Barriers and Opportunities for 2-Year and 4-Year STEM Degrees: Systemic Change to Support Students Diverse Pathways Book Discussion group FIG Final Report.

FALL 2023 & Winter 2024

The FIG consisted of members from Different Disciplines with in the STEM division
Members Included:

1. Jacqueline Smits -Chemistry
2. Wendy Rose – Math
3. Candice Ruscher -Math
4. Jeneva Anderson -Biology
5. Colin Phfier -Biology

Project Summary:

The culture surrounding STEM education has been found to have a direct impact on students in terms of their interests, sense of belonging and persistence in these disciplines. Our goal was to further educate ourselves and discuss the major areas where barriers to success in STEM education arise and to brainstorm opportunities for resolutions for these barriers.

During the course of the Fall and Winter terms our group meet to read “Barriers and Opportunities for 2-Year and 4-Year STEM Degrees: Systemic Change to Support Students Divers Pathways”. A resource published by the National Academies of Science that provides current research into the barriers facing students pursuing education in the STEM fields. The table below provides a summary for each chapter as well as specific action items discussed during the meetings

Outcomes and benefits from the FIG:

This project allowed for a cross disciplinary group to meet and discuss current teaching practices discipline culture and institutional resources. During the meeting we shared insights, experiences and teaching strategies. We also worked to develop a set of actionable project ideas that we believe would increase support and retention of students in STEM at Lane. These projects align with data presented in “Barriers and Opportunities for 2-Year and 4-Year STEM. Degrees: Systemic Change to Support Students Divers Pathways”. Our hope is that this project will become a launching point for several innovative future projects in the STEM department.

Sharing of learning: A brief Summary of this project was presented at the April 15 SME Division meeting

Meeting Notes and Chapter Summaries

Meeting 1 10/16	Attendance Candice Ruscher Wendy Rose Jeneva Anderson Jacqueline Smits
	Chapter 1 and 2 Introduction: What is meant by STEM Multiple pathways
	Summary: NSF definition of STEM includes social sciences and economics the research presented is focused on areas that see highest attrition particularly among underrepresented groups. The course we have in our STEM dept would fall into the authors definition of STEM • Major success is achieved when students who are interested in STEM majors • Able to make informed decisions about courses based in interest and aspirations • Understand the variety of career pathways • Have clear understanding of STEM content and practices • Do not face unreasonable barriers • Aware of connection between STEM and societal issues MAJOR Message • Interest in STEM credentials continues to grow • Students are taking complex pathways to earn credentials entering and exit at different phases of their studies and concurrently enrolling at multiple institutions • Make up is not what it was 25 yrs ago, more likely to be from minority groups and be single parents • "On-time" completion is infrequent only 22% earn a degree in 4 yrs • Completion rates for STEM fields continue to be lower than for other fields. Led to questions about quality of the educational experiences
	ACTION ITEMS and IDEAS
	• Math boot camps for STEM students? • Optional online Moodle course to prep for STEM classes • Development of questions from STEM examples in M95? • STEM day camps for students whose kids are out of school *Grant funding Rose Lopez? Stipends for faculty volunteers* *(Union check) K-6? There was a Lane Forward grant that was funded to provide something similar and I think they mentioned funds available from 4J (Jen K I think)* • Development of assessment tools that provide feedback for instructors

