

A Needs Assessment of Social Emotional Learning Integration in Pre-College STEM Education at OSU

Abstract:

STEM education is delivered to K12 audiences by Pre-college Programs across the nation, many of which serve underrepresented and underserved students as part of their core missions. While there is robust attention to STEM curriculum development and college connection events in such programs, few have social-cultural aspects of learning as integrated curriculum. Social emotional learning is an important aspect impacting students' STEM education experiences, as well as recruitment and retention in postsecondary education. In the following case study, we investigated how pre-college program leaders at Oregon State University define social emotional learning and integrate it into their program curriculum and social events. We utilized a mixed-methods approach, conducting a university-wide survey of pre-college program leaders across the STEM disciplines and semi-structured interviews with a subgroup of survey participants. We conducted quantitative analysis of survey data and qualitative analysis of interviews to gauge similarities and differences across programs as far as shared definitions and efforts related to integrating social emotional learning into K-12 STEM curriculum. This study showed that a few precollege programs at Oregon State University have an official SEL definition while others do not but have initiatives that fall within the SEL definition we used. Lastly, this assessment will inform future research on aspects of social emotional learning impacting pre-college STEM education as well as provide an assessment of the SEL programs at Oregon State University, the implementation of programs that empower students, especially amplifying underrepresented voices in science through Social Emotional Learning. This is ever

more important for broadening participation in STEM in today's COVID-19 era that is increasing the inequalities and hindering inclusion in the STEM enterprise.

Introduction

A 2009 National Research Council report showed that schools alone are not sufficient to deliver 21st Century Science, Technology, Engineering and Mathematics (STEM) education for youth in the United States (NRC, 2009). That report demonstrated the ways in which informal STEM education delivered by museums, afterschool programs, television shows and the internet not only support school STEM learning, but also create broader access to STEM. Beyond the kinds of sources listed in the NRC report, this kind of informal STEM programming is delivered to K-12 audiences by university-based Pre-college Programs (PP) across the nation. In a recent publication picturing PP as an evolving landscape in higher education, Seth & Trembley (2019) provide an overview of the variety of ways pre-college programs work at universities, pointing out that programs offered at individual colleges and universities are very diverse and that efforts are constantly changing and adapting to learners, educators, and community needs. The authors take a holistic and critical view of programs in the face of shifting demographics, discuss the need for early college engagement, and describe 25 dimensions of high-quality pre-college education (Seth & Tremblay, 2019). While the list of dimensions is comprehensive and extensive it does not clearly emphasize the importance of integrating Social and Emotional Learning (SEL) in youth programming in intentional ways.

The Collaborative for Academic, Social, and Emotional Learning (CASEL) defines SEL as “the process through which all young people and adults acquire and apply the knowledge, skills, and attitudes to develop healthy identities, manage emotions and achieve personal and

collective goals, feel and show empathy for others, establish and maintain supportive relationships, and make responsible and caring decisions” (CASEL, 2021). Although SEL is an integral component of any individual’s education and development, STEM programs mostly focus on disciplinary content and youth cognitive development, missing the opportunity to integrate SEL practices and strategies to elevate STEM curriculum and training for youth learning, engagement and building sense of belonging. For example, the National Governors Association (2010) reports that students’ interest in STEM decreases from elementary to high school due to various factors, including psychological barriers (e.g. Scot & Martin, 2014) and social and emotional barriers (Fowler & Schreiber, 2017) that cause learners to hesitate to follow STEM careers because they do not feel like they belong or they do not develop a STEM identity. Furthermore, Talafian et. al (2019) draw from Luhtanen & Crocker (1992) to relate that learners in various educational settings can also develop both social and personal identities in relation to the “education community” they are in (a formal or informal education setting), named by the author as a kind of community of practice (Lave & Wenger, 1991) where they can reframe interest and identities and develop adaptive skills (Flum and Kaplan 2006). Kaplan et al., (2014) refer to this process as identity exploration when learners get exposure and can reflect about their identities. Shaped by the environment, learners undergo shifts in “possible selves” and emerge as “new selves” at the end of their learning experience (Foster and Shah 2016).

From a learning sciences perspective, the impact of such identity exploration reflects the personal, physical and social-cultural aspects influencing the learning experience (Bransford et. al., 2000) and, consequently, identity exploration per the rationale above. We suggest that building a “healthy STEM identity” requires a curriculum that incorporates engaging STEM content and also addresses the social and emotional barriers for learners to engage in identity

exploration in impactful ways. On one side, there is robust research indicating what drives STEM identity development, while on the other psychology and education researchers have examined the impact of SEL for students to build healthy identities. We see a merge of these two fields and their evidence-based practices to help transform STEM education curriculum helpful for students to build “healthy STEM identities.”

