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MEMO

TO: David Cedrone, Massachusetts Department of Higher Education

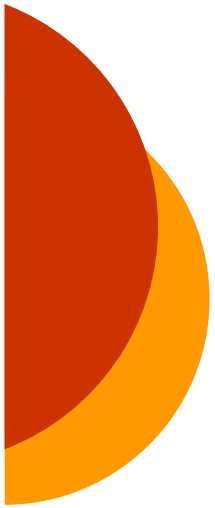
FROM: Jeremiah Johnson and Jacklyn Stein, UMass Donahue Institute

DATE: 4/29/2014

RE: STEM Starter Academy: Promising Practices for STEM Programs in Community Colleges

The following document, “STEM Starter Academy: Promising Practices for STEM Programs in Community Colleges,” was prepared by the UMass Donahue Institute for the Massachusetts Department of Higher Education (DHE) as a resource for community colleges participating in the STEM Starter Academy (SSA) initiative. The document provides brief references to some of the promising practices highlighted by the literature to promote community college student engagement, retention, progress, and graduation in STEM fields. The document includes an annotated bibliography that directs readers to additional resources.

The Donahue Institute is working with DHE to evaluate the SSA initiative and provide technical assistance to DHE and the SSA program sites. This document serves as a form of technical assistance, supporting community colleges in their efforts to build upon, codify, and extend system-wide best practices that undergird student progress through and completion of STEM curricular pathways. It is our intention that this document will continue to be modified, as the SSA initiative takes shape, to better meet the needs and reflect the practices of SSA participants.



STEM Starter Academy: Promising Practices for STEM Programs in Community Colleges

The STEM Starter Academy (SSA) initiative aims to build a model for student success in community college STEM programs by supporting community colleges in their efforts to build upon, codify, and extend system-wide best practices that undergird student progress through and completion of STEM curricular pathways.

This document is intended to provide a collection of innovative, evidence-based strategies that STEM Starter Academy colleges can use as springboards for collaborative investigation and conversation as they flesh out system-wide practices for STEM student success. Although not exhaustive, it captures some of the promising practices highlighted in the literature for community college student engagement, retention, progress, and graduation in STEM fields. This is a living document that will be modified, as the SSA initiative takes shape, to better meet the needs and reflect the practices of SSA participants.

In particular, this resource was developed to support three SSA goals, as mentioned in the Request for Proposals from the Massachusetts Department of Higher Education, helping campuses to:

- “identify student support service and activity gaps and/or capacity building opportunities that can be addressed through replication of currently available programs or through collaboration across campuses;”
- “engage in partnership with other campuses to assess, qualify, articulate and codify ‘best practices’ for student support services and activities;” and
- “refine the definition and implementation of the STEM Starter Academy as a model of student success across Massachusetts community college system.”

The practices included in this document were selected based on their potential utility to the Massachusetts community colleges participating in the SSA initiative. They were drawn from a range of sources including academic papers, evaluation reports, and conference proceedings. Evidence is still being gathered on the efficacy of many of these practices. To learn more about the evidence supporting any of the practices described here, please refer to the cited sources.



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* This document is meant to be a long-form reference, and therefore, we have not provided an abbreviated executive summary. However, at the beginning of each Promising Practice section, there is a brief summary of the practices highlighted in that section.

Outreach and Recruitment

This section highlights two general groups of practices: providing information and exposure to STEM pathways to students who might not have considered these options, and helping high school students prepare for and enroll in community college STEM programs by providing enrollment outreach and enhancing dual enrollment.

Provide information about and exposure to STEM pathways

- **Directly address affordability and feasibility during recruitment.** These are primary concerns of students and parents (Mattis & Sislin, 2005). When offering information about STEM programs, also offer information about financial aid, child care, academic supports, and internship and apprenticeship opportunities (Costello, 2012).
 - * Help students and parents understand the net price – the published price minus grant aid, scholarships, loans, tax credits, and deductions – that students actually pay. Research suggests that lack of knowledge about college costs, perceived lack of financial aid availability, and debt aversion contributes to the low number of minority and low-income students in college (Kruse et al., 2012).
- **Provide exposure to STEM-related career and transfer options.** Community college (CC) students are more likely than 4-year college students to not have been exposed to the array of occupational choices available within STEM fields (Boroch & Hope, 2009; Hagedorn & Purnamasari, 2012).
- **Provide opportunities for students to interact with role models with whom they can relate.** Examples include alumni from students' own communities or other students a step ahead of them in their education who can discuss challenges they overcame. Interactions with familiar role models can effectively motivate students to enroll, persist (Packard, 2012; Packard & Hudgings, 2002), and transfer (Mery & Schiorring, 2011).

Reach out to high schools to help students navigate the CC enrollment process

- **Embed CC outreach in high schools (HS).** For example: provide admission, enrollment, and financial aid services at high schools, or have scientists and college science students visit HS classrooms (Dimitriu & O'Connor, 2004; Mattis & Sislin, 2005; Packard, 2012).
 - * Personalize recruitment efforts. For example: hold workshops led by faculty and scientists who are women or people of color (Costello, 2012).
 - * See the example of the "Science Squad" at University of Colorado at Boulder where graduate students in STEM fields visit K-12 classrooms to give interactive presentations or discuss career possibilities (Laursen et al., 2007).
- **Help students understand the importance of placement tests.** Also, help students prepare so they do not test into courses that are mismatched with their actual knowledge (Chaplot et al., 2013).
- **Help HS students address knowledge gaps before they graduate.** CCs can support pre-testing early (in high school) to or re-testing after preparatory/refresher workshops or summer bootcamps. See p.13 in MDC, 2012 for successful example programs.

Case Study: Using Informal Interactions to Expose Students to STEM Career Options

The Expanding Pathways in Science, Engineering, and Mathematics (EPSEM) program at University of California Santa Barbara included "lunch with faculty" and "dinner with scientists" as part of their 2-week residential summer bridge program. Students reported that these activities were useful ways to gain information about different career options. They liked being able to talk directly with research faculty and industry scientists in an informal setting, preferring it to more traditional events such as a guest speaker or getting information from program staff.

(Lenaburg et al., 2012)

Outreach and Recruitment, continued

Enhance Dual Enrollment

- **Tailor location to the needs of your students.** Holding dual-enrollment classes on college campuses (and with a mix of college and high school students) can create a more “authentic” college experience for high school students and give them better access to academic and other support services on campus. However, transportation challenges may close access to some students (Hughes et al., 2012; Packard, 2012).
- **Expand eligibility for dual enrollment beyond those who are already high-performing.** A wider range of students can benefit from dual enrollment. Gaining college credit in HS makes students more motivated to persist (Karp et al., 2008b).
- **Smooth the process of credit transfer.** College credit hours should fulfil state requirements for days and minutes toward HS graduation. State and local districts can lift restrictions so college courses can count toward HS requirements as well as college credit (Hughes et al., 2012; Jobs for the future, 2006).
- **Provide professional development to dual enrollment instructors.** HS teachers may need assistance creating a college-like atmosphere and college instructors may need insight into pedagogical strategies for HS students (Hughes et al., 2012).
- **Identify dedicated CC staff to smooth logistical hurdles for dually enrolled students, especially during registration** (Hughes et al., 2012).
- **Embed college student interns within dual-enrollment classes.** Interns can bridge the gap between the students and professors, help students analyze assignments in small groups, and answer questions that students don’t feel comfortable asking the professors. Interns can perform this service as part of their college program’s work-based learning requirement (see North Orange County example in Hughes et al., 2012).

Resource Highlight:

The Recruitment and Retention chapter in *Enhancing the Community College Pathway to Engineering Careers* (Mattis & Sislin, 2005) provides examples of how “exemplary practices” for recruitment and retention are being carried out by a range of community colleges that are specifically focused on engineering programs.

Case Study: Dual Enrollment – The Concurrent Courses Initiative

A three-year study of career-focused dual-enrollment programs at 10 California community colleges and 21 high schools

- Dual-enrollment students at City College of San Francisco (CCSF) attend day-long orientations at the CCSF campus and receive half a college credit for their participation. Students hear from guest speakers, meet with a counselor, tour the campus, and receive information about textbooks and other logistical matters.
- At CCSF, a program counselor visits the first session of each course, holds weekly office hours on each campus, and uses social media to keep students abreast of ongoing activities. She sends out frequent text messages and emails to remind students about important dates and to encourage them to study for exams.
- North Orange County, California created “Counseling 150: Academic and Life Success,” which packages academic, behavioral, and personal supports within the same college-credit-bearing course – an effective way to include lower-achieving students in dual enrollment, helping to ease them into more academically rigorous courses.

(Hughes et al., 2012)

Outreach and Recruitment, continued

Case Study: ACCUPLACER Process at El Paso Community College (EPCC)

The Texas college has seen an increase in the number of students testing as college ready, as well as more students testing into fewer developmental courses, which means less time to credit-bearing courses.

