i.e., 77.24%) completed an undergraduate or graduate degree in AFNR education that included teacher certification. Additionally, 66.73% of demographic question respondents had completed a postgraduate degree at the time of data collection. On average, demographic respondents had taught school-based AFNR education for 9.57 years. Furthermore, 78.52% of demographic respondents taught in rural school districts and had an average of 97.45 students enrolled in their program.

Findings

The first objective focused on the scope of core academic credit being taught in Michigan AFNR programs (see Table 1). Inclusive of all potential academic areas, 95.00% of respondents taught at least one course where core academic credit could be obtained. Digging deeper, the most offered core academic area in Michigan AFNR programs was science (89.00%) followed by math (43.00%) and foreign language (38.00%). A total of 9.00% of respondents indicated offering at least one ELA credit through their AFNR program coursework.

Table 1

Frequency of Core Academic Credit Offerings in Michigan AFNR Courses (*n* = 100)

Academic Offering	Frequency	Percentage
Some Academic Offering	95	95.00%
Science	89	89.00%
Math	43	43.00%
Foreign Language	38	38.00%
English Language Arts	9	9.00%

For the second objective, we turned our attention to the AFNR education courses in which science, math, ELA, and foreign language credits were being offered (see Table 2). In total, there were 410 instances of a core academic credit being offered across AFNR course types. Science (*f* = 270) accounted for 65.85% of these instances followed by math (*f* = 71) and foreign language (*f* = 60). Of the four core academic areas considered, ELA was the least prominent across the AFNR course types (*f* = 9). Looking across the 16 course types, the most frequently used course type for core academic credit offerings was Introductory Animal Science (*f* = 77) which accounted for 18.78% of the recorded instances. Rounding out the top three, Introductory General Agriculture (*f* = 68) and Introductory Plant Science (*f* = 66) comprised 16.59% and 16.10% of course instances respectively. The course types in which the least core academic credit was offered included Advanced Agricultural Mechanics (*f* = 0), Advanced Leadership (*f* = 6), Introductory Agricultural Mechanics (*f* = 6), and Advanced Food Science (*f* = 6).

Table 2

Distribution of Core Academic Credit Received by AFNR Course Type (*n* = 100)

Course Type	Science	Math	Foreign Language	ELA	Course Type Total
Introductory Animal Science	56	7	12	2	77
Introductory General Agriculture	40	13	12	3	68
Introductory Plant Science	50	5	11	0	66
Introductory Natural Resources	27	3	2	0	32
Advanced Animal Science	19	7	5	1	32
Advanced General Agriculture	12	10	5	2	29
Advanced Plant Science	9	7	4	1	21
Introductory Food Science	15	2	2	0	19
Introductory Leadership	13	2	4	0	19
Introductory Agribusiness	9	5	1	0	15
Advanced Natural Resources	6	1	0	0	7
Advanced Agribusiness	2	5	0	0	7
Advanced Food Science	5	1	0	0	6
Introductory Agricultural Mechanics	4	1	1	0	6
Advanced Leadership	3	2	1	0	6
Advanced Agricultural Mechanics	0	0	0	0	0
Instance Total	270	71	60	9	410

Note. Multiple core academic credits could be offered by a single teacher and teachers could indicate multiple course types to describe an AFNR course; therefore, response totals are not constrained to the number of respondents.

Focusing on science credit distribution across AFNR courses (see Table 2), the most used AFNR course type in Michigan to offer science credit was Introductory Animal Science (f = 56), accounting for 20.74% of the instances relating to science. Introductory Plant Science (f = 50) and Introductory General Agriculture (f = 40) completed the top three AFNR course types most used for science credit. The AFNR course types least likely to count for science credit in Michigan were Advanced Agricultural Mechanics (f = 0), Advanced Agribusiness (f = 2), and Advanced Leadership (f = 3).

