SCHOOL COUNSELING AND THE PREPARATION OF PRE-COLLEGE STUDENTS FOR STEM CAREERS

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SUBJECT/PROBLEM

School counselors have a vital role in furthering STEM preparation among pre-college students. Secondary school coursetaking in mathematics and science has been shown to increase student selection of STEM majors as well as increase success in early college level STEM courses (Trusty, 2002; Tyson, 2011). Increasing the number of science and mathematics courses taken in high school suggests that school counselors must be involved with the student early in their secondary school experience (Enberg, 2013). Student caseload for counselors has been cited as a determining factor in whether students successfully transition from high school to college, as it has been noted that counselors advising less than 250 students are more likely to discuss college planning with students (Woods, 2014). Counselors must be trained in order to convey the range of STEM career options available to students (Enberg, 2013). This is particularly needed in lower income schools, where research has shown that counselors often have lowered expectations of these students which may impact mathematics and science coursetaking and achievement (Authors, 2013; West-Olatunji, 2010).

This pilot, ongoing research explored the following overarching questions: 1)How are school counselors prepared to offer advisement for science and engineering career preparation? 2) In what ways and to what extent do school counselors interact with students to impact pre-college preparation for post-secondary engineering study and careers? In an effort to collect data to answer these research questions, a professional development for school counselors was designed and implemented by university-based faculty to provide training in STEM preparation for post-secondary academic success. Participants were recruited for study participation.

DESIGN/PROCEDURE

This study employed a qualitative, phenomenological approach using a semi-structured interview protocol (Creswell & Creswell, 2017). Data were collected from a group of school counselors in middle and high schools to understanding current counseling practices and how university-based training might improve their knowledge base to impact student participation and preparation for STEM in higher education. Candidates were chosen using maximum variation sampling (Patton, 1990) from a pool of survey responses collected following the professional development program. From the counselor interviews, the research team attached open codes to different constructs in the transcripts and later developed axial codes to connect and better understand the roles of counselors and their work with students. The researchers coded responses independently followed by cross-case analysis and reached 90% interrater coding agreement after extended discussions.

Context. The study participants (n=10) were school counselors representing seven New York urban (n=2) and suburban (n=8) schools. Counselor job experience ranged from 1 year to 36 years with an average tenure of 15.5 years. Six of the schools were public schools with a single school classified as a public charter school. Geographically, the distance between the two furthest schools was just under 60 miles. School system enrollments (2017-18) ranged from

1,512 to 13,158 (6,282 average) students and spending from $15,366 to $37,682 ($26,846 average). Four schools were designated as high needs. Public school counselor caseloads as reported by the participants ranged from a minimum of approximately 170:1 to a maximum of 285:1. Counselor caseload for the urban charter system was not provided.

ANALYSIS/FINDINGS

Coding of the transcripts reveal six dominant themes found in counseling practices of these professionals and schools that impacted how students connect with STEM disciplines as a career.

Scheduling vs. Planning. All counselors noted that scheduling was an integral and substantial part of their job in the secondary school. However, it can be noted that there were two general practices among school counselors regarding scheduling. In some schools, scheduling involved simply rolling over the student's present schedule to the next sequential grouping of courses for the following year. So, for example, students who took Earth science in their 9th grade year were automatically enrolled in chemistry for 10th grade. Since scheduling occurred in many schools prior to January, counselors reviewed only 1st quarter grades prior to registration in the subsequent course. This process continued year to year. Depending on the student and the school, this process continued until either the student's minimum graduation requirements were fulfilled or the student completed a "strong" schedule suitable for college entrance. In this second scenario, students and counselors examined the student's transcript to identify subjects where the student enjoyed the greatest success, and then used this information to match the students to a career pathway.