1. Students complete a joint admissions application to EPCC and University of Texas, El Paso.
2. Students and their parents attend a comprehensive orientation about the ACCUPLACER in which they learn about its purpose, how scores are used, how not doing one's best can add time and cost to degree completion, and how to prepare for the exam.
3. Students take the test.
4. Counselors review the test scores with each student.
5. Students not passing all areas of the placement test are given interventions that focus on refreshing skills, and then are retested.
6. Students who still need help may enroll in a summer bridge program.

(Kerrigan & Slater, 2010; MDC, 2012)

Case Study: High Tech Academy at Cuyahoga Community College

High Tech Academy (HTA) is a dual enrollment program in which local high school students attend a half day of school at their home school and then attend classes on the Cuyahoga Community College campus.

Much of the college tuition costs are paid through a state-supported plan, which also allows college-level classes to count toward students' graduation requirements in high school.

The program focuses on computer technology, business and academic core courses. The school district provides a principal, and the College provides a program manager and together they coordinate programming for 200-300 high school students annually.

(Hagedorn & Purnamasari, 2012; Cuyahoga Community College web page)

Examples: Effective Practices for Promoting the Transition of High School Students to College

from a synthesis of consistent findings and recommendations identified through the analysis of the published literature by the Research and Planning Group for California Community Colleges

- **Rigor:** students should engage with academically intense curriculum in high school (not just the high achievers).
- **Relevance:** high school curriculum should be clearly connected to post-secondary education and career opportunities.
- **Alignment:** high school exit requirements should align with college entry requirements.
- **Realistic Expectations:** students and families should have access to accurate and timely information about knowledge, standards, and behaviors necessary for college success.
- **Support for transitions:** academic and non-academic support should be offered to students who are transitioning to a new phase of programming/learning (e.g., summer bridge).¹

(Boroch & Hope, 2009)

¹ See the Retention section of this document for more on summer bridge.

Retention

This section highlights two broad groups of practices: helping students overcome barriers to college access (by providing non-academic support, financial aid, and transition support); and, supporting students' integration into academic life and STEM fields in particular (through increased STEM relevance, undergraduate research, and socio-academic integration).

Provide non-academic support

- **Reward behaviors that contribute to completion.** Rewards could include acknowledgement (such as a congratulatory email) or incentives such as priority enrollment or even monetary scholarship (Chaplot et al., 2013).
- **Address psychological barriers to success.** Barriers include students' negative self-perception as math learners, doubts about the relevance of the material, and lack of personal connection to classmates and faculty (Silva & White, 2013).
- **Create predictable and streamlined criteria for progress and completion.** Financially needy first-generation college students are much more likely to complete an associate's degree if they attend an institution with reliable class schedules and an easy-to-navigate bureaucracy (Chaplot et al., 2013; Person & Rosenbaum, 2004).

For example:

- * Foster a "growth mindset" which frames intelligence as something that can be developed.
 - * Create a sense of belonging.
 - * Encourage students to see critical feedback as reflective of high standards.
 - **Create ways to access programs that meet the needs of working students.**
- For example:
- * **Scholarships that require full-time status may not be realistic for many CC students** (Packard, 2012).
 - * **On-site, subsidized child care might help minimize the conflict between family and school.** This is particularly true for female students (Karp and Stacey, 2013a). Drop-in child care options can allow students the flexibility to attend evening and weekend activities and complete homework (Costello, 2012).
 - * **Allow students to earn and stack credits over time.** Students whose work or family responsibilities require them to leave and return to college at a later point can still accumulate credits toward a credential and degree (Costello, 2012).
 - * **Offer "one-stop shopping," where prospective students can enroll, register, and apply for federal financial aid by working with a single person in a single afternoon** (Mattis & Sislin, 2005, p.35).
 - * **Offer courses in a regular sequence and at convenient times of the day.** Low-income students are more likely to complete an associate's degree if they can be confident of their access to the courses they need. Students often reported that classes had been canceled at the last minute, or that some of their required courses had been offered at night, but others during the day (Mattis & Sislin, 2005).

Resource Highlight:

WestEd's Game Changer Series publication, "Providing Structured Pathways to Guide Students Toward Completion," provides some concrete and evidence based strategies for creating clear and predictable pathways for students. It is also filled with implementation examples from community colleges across the U.S. (Dadgar et al., 2013a).

Retention, continued

Increase the relevance of STEM to students' lives:

- **Use STEM-specific internships to make work experiences career-relevant.** Seeing the relevance of school learning to a career can motivate students (Packard et al., 2012a).
- **Redesign intro STEM courses to help students see themselves within STEM pathways.** Using interdisciplinary courses, service-learning, and society-relevant materials can help students see STEM careers as more compelling to pursue (Brown et al., 2009; Chamany et al., 2008; Coyle et al., 2006).
 - * Example: One-minute descriptions of future careers at the beginning of class (Packard, 2011).
- **Increase social-contextualization of remedial or developmental courses** (Hulleman & Harackiewicz, 2009).
- **Partner with industry to pose problems that students can solve collaboratively.** This encourages relationship building and helps to make a clear link between academic success and future job prospects (Kisker & Carducci, 2003).

Resource Highlight:

See Salm et al. (2008) for an example of a 5-week undergraduate biology research summer program at a community college.

Case Study: Undergraduate Research Experience

The University of Oregon's Undergraduate Catalytic Outreach and Research Experiences (UCORE) program brings community college students to campus for a 10-week summer research residency. Students return to their community college campuses for a follow up year of outreach and service learning – acting as role models for their peers and helping to shift the learning environment of their departments.

(Strawn & Livelybrooks, 2012)

Support undergraduate research

- **Undergraduate research improves academic outcomes, and encourages students to pursue science careers** (Gregerman, 2008; Hathaway et al., 2002; Jones et al., 2010; Lopatto, 2004; Russell et al., 2007; Seymour et al., 2004).
- **Research experiences also have positive secondary effects** on peers when returning students act as role models and tutors (Strawn & Livelybrooks, 2012).
- **Integrate research into the classroom** (American Association for the Advancement of Science, 2011).
- **Use inquiry-based course designs to replicate the process and excitement of research** (Brown et al., 2009).
- **Develop time-flexible research programs or funded research so CC transfer students have opportunities similar to those of 4-year students to participate in undergrad research.**
 - * Paid research experiences can have the added benefit of helping students defray some college expenses while complementing and enriching students' learning (Tsui, 2007).
- **Create opportunities for students to publicly present research.** Student who present results from summer research experiences increase both confidence and communication skills (Lenaburg et al., 2012).

Resource Highlight:

The Council on Undergraduate Research has several resources to help community colleges integrate undergraduate research into community colleges. (www.cur.org)

Retention, continued

Increase socio-academic integration

- **Facilitate teacher-student and student-student interactions *in the classroom*.** CC students cite interactions in the classroom, and with institutional actors (such as faculty, staff and other students) as important contributors to their sense of comfort and integration in the college environment (Deil-Amen, 2011; Karp et al., 2008a).
- **Facilitate student participation in academic and social information networks.** CC students in particular benefit from relationships they build with peers in class. These relationships can be used to access information and often extend to social activities outside of the classroom (Karp et al., 2008a).
- **Offer course sequences taught by the same faculty member.** Students may develop stronger connections with faculty who teach a sequence of courses in consecutive semesters, such that students can follow that instructor as a cohort (Delcham et al., 2009).
- **Create opportunities for students to develop social connections related to their academic work** (e.g., collaborative in class work, study groups, scholar cohorts) (Karp, 2011).
- **Offer learning communities that involve special advising and interdisciplinary course planning.** Such communities can be successful in helping students pass developmental math courses and feel more socially integrated (Hodara, 2013; Packard, 2012; Scrivener & Coghlan, 2012).
- **Provide opportunities for those who participate in summer bridge programs to remain connected.** Once other students arrive on campus, the benefits of summer bridge programs may fade as “cohorted” students feel increasingly “on their own” (Strayhorn, 2012).
- **Pay attention to classroom climate.** Students reported that classroom climate (including their anxiety levels, how welcome they felt in class, how well supported they were by instructors, and instructor rapport with students) significantly influenced their decisions to stay in or leave STEM disciplines (Brown et al., 2009).

Case Study: Using Technology to Assist with Socio-Academic Integration

The Regional Center for Next Generation Manufacturing (which prepares students in Connecticut’s 12 community colleges for STEM careers) uses a Facebook page with chat rooms where students can communicate with each other about school projects and connect with mentors from industry and professional associations to ask questions.

(Costello, 2012)

Case Study: Cultivating a Sense of “Belonging” among Under-Represented Students in STEM

“Faculty members knew [students’] name[s], demonstrated an interest in their degree or professional goals, and seemed to care about their mastery of STEM course content. ... What students took away from these encounters was a sense of mattering, feeling appreciated, cared about, and special in some way. These experiences seemed particularly meaningful for students who might otherwise have felt marginalized, unprepared for, or ‘out of place’ in STEM fields (e.g., women, people of color).”