STEM-SEL curriculum integration is also essential for fostering equity and inclusion that lead to broadening participation in STEM (Jaggers et al. 2018). This has long been articulated in other terms by scholars outside of STEM fields (e.g., Vygotsky, 1998; Shields et al., 2001), but is only beginning to be focused on in STEM. Furthermore, current literature has shown the critical importance of 21st century skills (a broad set of knowledge, skills, work habits, and character traits), SEL and thriving role models (e.g., Borba, 2021) to prepare youth for college and promote workforce development (e.g., Osher et al., 2018). This has been made especially evident in the face of the immediate needs of educators, learners, families and communities in the aftermath of the COVID-19 pandemic and in light of the Black Lives Matter movement as we recognize that “culture and identity development underlie STEM engagement and persistence” (Mark, 2018 p. 983). For example, Morton et al. (2019) report that the coping mechanisms employed by Black students and the rationales they offer to explain them are shaped by individualism and Black collectivism, which have implications for Black student STEM education and research. With this in mind, there is robust research demonstrating that identity change motivates learners to develop more content knowledge (e.g. Kaplan and Flum 2012; Oyserman et al. 2004). Talafian et. al (2019) relate that this becomes even more important with learners whose identities are not represented in STEM careers (e.g. women, racially minoritized, low social-economical status) because they often face more physical, economic, social, and

emotional barriers upon entering STEM disciplines and career paths (Bailyn 2003; Clark Blickenstaff 2005; Kulis et al. 2002). SEL may be a crucial component of any STEM pre-college efforts that take today's challenges into consideration, and can provide educators with a suite of tools for navigating shifts in STEM teaching and learning inside and outside schools, as in the case of university-based pre-college education.

In *Considerations for Teaching Integrated STEM Education*, Stohlmann et al. (2012) explain how integrated STEM education often requires numerous materials and resources for students to examine solutions to real-world problems by designing, expressing, testing, and revising their innovative ideas. While there is strong attention to STEM curriculum development, as previously mentioned, few have paid attention to social-cultural aspects of learning as an integrated curriculum. However, through social-emotional learning (SEL), students who have stronger social-emotional skills are more likely to meet educational milestones, since SEL focuses on communicating clearly and assertively, recognizing emotions in oneself and others, and maintaining cooperative relationships (Committee for Children, 2019). Other studies have shown that SEL practices offer developmentally rich contexts for learners and a constructive web of supports that influence positive youth relationships and deep, lasting learning (Osher et al., 2018; Lopes & Salovey, 2004, Reyes et al., 2013), which results in significant increases in self-perception, positive attitudes towards school, positive social behaviors and academic performance (Durlak, et al., 2010).

Now more than ever and considering the evolving landscape of pre-college education responding to the needs of communities, STEM programs need to consider incorporating SEL practices (Marsh, et al. 2018; Berkowitz et al., 2017; McCormick et al., 2015; Durlak et al. 2011) as SEL

impacts extend beyond the school and are not limited to family, peers, and other learning institutions (Hurd & Deutch, 2017; Jones et al., 2017). SEL is impactful for students' STEM learning experiences and increases youth's career awareness, preparation, and postsecondary success (Talaftian et.al, 2019). This case study provides a needs assessment for SEL integration in STEM K-12 curriculum for pre-college education programs offered through various departments, colleges and units at Oregon State University. This needs assessment sought to understand the ways in which SEL is currently integrated in pre-college programs offered at OSU. Our objectives were:

1. To identify how many pre-college programs currently offer or know about SEL;
2. To examine how pre-college programs define SEL, if they do;
3. To identify how SEL is integrated in program curriculum and social events, if present;
4. To identify the potential barriers and challenges for SEL integration in STEM programming, if any.

Methods:

We conducted a university wide online Qualtrics survey of pre-college programs (N=30 respondents) across OSU departments, colleges and units and collected semi-structured interviews with a subgroup of survey participants (N=5). As a needs assessment, the project was exempt from IRB oversight. Some of the participants were and were not familiar with the practices and terminology of SEL.