Meeting 2 11/03	Attendance Candice Ruscher Wendy Rose Jeneva Anderson Colin Phfier
	Chapter 3 The Culture of Undergraduates in STEM Education
	Summary: The culture that students encounter when studying STEM has an effect on their interest, self-concept, sense of connectedness, and persistence in STEM. Many students encounter messages that success in STEM fields requires either natural ability or high-quality training, Academic cultures characterized by race, ethnic, or gender stigma may lead students to assess those academic contexts as incompatible with their personal identities; Students who persist often have to draw on co-curricular resources to counter messages about ability and stereotypes. institutions have the potential to create STEM academic climates that promote engagement, sense of connectedness, and persistence among students by positioning STEM as a context in which one can learn and develop, avoiding emphasis on inherent or natural ability. Institutions can also address the subtle and direct ways that students may experience messages and treatment in STEM contexts that are based on negative racial and gender stereotypes, including acknowledging and drawing on the cultural strengths that underrepresented students bring to their academic contexts and in efforts to develop or improve curricular and co-curricular practices and programs. <u>MAJOR Message</u> • The culture of science, technology, engineering, and mathematics (STEM) education has an effect on many students' interest, self-concept, sense of connectedness, and persistence in these disciplines. • New research is needed to understand whether STEM "gateway" courses continue to negatively impact STEM student persistence due to the culture of the classrooms and a heavy reliance on lectures, as research from over a decade ago has revealed
	ACTION ITEMS and IDEAS
	• Overlapping activities between math and science for applied problem solving (e.g. tree measuring and trig) Support the RvR initiative • Overlapping activities between math and science for applied problem solving (e.g. tree measuring and trig) *Support the RvR initiative* • Lactation room as part of building remodel *There is a lactation room available in the center building this could be better advertised to our students* • Thinking Classroom- assigning groups in a randomized fashion • Syllabus Share-Out or peer review syllabus workshop

Meeting 3 11/17	Attendance Candice Ruscher Wendy Rose Jeneva Anderson Jacqueline Smits
	Syllabus Workshop
	ACTION ITEMS and IDEAS
	• Updated syllabus template on the division server Include necessary and suggested information
Meeting 4 12/05	Attendance Candice Ruscher Wendy Rose Jeneva Anderson Jacqueline Smits
	Chapters 5 Institutional State and National Policies
	Summary: Summary: Many undergraduate education policies are not well situated to support students through a STEM degree. Research suggests that changing policies surrounding transferring credit to increase the transfer of community college course credits could have significant positive effects on student retention and degree completion. Articulation agreements among institutions, including common gen ed requirements, common introductory courses, common numbering, and easily available access to shared information on course equivalencies, can improve the percentage transfer credit and student success. Institutional tracking and data sharing can assist in developing policies that lead to student success. Reconsideration of the current model of course-by-course articulation based on content and overseen by individual partnerships and changes to support smoother transfer experiences can also be made Departments can implement policies to smooth the transition process for students, such as simplifying the credit transfer process and provide students with mentoring and other supports needed to successfully transfer. Undergraduate credentials and degrees in many STEM fields are widely believed to cost more than degrees in other fields, there is some evidence to support this belief. Some institutions have instituted differential tuition policies. There are concerns that such policies will have a chilling effect, especially on attracting students from underrepresented groups who already have high levels of borrowing
	ACTION ITEMS and IDEAS
	• Look at shorter boot camp style classes to allow students to make-up course work (summer lag classes) • More uniform course numbering *Currently being done statewide (common course numbering)* • Look into coordination with OSU and UO for student completing rates or other institutional outcomes per student that could be used to improve program outcomes

	• Discussion of best practices for programs *Uniform practices within a given course / program* • Voluntary Peer review of instructional practices
Meeting 5 02/28/24	Attendance Wendy Rose Jeneva Anderson Candice Ruscher Colin Phfier Jacqueline Smits
	Chapters 4 & 6 Instructional Practices, Departmental Leadership and Co-Curricular supports Leading and Sustaining change
	Summary: Students encounter STEM through department and discipline as reflected in the curriculum, classroom, laboratory, and research experience as well as through interactions with faculty, staff, and peers and through the expectations, behaviors, and beliefs of those around them. Students can either adopt a STEM identity and thrive in a community or be pushed into isolation, or abandonment of their STEM goals Instructional strategies that have demonstrated efficacy include: more time with students engaged in active learning, and use of formative assessment and feedback. Significant resources have been invested in disseminating effective practices. While there is emerging evidence on the rate of change; existing evidence makes it difficult to know level of effective adoption of these practices has been implemented classroom strategies. Faculty appointments are associated with the learning environment that STEM students encounter. Teaching strategies of part-time contingent faculty are less likely to reflect the qualities of effective instructional strategies, in comparison to tenured or tenure-track faculty. Changes in instructional strategies can be difficult due to a lack of institutional incentives, minimal time to research and implement evidence-based strategies, and a lack of resources to invest in evidence-based strategies. Although classroom reform, co-curricular programming, or integrative reforms can address the normative STEM culture that sends negative messages to students, especially to women and those from underrepresented minority groups, about their ability and belonging in the disciplines, students also face barriers to earning a STEM degree that arise from departmental, institutional, and national policies. Awareness of these barriers has become increasingly acute as the ways that students navigate the higher education system have become increasingly complex. <u>MAJOR Message</u> • Adoption of reformed curriculum and teaching practices remains difficult. Barriers such as little support from other faculty and the department, few incentives for improved teaching, inappropriate classroom infrastructure, limited awareness of research-based instructional practices, and lack of time limit change. Departments are a critical unit for change in (STEM) education representing both individual faculty values as well as curriculum as a whole