(Strayhorn, 2012, p.69)

Retention, continued

Ease the transition into college

- **Teach college navigation skills.** These skills include time management, study skills, how to access financial aid, how to find internships, what various grades and credits mean, how to access tutoring services, and soft skills to meet the unspoken cultural expectations of both the college and future employers (Karp, 2011).
- **Consider making college skills courses mandatory.** However, remember that students are wary of mandatory services, and that “if a service is mandatory, [students] want it to be of high quality, engaging, and clearly connected to their plans and goals” (Nodine et al., 2012, p.1; see also Chaplot et al., 2013; Dadgar et al., 2013a; Scrivener & Coghlan, 2012).
- **Facilitate the development of problem-solving skills in both academic and advisory settings** (Urias et al., 2013). For example, counselors can emphasize the importance of identifying and evaluating potential courses of action and faculty can provide students with choices of assignments, groups, or lab dates.
- **Create structured pathways that help students navigate the many choices they have to make when they first enter CC.** For some suggested strategies, see Dadgar et al., 2013a.
 - * Students who identify clear educational goals early on are less likely to drop out (Summers, 2003).
- **Help students complete developmental coursework.** Developmental math course completion is correlated with student retention (Fike & Fike, 2008). See the *Developmental Education* section of this document for more resources.
- **Offer multiple forms of mentorship.** Students are more likely to persist in STEM when they experience both socio-emotional mentoring such as role modeling or encouragement *and* instrumental mentoring such as academic support, or college and career coaching (Packard, 2004-2005; Starobin, 2004). >>

Resource Highlight:

The Community College Research Center has several publications with evidence-based suggestions on the most effective mechanisms of non-academic student support. (<http://ccrc.tc.columbia.edu/>)

Examples: Designing Student Success Courses for Sustained Impact

- **Narrow course content** to cover fewer topics in greater depth.
- **Make more strategic staffing choices** to ensure that teaching in success courses promotes learning-for-application. For example: using disciplinary faculty to teach student success courses would help to bridge the divide between academic courses and student success courses.
- **Teach for application** and sustained practice (e.g., use problem solving activities).
- **Develop common course assignments** geared toward reflection, application, and practice.
- **Reinforce student success** learning objectives in academic courses.
- **Integrate student services functions** to build and sustain students' progress toward specific student success learning objectives.

(Karp & Stacey, 2013c)

Retention, continued

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- **Summer bridge programs between high school and college may help students transition into college.** Bridge programs may also improve retention and academic success. However, there is still little empirical research on what elements of these programs lead to success (Sablan, 2013; Tsui, 2007).
 - * For a recent review of the research on summer bridge programs, see Sablan, 2013.
 - * For evaluations of existing summer bridge programs, see Barnett et al., 2012 and Lenaburg et al., 2012.
 - * For some promising practices related to summer bridge programs, see Borochoff & Hope, 2009 (pp.29-36 and 52-53).
 - * For more information on engaging faculty in curricular innovation for summer bridge programs, see Goldfien & Badway (2014).
- **Offer Financial Aid:**
 - **Provide performance based scholarships.** In addition to regular financial aid, these can enhance academic performance (Scrivener & Coghlan, 2012), but it is not clear if performance based scholarships enhance persistence or completion.
 - **Provide scholarships for students who follow STEM pathways** (Dowd, 2012).
 - **Provide financial aid counseling.** Help ensure that students apply for and receive all of the aid to which they are entitled (Costello, 2012). Money is often a factor in attrition (Dowd & Coury, 2006; Hagedorn et al., 2001-02; King, 2002; Paulsen & St. John, 2002).
 - **Support policy to increase financial aid for STEM students at community colleges** (see Costello, 2012 for recommendations).

Resource Highlight:

MDRC is running a performance-based scholarship demonstration.

See interim results at their site: (http://www.mdrc.org/project/performance-based-scholarship-demonstration#design_site_data_sources)

Examples: Strategies for Reducing the Financial Burden of College

- Loan-to-own computer programs for students with certain GPAs – laptop computers to loan that can become the student's upon completion of a certain degree.
- Emergency funds for books, transportation, and college fees to support students to stay in school when financial hardships arise.
- Employ students as peer tutors.
- Partner with industry for scholarships, summer jobs, internships, and research experiences.

(Costello, 2012)

Advising

This section highlights a few practices: creating ongoing, “intrusive,” and transparent advising; engaging faculty in advising; integrating advising into academic work; and, using technological tools to better monitor student progress.

Use Sustained, Strategic, Personalized Advising

- Personalized, sustained advising has better long-term outcomes than short-term intensive advising (Bettinger, 2012; Karp & Stacey 2013b).
- **Continually monitor student progress and regularly give feedback.** Use regular outreach and tracking to acknowledge milestones or hurdles rather than only checking in once a student has already missed a deadline or is failing (Chaplot et al., 2013).
- **Mandate student engagement in a range of student support activities.** Mandating engagement “shifts the responsibility of asking for help away from those who are already struggling most and towards the college that knows which supports can benefit all students” (Chaplot et al., 2013, p.25).
- **Reach students early.** Students who take 40% or more of their first-term coursework in STEM are more likely to persist in STEM majors (Bettinger, 2012).
- **Provide transparency and structure.** It is understood that “students do best with clarity, transparency, and structure. Their faculty and staff advisors should be on the same page to provide a unified learning experience. In addition to clear start and end points, structured programs have fully transparent sequences of courses, including identified prerequisites, so that students know what classes to take and when to take them in order to reach the end goal” (Rassan et al., 2013b).

Examples: A Sustained, Strategic, Intrusive, and Personalized Advising Model

- Integrate academic and career advising.
- Integrate face-to-face and e-advising systems.
- Provide services to students based on their level of need.
- Strategically deploy resources to allow for developmental advising over time.
- Integrate metacognitive skill-building practice into academic courses – joining advising and teaching.

(Karp & Stacey, 2013a and 2013b)

Examples: Provide Proactive “Intrusive,” Ongoing Support

Examples of proactive supports include:

- Requiring all students to update educational plans periodically.
- Identifying students who are not making progress toward a degree and offering advisement and other services to guide them in course-taking.
- Identifying students who are at risk of failure in a class and requiring them to attend tutoring sessions.
- Contacting students who have left the college, inviting them to return, and showing them how to do so.
- Offering internships and other services to help students learn about careers and how to connect with employers.

(Dadgar et al., 2013a)

Advising, continued

Use online resources to monitor student progress

- **Strategic advising with the help of online systems can help students stay on track while conserving advising time and the college's financial resources** (Chaplot et al., 2013; Karp & Stacey, 2013a).
 - * Online systems can provide frequent and easily accessible opportunities for students to assess their progress toward their goal of choice. For example, an online system can send an email alert to students who complete one level of math but do not enroll in another (Hagedorn & Dubray, 2010).
 - * See the example of Tacoma Community College's online advising "dashboard" and the way it helps facilitate faculty and staff collaboration as well as student monitoring (Focusing on Student Success, 2010).
 - * MentorNet, for example, has been effective at sustaining STEM career interests by providing access to industry career professionals (Packard, 2003b).

Case Study: Online Advising at Santa Fe College in Florida

Students use two online systems to gain a better understanding of each step toward their educational goal. First, students work with college personnel to create an electronic educational plan. They then use the Degree Audit system to track progress toward their goal. Students are also required to look at Degree Audit before registering for classes each semester and the combination of these two programs lets students know:

- Exactly what courses are needed for which programs;
- When a course they have selected is not part of their plan and will not count toward financial aid eligibility;
- Whether specific courses will count toward transfer to various four-year schools; and,
- How to build a schedule that both supports their plan and responds to their particular preferences.

Through these systems, students are aware at all times of their progress toward identified goals and are able to make adjustments as needed. The college is also able to offer positive feedback to students as they achieve certain milestones; for example, students who complete the developmental education sequence receive an email congratulating them on their achievement.

(Chaplot et al., 2013)

Case Study: Advisor Data Portal at Walla Walla Community College

The online Advisor Data Portal houses a wealth of information about each student that used to be scattered in various places (e.g., placement scores, grades, educational plans, and warning flags for poor performance or attendance). Members of student services and information technology staffs meet weekly and have collaboratively designed many tools to improve student completion. A degree estimator, for example, automatically maps students' transcripts against program requirements to determine how close they are to completion. Notices go out to students near a credential – even if they are no longer enrolled – and they are offered a bookstore gift certificate if they talk with a counselor, who helps get them back on track.