The survey was administered through the Qualtrics program and included the following questions:

- Name of Program
- OSU college or unit affiliation

- Content disciplines represented in programs
- The age group(s) programs work with
- How many youth they serve annually
- Whether they offer professional development for educators and volunteers
- Whether they are familiar with the term Social Emotional Learning
- Whether the program has an explicit definition of SEL
- The definition of SEL in their own words
- Examples of the integration of SEL into programming
- Plans with examples to offer SEL programming in the future (or not)

The 20-40 minute interview included the following questions:

1. In what ways are you implementing SEL practices in your program?
2. If you are integrating SEL practices, what are the impacts you see for the audience?
3. What are the challenges and barriers you perceive in the integration of SEL practices in STEM?
4. What are the resources you need to integrate SEL practices into your programming?
5. Can you speak about how important it is to have SEL practices being incorporated into STEM programs?

Additionally, we conducted quantitative analysis of the survey data as well as qualitative analysis of interviews from survey participants. Based on these interviews, repeating topics and ideas were identified using techniques adapted from thematic analysis (Patton, 2014). We gauged similarities and differences across programs regarding shared definitions and efforts related to integrating social-emotional learning into the K-12 STEM curriculum from both of these tools. The interviews were also broken down into five sections based on the interview questions and

answers were compared to each objective in order to identify both important differences and similarities.

Results:

To identify how many pre-college programs currently offer or know about SEL, the survey included both closed ended (yes/no; multiple choice) and open ended (free answer) questions. The results of both the surveys and interviews are presented here in relation to the four objectives listed above:

1. How many pre-college programs currently offer or know about SEL;
2. How do pre-college programs define SEL, if they do;
3. How is SEL integrated in program curriculum and social events, if so;
4. What are the potential barriers and challenges for SEL integration in STEM programming, if any.

The survey was sent to all OSU pre-college programs on the OPEN list for a total of 70 different STEM-related programs at OSU. Thirty respondents represented 17 different programs, for a 24% percent response rate. Table 1 shows the programs responding to the survey as well as their corresponding units or colleges.

Table 1: Programs and units represented in survey results

Name of Program	Unit or College
<ul style="list-style-type: none"> ● Office of Institutional Diversity 	Office of Institutional Diversity
<ul style="list-style-type: none"> ● SMILE Program ● STEM Academy ● TAG 	Enrollment Management

<ul style="list-style-type: none"> ● 4-H Youth program ● Outdoor School ● OSU Open Campus ● OSU KidSpirit ● STEM Beyond School 	Division of Outreach and Engagement
<ul style="list-style-type: none"> ● Oregon Agriculture in the Classroom ● Jr. MANRRS 	College of Agricultural Sciences
<ul style="list-style-type: none"> ● EOP 	
<ul style="list-style-type: none"> ● Oregon Natural Resources Education Program 	College of Forestry
<ul style="list-style-type: none"> ● Family Resource Center/Our Little Village Child Care/Campus Children's Centers 	Office of Student Affairs
<ul style="list-style-type: none"> ● Boys & Girls Club of Corvallis Elementary Program 	
<ul style="list-style-type: none"> ● Inspiring Girls Expeditions 	College of Earth, Ocean and Atmospheric Sciences (CEOAS)
<ul style="list-style-type: none"> ● Oregon GEAR UP 	

The 17 programs represent the full range of precollege program audience types from infant and preschool to undergraduates and audience sizes ranging from small programs for 30 youth a year to programs reaching over 200,000 youth annually. The 17 programs represented by the survey reach approximately 304,000 students annually. Table 2 shows youth audience type and size by college or unit responding to the survey.

Table 2: Age and size of precollege audience reached by responding college or unit annually.

	CEOAS	Agricultural Sciences	Pharmacy	Enrollment Management	Outreach & Engagement	Forestry	Student Affairs
Infants/Families							
K-8							
9-12							

Small < 100 Red; Medium 100-1000 Orange; Large 1000 – 40,000 Green; Very Large > 40,000 Blue

The 17 programs also represent a wide variety of disciplines and content as shown in Figure 1 which shows the frequency of discipline areas identified by respondents in an open-ended question. Additionally, 9 out of the 17 programs listed more than one disciplinary area.