Students and counselors in many of these schools aimed for graduation rather than planning how to successfully transition the student to the college environment. Little could be done at the high school level if the student was found deficient in coursetaking for a STEM major and counselor advice often centered on the student "catching up" or taking remedial courses at a community college. In other schools, there was a multi-year coordination of student interests and career interests with coursework to achieve a college or career goal. These counselors attempted to identify student strengths early with career interest inventories, and worked with the students to cultivate an achievable long-term plan. Some schools began this process in middle school with general interest inventories, while other schools initiated this process in high school with career interest inventories. The most robust planning systems required early student buy-in and built in backstops. A common backstop included periodic evaluation of student performance, which worked to refocus attention on the student's original career goals. These schools were more closely grooming students for careers.

Some counselors noted that students with career goals in place early were less likely to be registered into courses due to course easiness or the likability of the teacher, factors that influenced students with less fixed career aspirations.

Ability Tracking. The research team identified that, while not necessarily explicit, tracking continued to be prevalent in schools and that it could be difficult, if not impossible, for a student to change tracks. Inadvertent tracking often occurred in primary grade levels as some students were pulled from classes for additional services. Many counselors indicated that their schools offered accelerated mathematics (algebra) and science (Earth science or living environment) in 8th grade. Students who missed prerequisites for advanced standing lost upper level coursetaking opportunities in STEM, which may have affected their desire and ability to succeed in STEM

majors in college. When pressed, many counselors could only offer that students affected would have to "double-up" courses or work harder to catch up to their advanced peers. As a result, these students were unlikely to take advanced science and mathematics electives deemed necessary for success as a STEM student in college.

Active and Passive Gatekeeping. Initial findings indicated that some school counselors were not fully aware of the extent to which they were gatekeepers. While many understood the active role they played in helping students shape their career prospects, there were some indications that counselors could impede a student's progress toward a STEM career through their own inaction or lack of knowledge. None of the counselors interviewed had backgrounds in STEM. Several counselors indicated they were not well versed in all of the different types of engineering disciplines, for example, but felt confident that they could direct students to the correct resources if a student asked about them. This passive approach, however, may mean that a student seeking a career in a STEM discipline would not get needed information in a timely manner. Several counselors had preconceived notions of student aptitude, ability, or interest by referring to students as "math kids" or "science kids." This may deny access to students who might be fit for a career in STEM, but do not fit counselor expectations of a STEM student. In one case, an expectation was that math/science students have B+ or A grade point averages. Following this logic to its conclusion means that upper level physics and calculus courses in 12th grade are for the best of the best. Research has shown that these practices have often eliminated opportunities for students to take foundational coursework to prepare them for post-secondary STEM study and careers (Authors, 2008, 2013, 2018, 2019).

Students depend on counselors for accurate college and career information. Some counselors expressed surprised at how competitive admission to engineering programs have become and how students must the "hit the ground running" when they arrive on campus relying on strong mathematics and science preparation from high school. Some counselors had the notion that students could figure things out once they arrived on campus and that students could change majors easily if desired.

Counselor availability and student dependence on counselors may keep many students out of the counseling office. The data indicated that financially constrained and first-generation students had a high dependence on counselors. Also, students with high parental expectations and students who were high academic achievers also placed high demands on counselors. Some counselors acknowledged that because of crises that often presented during the school day, the workload easily expanded to fill working hours. Other students were likely to see counselors fewer times and receive less support.

Lastly, schools that scheduled rather than planned course registrations often built in a disconnect between pre-college preparation and college readiness. Some counselors acknowledged that many students showed interest in STEM majors as 11th or 12th grade students, but those without strong preparation had limited options. Many counselors recommended remediation in a community college with subsequent application to a four-year STEM program later.

Counseling Workplace Challenges. Counselors noted that regardless of their caseload that the workload filled available gaps in time. Some counselors noted that crisis management frequently interrupted student and parent appointments. Counseling offices have a seasonality to the work which put priority on some office functions that could reduce counselor interactions

with students. Greater paperwork requirements such as individual education plans (IEPs) were noted. Counselors consistently related that college recommendations and scheduling took a significant amount their time. Several counselors remarked that it was difficult to seek professional development programs outside of the school because the workload awaits when they return.