(Aspen Institute, 2013)

Advising, continued

Integrate instruction and student support services

- **Build supports such as advising and study skill building directly into the classroom** (Chaplot et al., 2013).
 - * Students are more likely to take advantage of support systems if they are integrated into their academic experiences rather than something they have to actively and separately seek out (Chaplot et al., 2013; Dadgar et al., 2013b).
 - * Without integrated support, it is often the students who already know how to navigate college systems who take advantage of these resources (Dadgar et al., 2013b).
- **Create incentives and opportunities for faculty and support services staff to collaborate.**
 - * Faculty and support services staff can participate in common professional development activities (Dadgar et al., 2013b).
 - * Online progress-monitoring systems can help faculty and support staff better coordinate their work. For example, Tacoma community College's online "Dashboard" system allows faculty and staff to share notes on student's progress, document advice the student has received, and alert each other when they have concerns about a student (Focusing on Student Success, 2010).
 - * Valencia College has created "reading circles" where faculty and staff gather to read and discuss the most recent literature in the field (Dadgar et al., 2013a).
 - * Santa Barbara City College provides an interesting case study, where academic and student support functions are integrated into a single unit (Dadgar et al., 2013a).

Case Studies: Integrating Instruction and Student Support Services

At Highline Community College in Seattle, students who are enrolled in Engineering 101 also learn about required courses for transfer, financial aid, and support services available for them. During the course, students develop a two-year plan to map an academic path to transfer (Starobin & Laanan, 2008).

At Florida's Valencia College, developmental education instructors team-teach with Student Success instructors a semester-long course in which students create personalized educational plans and develop organizational skills. In addition, many developmental education faculty members are integrating study skills into all of their courses (Chaplot et al., 2013).

Resource Highlight:

WestEd's Game Changer Series Report, "Integrating Student Support Services and Academics" provides concrete, evidence based strategies as well as implementation challenges (Dadgar et al., 2013b).

Examples: Integrating Academic Instruction and Student Support

- Faculty and advisors can co-teach some parts of the curriculum or can teach "paired" academic/student success courses to a cohort of students.
- Tutors can be scheduled to help students with assignments during class time, or scheduled meetings with tutors can be part of required class time.
- Designate faculty advisors within STEM disciplines: faculty can provide info about academic requirements, make discipline-specific referrals, and provide students with advising consistency.
- Advisors can be embedded in classrooms to work on educational and career planning.

(Dadgar et al., 2013b)

Advising, continued

Engage STEM faculty in formal and informal advising:

- **Facilitate student access to faculty.** Faculty approachability and accessibility have a direct impact upon student perceptions of self-efficacy, which directly influence GPAs, academic confidence, and retention rates (Deil-Amen, 2011; ENGAGE, n.d.). Faculty are also in a good position to give discipline-specific advice to STEM majors (Dowd, 2012).
- **Help faculty improve their interactions with students.** One of the strongest predictors of student engagement and persistence in STEM fields is the quality and type of interactions with faculty (Amelink & Creamer, 2010; American Society for Engineering Education, 2009; Kim & Sax, 2009; Ohland et al., 2008; Thompson, 2001; Vogt, 2008).
 - * Small, casual interactions – such as a conversation after class – can make a difference in student persistence and also save time in office hours (Amelink & Creamer, 2010).
- **Encourage faculty to embed advising into the classroom.** Using classroom time allows faculty to reach more students while conserving time (although one-on-one advising is still very important).
 - * For example, in a few minutes per class, faculty can incorporate discussion of content needed for 4-year transfer, give motivational pep talks and strategies for adjusting to 4-year college, explain the value of attending a 4-year institution, discuss career possibilities, or advertise transfer office resources and programs (Packard, Tuladhar, & Lee, 2013).

Promising practices for approachability:

- * Use students' names, use small group office hours, and invite questions in writing during class (Packard, 2011).
- * Give constructive feedback. Faculty expectations influence student performance (Packard, 2011; Yeager et al., 2013). Also, clearly explain the connections between feedback and ability, so students can more accurately evaluate their performance (Brown et al., 2009).
- * Positive student learning outcomes are correlated with faculty discussion with students about the nature of engineering work and affirmation of students' abilities to successfully perform such work (ENGAGE, n.d.).

Resource Highlight:

For tips on improving faculty-student interaction, see the ENGAGE website: <http://www.engageengineering.org/?page=138>.

Case Study: Engage Faculty in Advising

At Valencia College, faculty members receive training on the various campus services that are available, and adjunct faculty members are given monetary incentives to complete relevant training certifications. The certification process involves taking required modules on topics such as how to advise developmental education students and how to promote college success skills. There are also elective courses on topics such as how to motivate students and how to promote student development of affective skills.

(Dadgar et al., 2013a)

Developmental Education

This section highlights ways to help students avoid “stalling out” in developmental coursework. Strategies include curricular redesign that involves contextualization and addresses psychological barriers, as well as the provision of ongoing, collaborative support that de-stigmatizes help-seeking behavior.

Support the development of engaging curricula

- **Explore alternative formats for delivering developmental mathematics curricula.**

- * **Adapt curriculum to address socio-emotional and psychological barriers to math.** See Silva & White, 2013 for an example.
- * **Create contextualized coursework.** Allow students to earn credits toward transfer while learning basic skills. See Baker et al., 2009 for a faculty primer on contextualized teaching and learning. Also see Goldfien and Badway, 2014 for lessons learned regarding engaging faculty in the process, and Perin, 2011 for a review of the evidence supporting contextualization.

Contextualization is “the practice of systematically connecting basic skills instruction to a specific content that is meaningful and useful to students,” in this case, STEM content (Perin, 2011, p.270).

- * **Focus on demonstrated competencies instead of seat time.** Use a modular approach that targets specific skills and competencies. Provide remediation and college level course work simultaneously (Chaplot et al., 2013).

With modularization, students take short, focused “modules” instead of semester-long courses, allowing for multiple entry and exit points (Bragg, 2012).

The SMART math program at Jackson State Community College is an example of a modularized design (<http://www.thencat.org/SMART%20Math%20at%20JSCC.htm>).

- **Invest in faculty professional development to help create more engaging courses** (Goldfien & Badway, 2014).
 - * The Developmental Education Initiative found that it was more cost-effective to bring experts to their campuses for intensive trainings, and engaged many more faculty and staff, than the “go to the conference and bring something back for us” approach (MDC, 2012, p.23).
- **Facilitate substantive collaboration between basic skills instructors and discipline-specific instructors.** Developmental education courses can effectively use disciplinary context to enhance student motivation and learning (Perin, 2012).

Examples:

- * The IBEST program in Washington state **combines basic skills and professional technical education** in co-taught courses (Wachen et al., 2010). Enrollment in IBEST increased college-level credit accumulation and degree or certificate completion (Zeidenberg et al., 2010).
- * At Valencia College, **faculty developed online resources to help students prepare for placement tests** (Dadgar et al., 2013a).

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Resource Highlight:

Read about one group’s experience collaborating to create a health-contextualized math curriculum in Shore et al., 2004.

Example: Curricular Innovation for Developmental Education

Science Education for New Civic Engagements and Responsibilities (SENCER) curricula connect scientific knowledge to issues of public concern. La Guardia Community College adapted SENCER approach for their developmental math courses and saw a 34% decrease in their dropout rate (Delcham et al., 2009). For more information, see www.sencernet.org and La Guardia Community College’s [Project Quantum Leap Sampler \(2008\)](#).

Developmental Education, continued

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- **Offer administrative support for collaboration.** Support in terms of time, scheduling, and funding is crucial to the success of developing contextualized curricula (Goldfien & Badway, 2014).
- **Foster interdisciplinary collaboration among faculty.** Interdisciplinary collaboration – for example between math and physics – can help students align what they learn and make their learning more synchronized and the transitions between topics easier (Delcham et al., 2009).

For example:

- * A workshop was created to involve faculty from mathematics and nursing to put together a prototype lesson that used problem-based learning and integrated nursing topics. Through this work, the faculty decided to write a FIPSE (Fund for the Improvement of Post-Secondary Education) proposal to more fully develop a contextualized curriculum, which was accepted (Shore et al., 2004).

Resource Highlight:

Learn about the challenges of developing a biotechnology-contextualized summer bridge curriculum in Goldfien & Badway, 2014.

Resource Highlight:

Read about the outcomes of a three-year effort to identify and scale programs that increase the number of community college students who complete developmental education and successfully move on to credit-bearing studies (MDC, 2012).

Provide academic support that is collaborative and non-stigmatizing

- **Offer peer-facilitated study groups.** Provide a review of lectures with prepared interactive material designed to target trouble spots. Design activities to de-stigmatize help seeking behaviors.
 - * Uri Treisman's Mathematics Workshop Program provides one of the original successful models for facilitating collaborative academic support (Fullilove & Treisman, 1990).
 - * Students who participate in collaborative academic support benefit from improvements in their academic performance and from opportunities to grow into leadership positions (Packard, 2012; Treisman, 1992).
- **Structured collaboration has been shown to improve math preparedness** (Hodara, 2013).
- **Student success centers integrate academic and career counseling in a potentially non-stigmatizing environment.** When organized by topic, rather than developmental level, some of the stigma around help seeking is eliminated. Student success centers are perceived as services that everyone uses, not just those who are struggling academically (Dadgar et al., 2013b).
- **Help students understand and prepare for placement tests** so they will be placed in courses that are a good match for their skills. See p.13 in MDC 2012 for examples.