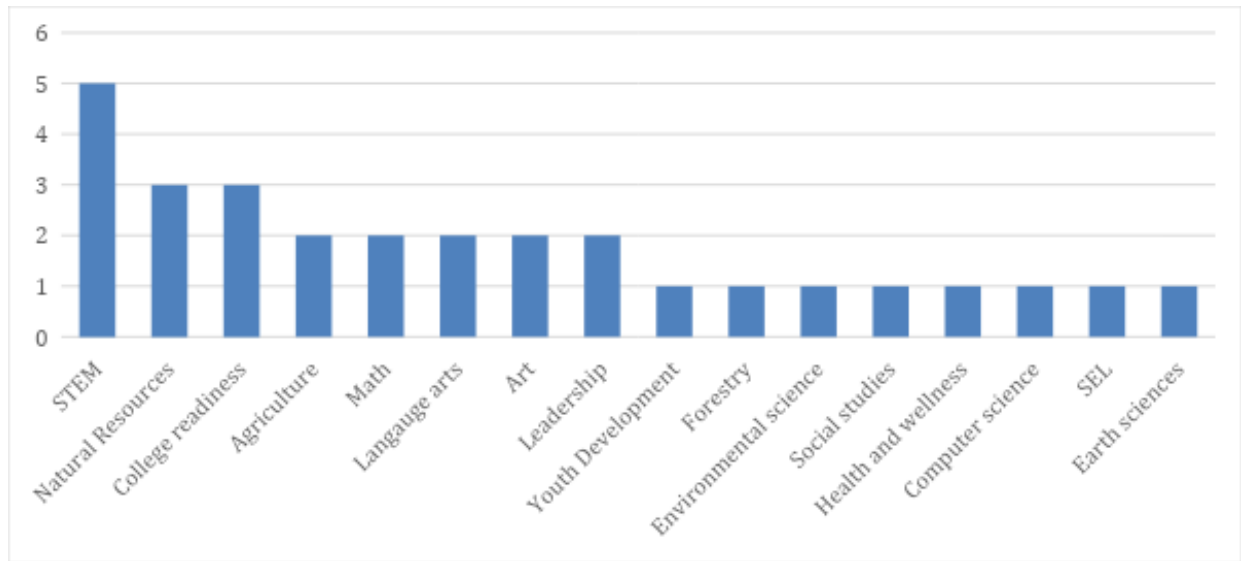


Figure 1: Number of programs reporting work in different disciplinary areas. Programs could identify more than one disciplinary focus area.

How many pre-college programs currently offer or know about SEL?

Respondents were asked first if they had heard about SEL. To identify how many pre-college programs currently offer or know about SEL, different questions were asked based on whether the respondent indicated that they had heard about the term Social Emotional Learning before or not. One hundred percent of respondents had heard of SEL.

How do OSU pre-college programs define SEL?

Of the 17 responding programs, only 2 programs had official, explicit program definitions of SEL. These included,

Social-emotional learning (SEL) is the process of developing the personal and interpersonal skills necessary to thrive as an individual and as a member of society, and to cope with challenges.

SEL is the process through which children and adults acquire and effectively apply the knowledge, attitudes, and skills necessary to understand and manage emotions, set and achieve positive goals, feel and show empathy for others, establish and maintain positive relationships, and make responsible decisions.

For programs that did not have an explicit definition, respondents were asked to give a definition in their own terms. Examples are included in Table 3.

Table 3: Respondents' definitions of SEL

I define SEL as practices, strategies that can be incorporated into curriculum to address the social and emotional aspects of learning.
SEL is a process of developing self-awareness, self-control, and interpersonal skills that are vital for school, work, and life success.
The process in which learners approach learning with appropriate emotional and interpersonal responses.
I like this definition from CASEL: Social and emotional learning (SEL) is the process through which children and adults acquire and effectively apply the knowledge, attitudes, and skills necessary to understand and manage emotions, set and achieve positive goals, feel and show empathy for others, establish and maintain positive relationships, and make responsible decisions.
SEL is the foundation for all learning; practices that support youth's mental, physical, social, emotional well-being including trauma informed, student centered (voice, interest), and culturally relevant and community based.
Our programs help build skills that contribute to positive social and emotional growth
We usually use the CASEL definition: SEL is the process through which all young people and adults acquire and apply knowledge, skills, and attributes to develop healthy identities,

manage emotions and achieve personal and collective goals, feel and show empathy for others, establish and maintain supportive relationships, and make responsible and caring decisions.
How youth learn skills to develop/manage/achieve emotions, goals, empathy for others, friendships/relationships with other, etc.
Supporting children's development (in age-appropriate ways) to identify and label feelings/states, develop self-regulation, a healthy sense of awareness of our own feelings and the feelings of theirs, etc.
We believe that students and families bring their whole selves to programming, and we adapt our programs to meet the unique needs of each student and family member.
Programming with appropriate academic and cultural supports
Validation of emotions as part of the "whole" participant; setting up a learning environment so the emotional component is integrated into the academic work
I think it means how we assess moods and attitudes and use that to inform our responses and behavior.
The non-academic skills students need to succeed - grit, perseverance, empathy, respect, self-management

How is SEL integrated in OSU pre-college programs and events?