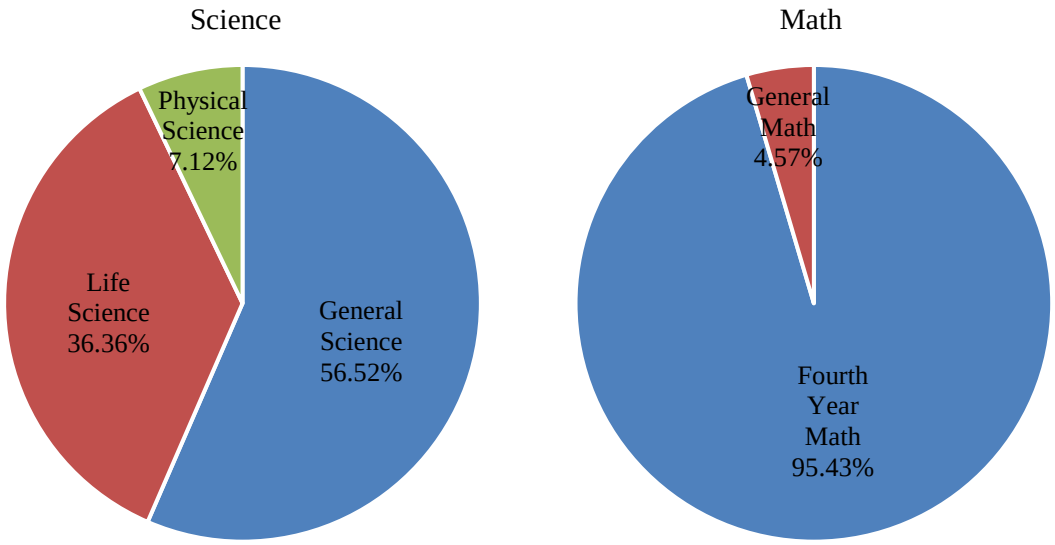
Within math (see Table 2), credits were most received within Introductory General Agriculture course types (f = 13) which accounted for 18.31% of the math instances. Advanced General Agriculture (f = 10) was the second most likely course type to include math credits followed by three courses which had seven instances, including Introductory Animal Science, Advanced Animal Science, and Advanced Plant Science. Four course types received one or zero instances of math credit being offered, including Advanced (f = 0) and Introductory (f = 1) Agricultural Mechanics, Advanced Natural Resources (f = 1), and Advanced Food Science (f = 1).

For the final core academic area, ELA (see Table 2), only nine total instances occurred across all AFNR course types. Those course types in which ELA credits were offered included Introductory General Agriculture (f = 3), Introductory Animal Science (f = 2), Advanced General Agriculture (f = 2), Advanced Animal Science (f = 1), and Advanced Plant Science (f = 1).

For the final objective, we identified the type of core academic credit received for each discipline, defined by the Michigan Merit Curriculum requirements for graduation (see Figure 1). In science, the majority of AFNR courses received a General Science credit (i.e., 56.52%), with 36.36% receiving a Life Science and 7.12% receiving a Physical Science credit. In the math discipline, the majority of AFNR courses received a fourth-year math credit (95.43%), with only 4.57% receiving a general math credit. The other disciplines were not separated into subcategories because the Michigan Merit Curriculum simply requires four ELA credits and two foreign language credits for graduation.

Figure 1

Distribution of Credits Within Science and Math Offered in Michigan AFNR Programs



Conclusions and Discussion

The potential gains in student numbers and interdisciplinary learning make offering core academic credits through AFNR programs a valuable approach. Research suggests offering core academic credits is common in AFNR (Nowakowski & McKim, 2021), however, additional information regarding the scope of core academic credits in Michigan is needed to empower teachers and the discipline to promote additional core academic learning opportunities. Findings from this research highlight three critical conclusions regarding core academic offerings in Michigan; these conclusions are titled (a) core academic frequency, (b) science strength, and (c) opportunities for expansion.