Case Study: Placement Test Preparation

Housatonic Community College offers a 4-week "prepare for math" lab with individualized instruction (to students who score just below the cut off for the next level course) rather than the typical 16-week version. After the 4-week lab, 50% of students scored higher on retest.

(MDC, 2012, p.21)

Transfer to 4-year colleges

This section highlights two general practices to support transfer: relationship building between CCs and 4-year colleges; and, creating financial, social, and academic support for transfer students at receiving institutions.

Create alignment between levels of education

- **Memos of understanding/articulation agreements between CCs and 4-year institutions are promising, but perhaps not sufficient** (Anderson et al., 2006; Hoffman et al., 2010; Jackson et al., 2013; Kienzl et al., 2011; Kisker, 2007; Mattis & Sislin, 2005).
Transfer partnerships should include:
 - * collaboration between faculty,
 - * campus visits by university faculty to community college campuses,
 - * joint undergraduate research programs, and
 - * financial support for transfer students.
- **Admissions advisors from 4-year colleges can visit 2-year institutions.** Advisors counsel students and parents on admission, prep for STEM majors, financial aid, housing, internships, and other student services. STEM-specific advisors can provide transcript evaluations, seminars on academic and career opportunities in STEM, and guided tours of their university departments (Mattis & Sislin, 2005). See UC Davis “TOP” program as an example (Case Study)
- **Consider block transfer systems.** Giving premium transfer credits for completing an A.S. degree encourages persistence and completion more than course-by-course articulation agreements, which may discourage students from completing the A.S. (Mattis & Sislin, 2005).
- **Give faculty release time to develop new curricular pathways and to align curriculum from developmental studies to content disciplines** (MDC, 2012).
- **Expose students to 4-year institutions, increase the visibility of universities on CC campuses, and provide CC students opportunities to get involved at university campuses** (Jackson & Laanan, 2011; Mery & Schrioring, 2011).
- **Provide professional development and training for faculty advisors who work with transfer students.** Advisors can spark intention to transfer and support transfer goals (Bahr, 2008).

Case Study:

UC Davis Transfer Opportunity Program (TOP)

TOP is a collaboration between the University of California, Davis (UCD), and 15 northern California community colleges. TOP coordinators from the Undergraduate Admissions Office at UCD regularly visit participating colleges to counsel students and parents on admission to UCD; preparation for majors and general education requirements; and financial aid, housing, internships, study abroad, and other student services. Engineering advisors also provide transcript evaluations, seminars on academic and career opportunities in engineering, and guided tours of the UCD campus.

(Mattis & Sislin, 2005, p.23)

Example: Elements of Exemplary Articulation Agreements

According to the National Academy of Engineering and the National Research Council, exemplary articulation agreements offer transfer students per-semester scholarships, allow students to take courses at a community college with financial aid from the four-year institution, and require a single application process and fee for partnering institutions.

(Mattis & Sislin, 2005)

Transfer to 4-year colleges, continued

Foster collaborative relationships between CC faculty and 4 year college faculty

- **Build interpersonal relationships across institutions.** Dowd (2012, p.127) argues that “transfer structures are not sufficient to support robust transfer pathways in STEM in the absence of interpersonal relationships and shared cultural norms across sectors.”
- **Involve faculty.** Facilitate regular collaboration between 2- and 4-year college faculty members. Involving faculty is key to fostering a “culture of transfer” on CC campuses (Kisker, 2007).
- **Engage in collaborative activities across institutions.** The National Academy of Engineering and the National Research Council suggest that collaborative activities, such as the joint development of grant proposals and workshops, can also increase the level of cooperation between transfer partners (Mattis & Sislin, 2005).
 - * One example is regular lunches between CC and 4-year faculty members that improved their relationships and the transfer of students (Dowd, 2012).
- **Support faculty participation through stipends or release time.** Heavy course loads and other responsibilities may often keep faculty from being more involved, but offering temporal or financial support can create a “mutually reinforcing cycle” where involved faculty can help other faculty think more about assisting students who want to transfer to a 4-year institution (Kisker, 2007).
- **Transfer information between community college and university faculty.** Educate 4-year faculty about the talent at CCs and help CC faculty understand what is needed at the 4-year level (Dowd, 2012).
 - * Negative stereotypes about transfer students’ ability can impede success (Laanan, 2007), so disseminating information about CC student success to 4-year college faculty, administrators and student affairs staff is critical (Hoffman et al., 2010).
 - * Negative attitudes toward transfer students regarding their academic performance contradict research findings showing that the academic abilities of transfer students, including those in STEM fields, are comparable to the academic abilities of non-transfer students (Laanan, 2001).
 - * Note that some transfer students who excelled at community colleges may experience transfer shock – a drop in academic performance in their first year of study at a four-year institution (Laanan, 2001).
 - * Although community college students are less likely to earn a baccalaureate degree compared to their four-year institution peers, CC students who successfully transfer to a four-year college or university are as likely to earn the bachelor’s degree as those who begin at four-year institutions (Handel, 2011).

Resource Highlight:

See NIH’s “Bridges to the Baccalaureate” program, which supports institutional partnerships between 2- and 4-year colleges for students studying the biomedical sciences (<http://www.nigms.nih.gov/Research/Mechanisms/Pages/BridgesBaccalaureate.aspx>).

Transfer to 4-year colleges, continued

Foster support at receiving institutions:

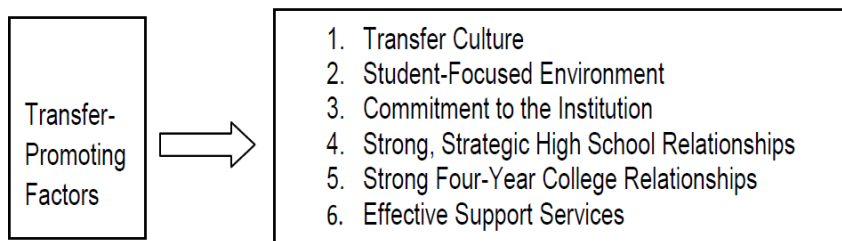
- **Offer orientations specifically designed for CC transfer students.** Transfer students in STEM fields benefit from intentional and comprehensive orientation and mentoring programs oriented specifically to their needs (Townsend & Wilson, 2006).
 - * Some schools, like LaGuardia Community College have arranged “joint transfer orientations” where CC students meet with 4-year college deans, financial aid advisors, directors of admission, career placement personnel and chairs of various STEM departments (Delcham et al., 2009).
- **Encourage the assessment of campus climate in STEM learning environments at universities.** Climate issues in STEM programs at 4-year colleges (faculty and peer interactions) have been tied to the disproportionate loss of women and racial minority students from these fields (Dowd, 2012; Walton & Cohen, 2011; and, Walton et al., 2012).
- **Improve talent assessment and identification systems in community colleges.** In short, “poor signaling of student talents and accomplishments hampers transfer rates because the quality of the community college curriculum is viewed with suspicion by university and liberal arts faculty” (Dowd, 2012, p.108).

Offer Financial Support

- **Offer transfer scholarships that are specific to STEM** (Dowd, 2012). Students receiving financial aid are more likely to transfer (Anderson et al., 2006).
- **Encourage students to use individual development accounts.** These savings accounts are matched by public and private sources (Dowd, 2012).
- **Seek federal funding for STEM-specific experiences through work study or internship programs** (Dowd, 2012).
- **Involve industry in identifying mechanisms to provide work-study positions in collaboration with academic institutions** (Dowd, 2012).

Case Study: Six Key Factors Influencing Transfer to Four-Year Colleges

*Results from the Successful Transfer Approach Research (STAR) Project
Investigating seven California community colleges with consistently high transfer rates.*



(Mery & Schiorring, 2011)

Transfer to industry/career

This section emphasizes the importance to community colleges of building relationships with leaders of local industry. These relationships can help engage students in STEM careers, create internships, and facilitate job placement.

Build relationships with local industry

- **Facilitate regular contact between faculty and representatives from local industry.** Advisory committees are an example. Example: Modesto Junior College Accelerated Careers in Technology program (Levin et al., 2010).
- **Partner with industry to create internships.** For lessons learned and best practices for CCs partnering with industry, see Kisker & Carducci, 2003.
 - * See examples of Cisco Networking Academy and General Motors Automotive Service Educational Program in Hagedorn & Purnamasari, 2012.
- **Consider recruiting industry experts to teach on CC campuses.** For example, many practicing and retired engineers could contribute to engineering education and strengthen the links between the engineering curriculum and the real-world applications of coursework (Mattis & Sislin, 2005).

See examples in *Retention* and *Outreach & Recruitment* sections of this document:

- Partner with industry to pose problems that students can solve collaboratively (Kisker & Carducci, 2003). [pg. 7]
- Use online tools to help students connect with industry mentors (Costello, 2012). [pg. 8]
- Create opportunities for students to have informal interactions with industry professionals – for example, “dinner with scientists” (Lenaburg et al., 2012). [Pg. 3]

Case Study: Involving Industry in Curricular Development

The Regional Center for Next Generation Manufacturing (RCNGM) developed a specialized, industry-driven curriculum that addresses “real-world” problems. Through a partnership with Connecticut industries, RCNGM identifies demand for skilled, technical workers in STEM fields and develops Technology Studies Curricula that prepare students for careers in these fields. Instructors are placed with advanced manufacturing companies for four-week externships in cutting-edge technologies – which prepare them to implement relevant curricula and classroom projects using real world, hands-on design projects.