The Center for the Advancement of Social Emotional Learning (CASEL) provides the following definition of SEL:

The Collaborative for Academic, Social, and Emotional Learning defines SEL as the process through which all young people and adults acquire and apply the knowledge, skills, and attitudes to develop healthy identities, manage emotions and achieve personal and collective goals, feel and show empathy for others, establish and maintain supportive relationships, and make responsible and caring decisions (CASEL, 2021).

For this portion of the research, we asked participants to review the CASEL definition of SEL and to identify ways in which SEL as identified in the CASEL definition is integrated currently in programming. Fifteen of the seventeen programs responding offered concrete examples of

current SEL related programming. Responses covered everything from simply integrating leadership training and exploring ways of talking with youth about emotions and experiences, to full trauma-informed pedagogy training opportunities for educators.

Interviewees were asked to talk about the types of impacts they had seen for audiences from integrating SEL curriculum into their broader STEM programming. Interviewees numbers two and four interpreted this question as having to do with formalized evaluation and noted that documenting the impacts of SEL work is difficult. One interviewee, for example, pointed out that because SEL is really about the “long-term view” it is not always possible “to assess right away” (Interview #5). Other respondents gave specific examples of how working with youth to talk about their feelings could make a difference in peer teamwork in the field (Interview #3). Others spoke about youth becoming more comfortable and confident in their learning or in approaching faculty. As one faculty member put it,

In some cases, yes ... for younger high-school camp students the level of comfort has increased.... [seeing faculty as] being more approachable (Interview #1).

What are the potential barriers and challenges for SEL integration in STEM programming at OSU in pre-college programming?

Survey respondents were not asked to comment on potential barriers and challenges, but interviewees were. Participants relate three main assumptions as barriers for implementing SEL practices and strategies within OSU pre-college efforts, including youth programming and educator development. The first is the common view of science as rigorous and unbiased, which governs work in academic settings regulating STEM youth programming to remain focused on scientific content and cognition and detached from the social and emotional experiences that contribute to learning (Interviews 1, 2, and 3). Although participants do not necessarily make this separation, they recognize such to be a hindrance to attaining support for SEL integration in

STEM programming. The second is the perceived misunderstanding that SEL work is restricted to affect and emotion when in fact it is much more than that (Interview 2). The third is simply the limited time and capacity given the duties and time already allocated and necessary to reach core program or curricular goals and objectives (Interview 1, 2).

As a result, SEL practices are viewed as good to implement but in many cases may only be integrated in program offerings somewhat randomly by virtue of individual interest and effort. As evidence, only 2 of the 17 responding programs had official definitions of SEL. Additionally, when asked, only 11 of the 17 programs offered specific examples of integration of SEL in programming. Moreover, educators, scientists, and leadership may believe that support of SEL may be something that individuals are good at rather than being something to be implemented at the program or unit level (Interview 1). Consequently, youth learners also randomly engage with SEL content instead of that being planned for and integrated in STEM curriculum in meaningful ways. Added to these barriers is the fact that the impact of SEL practices takes time to measure (Interview 3) as it is often the case for social projects and lifelong learning efforts, but programs are often held upon measures that need to demonstrate immediate results (Interview 4). Overall, SEL is perceived positively but is not yet an essential component of the cultural fabric of most programs.

Discussion:

In the course of this research investigation, I observed through the survey responses and the interview questions how the different programs were different but at the same time had an overlap of how they view SEL. For example, in the following table of comparisons (Table 4), we detected the different words that match one another but also the exact differences and uniqueness that each program provides for its student's groups depending on the area of specialization,

including but not limited to College of Agricultural Sciences, Open Campus, Extension, College of Earth Ocean and Atmospheric Sciences, College of Engineering, Sea grant, Pre-college programs, and others:

Table 4: Program identified current and future SEL practices. These identify areas for future professional development.

Future practices of SEL integration	Current Practices from the programs (SEL knowledge not required).
<ul style="list-style-type: none"> ● Better educational models ● Workshops of SEL for educators ● Leadership trainings ● Family community and communication 	<ul style="list-style-type: none"> ● Professional development workshops ● Creation of a safe space for students ● Level of challenges

The results demonstrate that despite not being aware of the exact definition, the different programs already incorporate and acquire the various aspects of Social Emotional Learning. For example, in other parts of the interview, I observed how some interviewees, aside from practices, did mention how their programs first focus on the educators, then the students, because the ideal goal is first to nurture the professional development aspect of teachers, which consequently will have an impact on students.