Core Academic Frequency

The CTE Student Typology (Aliaga et al., 2012, 2014) suggests student experiences are no longer solely vocational or academic; instead, their experiences entail courses combining vocational *and* academic learning. In the current study, we found 95.00% of programs in Michigan offer some form of core academic credit within their elective AFNR coursework. Therefore, our data support the assertions made by Aliaga et al. (2012, 2014). The prevalence of core academic offerings in Michigan AFNR programs is most likely a strategy used by educators to increase the relevance of their coursework in the face of mounting core academic graduation requirements (Martin et al., 2006; McKim et al., 2017a). Regardless of motivation, the overwhelming majority of AFNR programs in Michigan incorporating core academic learning positions programs to reap the associated recruitment benefits (Nowakowski & McKim, 2021) and provides a foundation for interdisciplinary learning within AFNR programs.

The findings from this study suggest more core academic integration (i.e., 73.66% of instances across disciplines) occurs in “introductory” course types. This finding contradicts conventional thinking - that core academic integration is reserved for advanced AFNR courses (e.g., Advance Animal Science, Advanced Plant Science) which cover topics in more depth.

Instead, these data indicate teachers are incorporating core academic credits within courses attracting novice students. We posit the prevalence of core academics within introductory courses is less dependent on the nature of the AFNR course and more dependent on the core academic credit being received. Specifically, more foundational concepts in core academic areas are being included within the AFNR curriculum and, thus, occur earlier in their academic progress when they take introductory AFNR courses. Meanwhile the advanced core academic concepts appear to be reserved for the core academic classroom itself.

The final discussion item relating to the frequency of core academic offerings relates to foreign language credits being earned through AFNR programs in Michigan. This finding is worth discussing as one would not naturally connect AFNR curriculum with foreign language content. In Michigan, students are required to complete two foreign language credits to graduate; however, completing a CTE program waves one of the two required foreign language credits (Michigan Department of Education, 2017). Therefore, some respondents indicated this waving of requirements within the survey.

Science Strength

The second conclusion theme foregrounds findings relating to science credit. In total, 89.00% of respondents indicated teaching AFNR courses which count for science credit. Research within the discipline has continually reinforced the overlap between science education and AFNR education (McKim et al., 2017a; Scherer et al., 2019); therefore, finding some overlap was expected. However, the scope of science credit offerings across the state was broader than initially imagined. Reflecting upon these findings led us to consider two structural realities in Michigan that may explain the high instance of science credit being earned. First, until recently, the only AFNR teacher education institution in the state, Michigan State University, required preservice teachers include a minor teaching area in their coursework, leading to teaching certifications in a minimum of two subject areas. The overlap in required coursework between the AFNR education major and biology minor led many to pursue their teaching minor in biology. This resulted in many AFNR programs in which the teacher also teaches a non-AFNR biology course. Importantly, respondents were counseled not to include these non-CTE courses within their responses. It is our position, however, that the training received through preservice education and experiences teaching non-AFNR science courses has positioned Michigan AFNR teachers to seamlessly teach science credit through their AFNR courses.

The second structural reality in Michigan potentially contributing to the science strength is a tool commonly used by Michigan AFNR teachers. This tool helps teachers organize curriculum standards within their course sequence. Originally designed to increase program funding, the tool has been expanded to illuminate Next Generation Science Standards (NGSS) which are aligned to the Michigan academic standards. Within the tool, the final course report details the NGSS which overlap with selected AFNR standards, as identified by Michigan teachers, and example curriculum to teach to reinforce those interdisciplinary connections.

In total, the overlap between science and AFNR concepts, dual teaching certification requirements, and tool built to illuminate connections between science and AFNR have contributed to a robust portfolio of science credit being received through AFNR programs across the state. For states seeking to increase science credit offerings in AFNR, similar initiatives should be considered to shift the landscape of science credit availability.