(Costello, 2012)

Data Management

This section emphasizes two general practices: detail-level data collection to better identify points in students' paths where they might go off course, and sharing of this and other student success research with faculty and relevant staff so they can better use evidence-based practice as they serve students.

Collect disaggregated data at points spanning students' paths through and beyond CC

- **Track student progress at multiple points along their pathways, not just at entry and exit.** Collect data at intermediate points on pathways toward STEM program milestones. This kind of tracking reveals critical junctures where students might exit STEM programs and where supports might help them regain momentum.
 - * See resources from Completion by Design to help trace student pathways through community college including the Loss/Momentum Framework (Rassen et al., 2013). Also see Completion By Design in the "Additional Resources" section.
 - * Achieving the Dream participants developed both outcome and intermediate measures of student success that are not specific to STEM (Baldwin et al., 2011).
 - * Example: The Benchmarking Equity and Student Success Tool (BESST) enables colleges to look at cohorts in a fine-grained manner along milestones and momentum points (Dowd et al., 2009).
- **Continue to track students once they complete their 2-year degree.** Monitor educational and career trajectories. Compiling and publicizing data on, for example, transfer students' success in obtaining B.S. or advanced STEM degrees can demonstrate the effectiveness of STEM studies in community colleges nationally and improve their recruitment rates or point to the need to strengthen community college programs (Delcham et al., 2009; Mattis & Sislin, 2005).
- **Collect mid-program student feedback.** When studying the success of certain programs, such as summer bridge programs, mid-program feedback may provide better data. Lenaburg et al. (2012) found that focus groups held during the middle of a bridge program produced the most helpful constructive feedback compared with data collected at the beginning or the end of the program.
- **Disaggregate student data to identify gaps by gender, ethnicity, or other demographic factors** (Hagedorn & Purnamasari, 2012).

Learn more about what works and share that information with faculty

- **Familiarize faculty with data regarding contributors to student performance.** They might otherwise rely on anecdotal or impressionistic information when making teaching or advising decisions (National Research Council, 2012).
- **Study mentoring strategies, and how they are linked to retention outcomes** (Carnegie Foundation for the Advancement of Teaching, 2008; Packard, 2012).

Bibliography

- American Association for the Advancement of Science (AAAS)** (2011). *Vision and Change in Undergraduate Biology Education: A Call to Action*. Washington, DC. <http://visionandchange.org/finalreport> [2/25/14]
- Report from a 2009 national meeting focused on recommendations for improving undergraduate biology education for all students. Includes recommendations for creating “student-centered classrooms” and for integrating undergraduate research experiences into the classroom and the curriculum more generally.
- American Society for Engineering Education** (2009). *Creating a culture for scholarly and systematic innovation in engineering*. http://www.asee.org/about-us/the-organization/advisory-committees/CCSSIE/CCSSIE_Phase1Report_June2009.pdf%20 [2/11/2014]
- Report focused on improving the quality of engineering education through innovation in curriculum, instruction, and assessment. Reviews literature and offers suggestions for practice.
- Amelink, C.T., and Creamer, E.G.** (2010). “Gender differences in elements of the undergraduate experience that influence satisfaction with the engineering major and the intent to pursue engineering as a career.” *Journal of Engineering Education*, 99(1), 81-92.
- Study of nine institutions with undergraduate engineering programs finds that program culture, including acceptance by peers, the presence of female mentors and role models, and the perception that faculty care about student learning make a difference for both males and females in terms of persistence in engineering programs and intention to pursue engineering careers.
- Anderson, G.M., Sun, J.C., and Alfonso, M.** (2006). “Effectiveness of statewide articulation agreements on the probability of transfer: A preliminary policy analysis.” *Review of Higher Education*, 29(3), 261-291.
- Based on a nationally-representative sample, the authors find that, controlling for individual demographic factors, students from states with state-wide articulation agreements are no more likely to transfer from 2-year to 4-year college than those students in states without those agreements (but the authors note that the study was conducted early in the implementation period). Suggests policies that might enhance transfer rates at the state level (pp.282-283).
- Aspen Institute** (2013). *Defining Excellence: Lessons from the 2013 Aspen Prize Finalists*. Aspen Institute, College Excellence Program, Washington, DC. http://www.aspeninstitute.org/sites/default/files/content/upload/DefiningExcellence_2.pdf [4/16/14]
- Report on lessons learned from finalists for the Aspen Institute’s Prize for Community College Excellence. Focus is on completion, learning, labor market outcomes, and equity.
- Bahr, P.** (2008). “Cooling out in the community college: What is the effect of academic advising on students’ chances of success?” *Res. Higher Educ.*, 49(8), 704–732.
- Analysis of students at 107 semester-based California community colleges finds that advising is beneficial to students’ chances of success and underprepared students benefit more from advising than their college-ready counterparts.
- Baker, E.D., Hope, L., Karandjeff, K.** (2009). *Contextualized Teaching & Learning: A faculty Primer*. Center for Student Success/RP Group <http://www.rpgroup.org/resources/CTL-primer> [2/20/14]
- Defines contextualized teaching and learning (CTL), reviews the literature supporting it, presents models for implementation, and provides case studies of implementation in California community colleges.
- Baldwin, C., Bensimon, E.M., Dowd, A.C., and Kleiman L.** (2011). “Measuring Student Success.” *New Directions for Community Colleges*, no.153, 75-88.
- Through three examples of current efforts (including Achieving the Dream and the Community College Student Success Project at UMass Boston), this chapter presents commonly used measures of student success, analyzes their strengths and weaknesses, and discusses innovative measures that are being used to benchmark community colleges.
- Barnett, E.A., Bork, R.H., Mayer, A.K., Pretlow, J., Wathington, H.D., & Weiss, M.J.** (2012). *Bridging the Gap: An Impact Study of Eight Developmental Summer Bridge Programs in Texas*. National Center for Postsecondary Research.
- Results of an experimental-design study examining short and long term effects of summer bridge courses on student outcomes.

Bibliography, continued

Bettinger, E., & Baker, R. (2011). “The effects of student coaching in college: An evaluation of a randomized experiment in student mentoring.” NBER Working Paper No. 16881. Cambridge, MA: National Bureau of Economic Research.

- Used a randomized experiment with university undergraduate students to test the effects of individualized student coaching on academic outcomes among non-traditional college students. They found that students who were coached were more likely to persist during the treatment period and more likely to be attending the university one year after coaching ended. Coaching also proved more cost effective in achieving retention and completion gains compared with increased financial aid.

Boroch, D. and Hope, L. (2009). *Effective Practices for Promoting the Transition of High School Students to College*. RP Group and Center for Student Success, California Community Colleges.

<http://www.rpgroup.org/projects/high-school-transition> [3/5/2014]

- Literature review that identifies practices consistently recommended for successfully transitioning high school students to college. Each practice is described, as are benefits to secondary and postsecondary students, results of research, research-based recommendations, and implications for practice.

Bragg, D.D., and Taylor J.L. (2014). "Toward College and Career Readiness: How Different Models Produce Similar Short-Term Outcomes." *American Behavioral Scientist*. Published online 1/7/2014.

- Exploration of pilot “College and Career Readiness” programs. Highlights different implementation models and uses qualitative data to explore the effects of different program elements.

Bragg, D.D. (2012). “Two-Year College Mathematics and Student Progression in STEM Programs of Study.” In National Research Council and National Society for Engineering report: *Community Colleges in the Evolving STEM Education Landscape: Summary of a Summit*. http://www.nap.edu/catalog.php?record_id=13399 [3/25/2014]

- Specific recommendations for improving two-year college mathematics programs to better prepare students for STEM fields of study. Paper prepared for the Dec 15, 2011 *Summit*.

Brown, M.K., Hershock, C., Finelli, C., and O'Neal, C. (2009). *Teaching For Retention in Science, Engineering, and Math Disciplines: A Guide for Faculty*. Center for Research on Learning and Teaching, The University of Michigan. <http://www.wskc.org/documents/281621/307235/>

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[GAGE_KendallBrownHershockFinelli2009.pdf/3901b794-b7b0-4628-95a6-5959909945d7?version=1.0](http://www.wskc.org/documents/281621/307235/EN-GAGE_KendallBrownHershockFinelli2009.pdf/3901b794-b7b0-4628-95a6-5959909945d7?version=1.0) [2/11/14]

- Focused on university students, this paper describes specific classroom strategies and teaching behaviors that have been demonstrated to improve student success in STEM. Also provides practical advice to individual faculty members who are seeking to implement these teaching strategies.