	• Co-curricular supports, can provide authentic disciplinary experiences and support the social and relational aspects that have been shown to influence students' academic engagement and persistence
	ACTION ITEMS and IDEAS
	• Teaching tips in Sci meetings. Short cuts and things that we were doing. *Ex: Candice showed us embedding you tube videos add free.* • Peer tutoring access use of AI tutoring? *ATC did a talk about this a while back* • Course embedded tutoring • Study group open session (pre-scheduled) group tutoring • Increase access to help resources for students • Critical interventions for students *(Discussion of failure, withdrawal etc)* • EAB liaison counselors to assist students • Develop a STEM Mentors program *2nd year students are matched with 1st yrs students to mentor* • UO or OSU STEM bridge mentor program *(Former LCC student mentors alumni contact list)*
Meeting 6	Attendance Wendy Rose Jeneva Anderson Candice Ruscher Colin Phfier Jacqueline Smits Dinner At Irie Jamaican Kitchen (Center Building)
	Final Meeting Chapter 7 Conclusions and Recommendations from the Study Authors
	CONCLUSION 1: There is opportunity to expand and diversify if there is a commitment to support students through degree completion and provide opportunities to engage in high-quality STEM learning and experiences. CONCLUSION 2: STEM students navigate the education system in new and complex ways. It takes students longer for completion of degrees, there are many patterns of student mobility within and across institutions, and the accommodation and management of student enrollment patterns can affect how quickly and even whether a student earns a STEM degree. CONCLUSION 3 National, state, and institutional data systems often are not structured to gather information needed to understand how well the undergraduate education system and institutions of higher education are serving students. RECOMMENDATION 1 Data collection To better understand student populations and the pathways to (STEM) degrees. RECOMMENDATION 2 Fund research in

	(STEM) education and prioritize research to assess enrollment mobility in STEM is a response to financial, institutional, individual, or other factors. CONCLUSION 4 Alignments of instructional practices, and student support. Policies that address the climate of STEM departments and classrooms, the availability of instructional supports and authentic STEM experiences, and the implementation of effective teaching practices can help students overcome barriers to earning a STEM degree. RECOMMENDATION 3 Entities that support research in undergraduate science, should support studies with multiple methodologies and approaches to better understand the effectiveness of various co-curricular programs. RECOMMENDATION 4 Educational policies should better align with the education goals of students Policies should account for the fact that many students take more than 6 years to graduate, and should reward institutions for success RECOMMENDATION 5 Institutions that fund undergraduate education should coordinate on critical issues RECOMMENDATION 6 Steps should be taken that support alignment of policies that can improve the transfer process for students. RECOMMENDATION 7 the efficacy and tradeoffs of different articulation agreements and transfer policies should be explored CONCLUSION 5. Undergraduate STEM education will require interconnected and evidence-based approaches to create systemic organizational change CONCLUSION 6 Improving STEM ed. will require a more systemic approach to change that includes use of evidence to support institutional decisions, learning communities and faculty development networks, and partnerships across the education system. RECOMMENDATION 8 Expansion and improvement of co-curricular supports for (STEM) students can be informed by and integrated into work on more systemic reforms in undergraduate STEM education to more equitably serve their student populations. RECOMMENDATION 9 Organizations should work together to support systemic and long-lasting changes to STEM ed