Opportunities for Expansion

In addition to identifying strengths relating to core academic offerings in Michigan, the current research also highlighted areas of potential growth. One area of potential growth relates to ELA credits being obtained through AFNR coursework. Existing research notes teachers support the integration of ELA within their AFNR coursework (McKim et al., 2015); this integration, however, requires resources and professional support to make this overlap a reality. This presents a tremendous opportunity for AFNR education faculty, for example, to collaborate with ELA Education faculty to create resources to be implemented within AFNR education to enhance ELA learning through AFNR courses, laying the foundation for expanded ELA credit offerings in AFNR education.

Similarly, there exists an opportunity for collaborative work between experts in agricultural mechanics, mathematics education, and science education to collaboratively develop resources and tools to increase the potential for core academic integration via agricultural mechanics coursework. One prime instance of overlap is between agricultural mechanics and physical sciences, which accounted for only 7.12% of science credit obtained in Michigan. Beyond students obtaining academic credit, providing these resources will empower teachers to educate students using curriculum which draws valuable connections between AFNR, math, and science in a learning atmosphere representing diverse, emerging careers in agricultural technology.

The final opportunity for expansion attends to the relatively low proportion (i.e., 36.34%) of instances in which advanced AFNR courses were leveraged for core academic credit. Seizing this opportunity is not without challenges. It is expected teachers of core academic areas want to maintain ownership over advanced disciplinary courses. As a path forward, administrators within schools where advanced AFNR courses are being counted for core academic credit should detail the circumstances and strategies being leveraged and communicate those instances with administrators in schools which would benefit from similar overlap. In this way, advanced AFNR courses including core academic credit expands via individuals in the school (i.e., administrators) who can bring together AFNR and core academic educators to find mutually beneficial approaches to seize the learning benefits of more interdisciplinary, advanced AFNR courses.

Recommendations

The first two recommendations emanating from this research bring to attention two limitations of our research. The first limitation is an assumption that courses receiving core academic credit provide students with a more interdisciplinary learning experience than courses in which core academic credit is not offered. While likely, this assumption was not evaluated in the current study. Therefore, future research should consider evaluating the authenticity of core academic overlap occurring within AFNR courses in which core academic credits are received. The second limitation of this research stems for the diversity of AFNR education program in Michigan. Namely, some programs exist outside of the comprehensive public high school setting, in “career centers.” These centers, which focus exclusively on vocational training, attract students from upwards of fifteen or more neighboring high schools to attend an extended class session. The core academic credit obtained by engaging in these career center programs is dependent on each individual school sending students to the career center; therefore, respondents struggled to complete the survey given this variance. For scholars studying this line of inquiry, consideration for career center teachers is warranted and alternative data collection methods (e.g., qualitative interviews) are recommended in these instances.

The second portfolio of recommendations includes research and practical interventions to increase the core academic offerings within AFNR courses. Namely, we recommend these data be shared with Michigan AFNR teachers, counselors, and administrators to illustrate the breadth of core academic offerings in the state. Sharing this information should be paired with opportunities for schools to evaluate their current offerings and identify new pathways to increase core academic credits in AFNR programs. In addition to sharing this information with counselors and administrators in current programs, these data should be shared with academic leaders in schools without a current AFNR program to illustrate the interdisciplinary potential of AFNR education. From a research perspective, the next steps within this line of inquiry include exploring structural features which increase core academic offerings within AFNR programs. For example, research exploring teacher certification(s), administrative support, AFNR and core academic teacher relationships, community support, and preservice teacher course requirements may reveal particularly salient variables to consider regarding core academic credit offerings. Additionally, the experiences of AFNR educators, administrators, and counselors from schools offering core academic credit through AFNR programs could be explored via qualitative methods, potentially illuminating barriers and/or best practices.

The final recommended area for research includes investigations into the outcomes of core academic offerings on students and programs. Example outcome (i.e., dependent) variables to consider in these analyses include the demographics of students enrolled in the AFNR program, community and school support, and student preparedness to solve complex problems. This research, along with the other approaches recommended within this study, will lay a foundation to guide the future of core academic offerings in AFNR programs in Michigan and beyond. The opportunity to enhance AFNR programs and learning opportunities for students compels the importance of continued efforts within this important area.

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