Carter, D.F. (2006). “Key issues in the persistence of underrepresented minority students.” In E.P. John and M. Wilkerson (Eds.), *Reframing persistence research to improve academic success* (pp.33-46). San Francisco, CA: Jossey-Bass.

- Review of the literature on retention of undergraduate under-represented minority students at universities.

Chamany, K., Allen, D., and Tanner, K. (2008). “Making biology learning relevant to students: Integrating people, history, and context into college biology teaching.” *CBE-Life Sciences Education*, 7(3), 267-278.

- Discusses the importance of making connections between biology and social issues, and then examines models of how to do so in the classroom and the curriculum.

Chaplot, P., Rassen, E., Davis Jenkins, P., Johnston, R. (2013). *Principles of Redesign: Promising Approaches to Transforming Student Outcomes*. Community College Research Center, Teachers College, Columbia University. <http://ccrc.tc.columbia.edu/> [2/20/14]

- Offers a “distillation” of research and practice on community college student success into eight core principles. Focused on being useful to practitioners, the guide “reflect[s] a fresh approach to thinking about student outcomes: one that looks at the institution from the students’ perspective and asks colleges to align structures, systems, programs and services in a coherent way.”

Bibliography, continued

Costello, C. (2012). *Increasing opportunities for low-income women and student parents in science, technology, engineering, and math at community colleges*. Student Parent Success Initiative, Institute for Women's Policy Research, Washington, DC. <http://www.iwpr.org/initiatives/student-parent-success-initiative/increasing-opportunities-for-low-income-women-and-student-parents-in-science-technology-engineering-and-math-at-community-colleges-1/view> [2/28/14]

- Report that analyzes trends in women's representation in STEM at community colleges as well as promising institutional and policy practices for improving outcomes for women students in general and student parents in particular.

Coyle, E. J., Jamieson, L. H. and Oakes, W. C. (2006). "2005 Bernard M. Gordon Prize Lecture: Integrating Engineering Education and Community Service: Themes for the Future of Engineering Education." *Journal of Engineering Education*, 95, 7–11.

- Describes the Engineering Projects in Community Service (EPICS) program at Purdue, which won the 2005 Gordon Prize for Innovation in Engineering and Technology Education. EPICs is built around the concept of long-term partnerships between student teams and not-for-profit organizations in the community.

Dadgar, M., Venezia, A., Nodine, T., and Bracco, K.R. (2013a). *Providing structured pathways to guide students toward completion*. San Francisco: WestEd. <http://www.wested.org/news-events/the-game-changers-series/> [2/26/2014]

- This is one of a series of "Game Changers" documents produced by WestEd for use by community colleges to generate discussion about innovative models for increasing completion rates. This report focuses on creating structures that help students commit to and complete programs of study.

Dadgar, M., Nodine, T., Bracco, K.R., and Venezia, A. (2013b). *Integrating Student Supports and Academics*. San Francisco: WestEd. <http://www.wested.org/news-events/the-game-changers-series/> [2/26/2014]

- This is one of a series of "Game Changers" documents produced by WestEd for use by community colleges to generate discussion about innovative models for increasing completion rates. This report focuses

on strategies for making student support services a more integral part of students' ongoing experience.

Deil-Amen, R. (2011). "Socio-Academic Integrative Moments: Rethinking Academic and Social Integration Among Two-Year College Students in Career-Related Programs." *The Journal of Higher Education* 82 (1), 54-91.

- Uses qualitative data to explore aspects community college socio-academic integration that positively contribute to student persistence.

Delcham, H., Hajallie, K., and Wang F. (2009). *Community College as a Pathway to Engineering Education and Careers*. Proceedings of the Conference Synergy in STEM: Bringing Mathematics, Physics and Engineering Together October 30, 2009 Brooklyn, New York. <http://websupport1.citytech.cuny.edu/faculty/mseip/conference09/printables/Proceedings-1.pdf> [2/18/14]

- Conference proceedings focused on strategies for STEM teaching and learning, including online courses, instructional innovations, interdisciplinary collaboration, interactive lecture demonstrations, etc.

Dimitriu, D., and O'Connor, J.O. (2004). "Forging Stronger Ties between Community Colleges and Four-Year Universities." Proceedings of the 2004 American Society for Engineering Education Annual Conference and Exposition (Session 2004-676). Washington, D.C.: *American Society for Engineering Education*, 6(1): 41–56.

- Brief lessons learned from the first year of two grant programs at San Antonio College. Focuses on four elements that emerged as vital for recruiting and retaining students in a community college engineering program and preparing them to be successful after transfer to a four year university.

Dowd, A.C. (2012). "Developing Supportive STEM Community College to Four-Year College and University Transfer Ecosystems." In National Research Council and National Society for Engineering, *Community Colleges in the Evolving STEM Education Landscape: Summary of a Summit*.

- Report focuses on recommendations for expanding access to STEM transfer pathways between community colleges and 4-year universities. Reviews national data and common challenges. Introduces "Evidence-

Bibliography, continued

Based Innovation Consortia” as a model for institutional change to support increased access to transfer pathways.

Dowd, A. and Coury, T. (2006). “The effect of loans on the persistence and attainment of community college students.” *Research in Higher Education* 47: 33-62.

- Analyzes the National Center for Education Statistics’ Beginning Postsecondary Students (BPS 90/94) data to predict persistence to the second year of college and associate’s degree attainment over five years. During the period under study, loans did not contribute to higher persistence and attainment rates. Loans are observed to have a negative effect on persistence and no effect on degree attainment. The findings are attributed to a combination of the high uncertainty of degree completion among community college students and the negative affective component of indebtedness.

Dowd, A.C., Malcom, L.E., and Bensimon, E.M. (2009). *Benchmarking the success of Latino and Latina students in STEM to achieve national graduation goals.* Los Angeles, CA: University of Southern California. <http://cue.usc.edu/news/NSF-Report.pdf> [2/11/14]

- Report that identifies 25 Hispanic Serving Institutions (HSIs) in five states as potential exemplars of effective practices for increasing the number of Latina and Latino bachelor’s degree holders in STEM. Encourages the use of three benchmarking strategies to monitor and increase the proportion of Latino STEM majors and graduates.

ENGAGE (n.d.). *ENGAGE Strategy research brief: Faculty-Student Interaction.* Engaging Students in Engineering. <http://www.engageengineering.org/?page=137> [2/11/2014]

- Brief summary of the research demonstrating the importance of faculty-student interaction in STEM disciplines in increasing student persistence and completion.

Evans, H. D. and Mody-Pan, P. N. (2010). "Interpreting Successes of a Community College-University Partnership in Retaining Underrepresented Engineering Students." Presented at WEPAN/NAMEPA Joint Conference: Baltimore, MD. <https://ojs.libraries.psu.edu/index.php/wepan/article/viewFile/58557/58245> [2/4/2014]

- Focuses on recruitment and retention of women and under-represented minorities in engineering. Presents an analysis of cross-sectional data (student survey responses) from the North West Engineering Talent Expansion Partnership, a statewide collaborative project among four community colleges and two universities in Washington State in 2004.

Fike, D.S., and Fike, R. (2008). “Predictors of First-Year Student Retention in the Community College.” *Community College Review*, 36(2): 68-88.

- Analyzed predictors of fall-to-spring and fall-to-fall retention among 9,200 first-time-in-college students at an urban, Texas community college.

Focusing on student success. (2010). TCC Magazine, Winter: 2–3. http://www.tacomacc.edu/UserFiles/Servers/Server_6/File/abouttcc/tccmagazine/Win2010_TCCMagazine_4web.pdf [3/6/2014]

- Tacoma Community College’s newsletter to the community, highlighting the outcomes of its Achieving The Dream implementation.

Fullilove, R.E. and Treisman, P.U. (1990). “Mathematics Achievement Among African American Undergraduates at the University of California, Berkeley: An Evaluation of the Mathematics Workshop Program.” *The Journal of Negro Education*, 59(3 – Summer): 463-478.

- Description and evaluation of Treisman’s innovative Mathematics Workshop Program (MWP) at University of California Berkeley. The MWP significantly improved academic performance, improving passing rates and persistence.

Gregerman, S.R. (2008). “The role of undergraduate research in student retention, academic engagement, and the pursuit of graduate education.” Paper presented at the National Research Council’s Workshop Linking Evidence to Promising Practices in STEM Undergraduate Education, Washington, DC. http://sites.nationalacademies.org/DBASSE/BOSE/DBASSE_072631

- Describes the University of Michigan Undergraduate Research Opportunity Program as a model program for increasing the retention of historically under-represented students in STEM fields. Describes program components as well as assessment and evaluation strategies.

Bibliography, continued

Goldfien, A.C. and Badway, N.N. (2014). "Engaging Faculty for Innovative STEM Bridge Programs." *Community College Journal of Research and Practice*, 38(2-3): 122-130.