It is essential to recognize the four primary outcomes of this needs assessment were to determine how Social Emotional Learning can be interpreted through different practices. It was well known by the survey and interview participants that it was not about who has the most efficient terminology but instead how they continue to innovate and find ways to support both students and teachers.

As an interviewer, it was essential to keep in mind the importance of having a broad and diverse way to gather information from the survey and interview. The interview process and survey was designed to identify the different strategies and opportunities identified by multiple groups at OSU working in STEM. “Data from the Bureau of Labor Statistics indicates that professional options in STEM fields are expected to grow by some 12.5% between 2012 and 2022, a faster rate than non-STEM fields (Langdon, McKittrick, Beede, Khan, & Doms, 2011; U.S. Congress Joint Economic Committee, 2012; Vilorio, 2014)”(cited in Carpi et al., 2017). Unfortunately, students who come from marginalized backgrounds continue to be underrepresented in STEM at higher education levels and are more likely to take longer to get a degree or more likely to leave STEM (Nugent, et al., 2015; Kang, et al., 2019). Addressing this problem is more about understanding the practice after the learning, but through this assessment, it was clear that programs at Oregon State University still have room for improvement in developing the Social Emotional Learning framework.

Subsequently, it is also important to mention that since the COVID-19 pandemic, there have been more and more demands to continue leading and programming into social movements and to have anti-racist education. However, to acquire the knowledge to create a more sustainable and inclusive education system, institutions also must provide a rich environment for educators and students. If we accept why Goleman et al. (2013) promote social intelligence competencies of empathy, attunement, organizational awareness, developing others, inspiration, and teamwork, then we need to understand better how to foster SEL competency for all educators (Gimbert, 2021; Miller et al.,2021; Herman et al.,2021; Herman et al.,2021; Breedlove et al., 2021) because it is not about developing a framework that focuses on empathy but instead analyzing the limits of SEL in formal and informal STEM education. Furthermore, this will

better equip policymakers and school leaders who have limited insight into how to advance SEL knowledge and behavioral skills in educators (Gimbert, 2021; Miller et al.,2021; Herman et al.,2021; Herman et al.,2021; Breedlove et al., 2021; Molina et al.,2021). The real intention of this assessment is also to continue listening from our educators and how they perceive this terminology and provide exposure to their programs and serve our students better.

Conclusion:

This study will inform future efforts on the integration of social-emotional learning as part of pre-college STEM education, and especially the implementation of programs that empower students, significantly amplifying underrepresented voices in science through Social-Emotional Learning. Today, it is crucial to explore how educators locate not only structural and multicultural frameworks, but also employ methods to broaden a more inclusive environment⁴. This is ever more important for broadening participation in STEM in today's COVID-19 era, which has lengthened the inequalities and hindered inclusion in the STEM enterprise (OECD CoronaVirus; 2020). STEM goes beyond being a scientific field; it is important to provide students with supportive tools that will provide confidence and emotional intelligence to be able to navigate the challenges they will face in their careers (Bailey et. al, 2021; Organisation for Economic Cooperation and Development, 2020). The needs assessment begins to illustrate how OSU pre-college program leaders define social-emotional learning and integrate it into their program curriculum and social events. It also describes any barriers and challenges their programs and their audiences have experienced relative to incorporating STEM and SEL. Finally, it is helping in the search for patterns between the groups who are already incorporating SEL into their curricula and those who perhaps have not used this terminology

before. The main objective was to identify critical patterns from the program curricula from pre-college programs and compare any advantages or disadvantages that SEL provides and analyze what university-wide supports might be necessary to programs seeking to better support students in STEM. Additionally, research experiences and growth in scientific self-identity appear to align student goal orientations toward optimal motivation (increasing task and performance-approach goals) while they buffer students from maladaptive trends in performance-avoidance goals (Hernandez, 2013; Schutlz et al.,2013; Estrada et al., 2013; Woodcock et al., 2013; Chance et al., 2013). It is more than examining whether or not Social Emotional Learning is more important than STEM programs at Oregon State University but instead about identifying the tools needed to integrate Social Emotional Learning. Furthermore, STEM programs at Oregon State University must continue working to close the barriers and challenges amongst underrepresented students in STEM and continue supporting educators and students.

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