In addition to their obvious workload pressures, counselors indicated that political optics often added additional pressure and scrutiny surrounding class sizes, graduation rates, Advanced Placement statistics, and college bound rates.

School or District Leadership and Vision. Several statements indicated that counselors, by and large, valued relationship building and saw its importance as a significant factor in their interactions with students, student interactions with teachers, and collaborative interactions among teachers. Some counselors noted that much more could be done to foster interdisciplinary collaboration among STEM subject teachers and that team teaching and collaboration in STEM subjects was unusual. Larger scale collaboration between teachers in schools could put these subjects in a more prominent place in the life of the school and in the minds of students.

Implementation of these larger scale collaborations fell at the feet of the school and school system leadership. It was noted more than once, however, that too often success (or failure) of some programs and initiatives depended on a single person driver or influencer. Job changes or retirements of influencers too often stall progress. Financial resources needed to accompany vision, as well.

There were some notable initiatives that seemed to promote collaboration and student STEM success. One counselor related an "MST" (Math, Science, Technology) course in her high needs school that had four concurrent teacher collaborators working with 29 students. Another example was a high needs school that linked registration in mathematics and science together so that a single cohort of students had the same science class and teacher connected to the same mathematics class and teacher.

Relationship building also includes the counselor student relationship. Adding additional school counselors is an important way for school systems to increase communication and trust. Counselors identified with smaller caseloads had greater opportunity to discuss college plans with their students, which may be of particular importance when working with students to provide options for STEM study and career pathways.

Using Feedback Loops to Reflect on Practices. Several counselors indicated they did not use data to proactively advise student career planning. More often than not, data from student transcripts were used to match students to a career as students approached the college application process. Evidence of feedback loops with backstops where student data from inventories and completed coursework directed career planning was seen in three of high needs schools in this study.

Counselors also indicated few robust feedback mechanisms among schools counseling departments to look at how their students were progressing beyond high school. This information could be of value in measuring STEM outcomes as they relate to precollege coursetaking and counseling. The public schools in which the counselors worked put few, if any, resources into discovering how students performed in post-secondary academic environments. Some schools collected exit data about where their students are going after graduation. Counselors seemed confident that information collected from students bound for four-year college programs was

reliable. Counselors felt less confident about students entering two-year programs, vocational programs, and the workforce. Interestingly, only the public charter school followed up directly with students in their colleges to measure success. and offered additional support to needy students.

IMPLICATIONS FOR LEARNING AND TEACHING SCIENCE

The issues brought to light in this study have broad implications for the learning and teaching of science. School counselors have significant influence over how students approach coursetaking in STEM disciplines. Counselors need to recognize potential STEM candidates and prepare a career plan that encourages more science and mathematics coursetaking in high school so these students are best prepared for transition to the college environment. Many obstacles impede the movement of high school students into STEM, including precollege preparation and performance in science and mathematics. School counselor, with appropriate training and resources, can help students take advantage of the opportunities available by increasing awareness of these career prospects among students and the prerequisites needed for success.

As a liaison between students, parents, teachers, and school leadership, counselors are in a unique position to develop effective feedback mechanisms that reflect on school practices and encourage a more wholistic collaborative approach to developing STEM career and college readiness.

CONTRIBUTION TO INTEREST OF NARST MEMBERS

This work is of interest to NARST members because of the persistent need to provide more equitable access to STEM study. Optimal school counseling practices need to be developed for identifying, guiding, and encouraging future STEM candidates. Since counselors have significant interactions with many potential STEM students, it is in the students' interest to work with counselors who understand the specific preparation required for post-secondary STEM study. Future research should examine whether some of these best practices may be unique innovations with a direct impact on fostering the entrance and subsequent movement of students through the STEM pipeline.

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