- Researchers followed four community colleges for a year to understand local factors that facilitated or impeded implementation of a bridge program in which basic skills were contextualized in biotechnology. The findings are that implementation of a contextualized curriculum requires substantial faculty learning. Recommendations include planning for faculty development, both for faculty collaboration and contextualizing curriculum.

Hagedorn, L.S. and DuBray, D. (2010). "Math and Science Success and Nonsuccess: Journeys within the Community College." *Journal of Women and Minorities in Science and Engineering* 16(1): 31–50.

- Uses transcript analysis and descriptive methods to trace patterns of success and non-success in terms of the climb through developmental mathematics, focusing on time, course completion ratio, and grades, disaggregated by gender and ethnicity among students expressing a desire for a STEM career. Concludes that mathematics success is key to further success for STEM students.

Hagedorn, L.S. and Purnamasari, A.V. (2012). "A Realistic Look at STEM and the Role of Community Colleges." *Community College Review*, 40(2): 145-16.

- Offers an analysis of the predicted workforce shortages in STEM fields and what role community colleges might realistically play. Emphasizes CCs role in creating access for under-represented groups and also in boosting STEM teacher education.

Hagedorn, L.S., Cypers, S., and Lester, J. (2008). "Looking in the review mirror: Factors affecting transfer for urban community college students." *Community College Journal of Research and Practice*, 32(9): 643-664.

- Traces the history of students who successfully transferred to universities from community colleges and argues that the strongest predictor of transfer success is taking transfer-appropriate courses at the community college level.

Hagedorn, L.S., Maxwell, W., and Hampton, P. (2001-02). "Correlates of Retention for African-American

Males in Community Colleges." *Journal of College Student Retention: Research, Theory and Practice*, 3(3): 243-263.

- Analyzes organizational data for three cohorts of African-American men to identify factors that best predict retention.

Handel, S. (2011). "Transfer and the role of two- and four-year institutional partnerships in addressing the nation's workforce and educational equity needs." *Journal of Applied Research in the Community College*, 18(2): 6–12.

- Introduction to a special issue on the role of transfer pathways between two- and four-year institutions in addressing educational equity gaps.

Hassoun, S., and Bana, S. (2001). "Practices for recruiting and retaining graduate women students in computer science and engineering." Proceedings of the 2001 International Conference on Microelectronic Systems Education. <http://csdl2.computer.org/comp/proceedings/mse/2001/1156/00/11560106.pdf> [2/4/2014]

- This paper summarizes current practices by Computer Science and Engineering departments aimed at recruiting and retaining graduate women students.

Hodara, M. (2013) "Improving Students' College Math Readiness: A Review of the Evidence on Postsecondary Interventions and Reforms." Community College Research Center Working Papers Series. <http://dx.doi.org/10.7916/D8M32SS7> [2/26/14]

- This paper reviews current research on the effectiveness of interventions and reforms that seek to improve the math preparedness and success of high school students entering college. Based on gaps in the research knowledge, it also provides recommendations for further inquiry

Hoffman E., Starobin, S.S., Laanan, F.S., and Rivera, M. (2010). Role of Community Colleges in STEM Education: Thoughts on Implications for Policy, Practice, and Future Research. *Journal of Women and Minorities in Science and Engineering*. 16(1): 85-96.

- Concluding essay to a special issue focused on the role of community colleges in STEM education. Discusses the measurement and analysis of current practices and suggests innovative research approaches and implications for institutional and state policy.

Bibliography, continued

Hughes K.I., Rodriguez, O., Edwards, L., and Belfield, C. (2012). *Broadening the Benefits of Dual Enrollment: Reaching under achieving and underrepresented students with career-focused programs.* Community College Research Center Report. <http://ccrc.tc.columbia.edu/publications/broadening-benefits-dual-enrollment.html> [2/6/2014]

- Report on the Concurrent Courses initiative, a program focused on making dual enrollment courses available to low-income, academically struggling, or historically underrepresented populations. Presents evidence on the benefits of dual enrollment and also offers lessons learned through the initiative for effective dual enrollment practice.

Hulleman, C. S. and Harackiewicz, J.M. (2009). "Making education relevant: Increasing interest and performance in high school science classes," *Science* 326: 1410-1412.

- In a randomized field experiment with high school students, authors found that a relevance intervention, which encouraged students to make connections between their lives and what they were learning in their science courses, increased interest in science and course grades for students with low success expectations.

Jackson, D. L., and Laanan, F. S. (2011). "The role of community colleges in educating women in science and engineering." In J. G. Gayles (Ed.), *New Directions for Institutional Research: No. 152. Attracting and retaining women in STEM* (pp. 39–49). San Francisco, CA: Jossey-Bass.

- This chapter offers policy and practice suggestions based on a mixed-methods study of the experiences of women in STEM who transferred to a four year college from the community college system (including suggestions for orientations, advising, and socio-academic integration). Discusses the role of community colleges in educating the next generation of women in STEM.

Jackson, D. L., Starobin, S. S., and Laanan, F. S. (2013). "The Shared Experiences: Facilitating Successful Transfer of Women and Underrepresented Minorities in STEM Fields." *New Directions for Higher Education*, 162: 69-76.

- This chapter addresses critical issues related to the

transfer success of women and underrepresented minorities (URMs) in STEM disciplines and will highlight implications for fostering a successful transfer experience for these populations.

James Irvine Foundation. (2012). *Dual Enrollment for All: Reasons and Ways to Make It Work. Lessons for Educators and Administrators from the Concurrent Courses Initiative.* Practitioner Brief: <http://ccrc.tc.columbia.edu/publications/broadening-benefits-dual-enrollment.html> [2/6/2014]

- Brief overview of recommendations for dual-enrollment programs based on lessons learned from the concurrent courses initiative.

Jones, M.T., Barlow, A.E.L., and Villarejo, M. (2010). "Importance of undergraduate research for minority persistence and achievement in biology." *Journal of Higher Education*, 81(1): 82-115.

- Statistical analysis of transcript and admissions application data at UC Davis shows that undergraduate research participation is significantly associated with earning a baccalaureate degree and with persistence and outstanding performance among biology majors for all racial/ethnic groups at a large research university.

Karp, M.M. (2011). "Toward a new understanding of non-academic student support: four mechanisms encouraging positive student outcomes in the community college." Community College Research Center Working Paper No. 28. <http://academiccommons.columbia.edu/catalog/ac:146656> [2/7/2014].

- This paper examines the ways in which academically vulnerable students benefit from non-academic support. By reviewing theories of student persistence as well as program evaluation literature, the author identifies four mechanisms by which nonacademic supports can improve student outcomes, including persistence and degree attainment. Programs associated with positive student outcomes seem to involve one or more of the following mechanisms: (1) creating social relationships, (2) clarifying aspirations and enhancing commitment, (3) developing college know-how, and (4) making college life feasible.

Karp, M. M., Hughes, K. L., and O'Gara, L. (2008a). "An exploration of Tinto's integration framework for community college students." *Journal of College*

Bibliography, continued

Student Retention: Research, Theory and Practice, 12(1): 69-86. <http://files.eric.ed.gov/fulltext/ED501335.pdf>

- Using in-depth interviews with students at two urban community colleges in the Northeast, the authors find that the majority of students do develop attachments to their institutions and this sense of attachment is related to their persistence in the second year of college. They also find that this integration is both academic and social – these two forms of integration develop in concert for community college students. Offers suggestions for ways to facilitate student integration via information networks.

Karp, M, Mechur J., Calcagno, J.C., Hughes, K.L., Jeong, D., Bailey, T.R. (2008b). *Dual Enrollment Students in Florida and New York City: Postsecondary Outcomes*. Report. Community College Research Center, Teachers College, Columbia University, New York. <http://hdl.handle.net/10022/AC:P:19274> [3/15/14].

- Provides findings and recommendations from a study of dual enrollment programs with a specific focus on Career and Technical Education students. Findings support dual enrollment as a strategy for promoting student access to and persistence in post-secondary education.

Karp, M., Mechur, J., Stacey, G.W. (2013a). *What We Know About Nonacademic Student Supports: Research Overview*. Community College Research Center, Teachers College, Columbia University. <http://dx.doi.org/10.7916/D88G8HPJ> [2/19/14]

- One of three reports (Karp et al., 2013a-c) that are part of the Community College Research Center's Nonacademic student supports practitioner packet. They are brief, data-driven resources. This report presents a rationale for their "Sustained, Strategic, Intrusive, and Personalized" advising model.

Karp, M., Mechur, J., Stacey, G.W. (2013b). *Designing a System for Strategic Advising*. Community College Research Center, Teachers College, Columbia University. <http://dx.doi.org/10.7916/D8D798D8> [2/19/14]

- One of three reports (Karp et al., 2013a-c) that are part of the Community College Research Center's Nonacademic student supports practitioner packet. This report outlines their recommendations for a

strategic advising model.

Karp, M., Mechur, J., Stacey, G.W. (2013c). *Student Success Courses for Sustained Impact: Research Report*. Community College Research Center, Teachers College, Columbia University. <http://dx.doi.org/10.7916/D8J10150> [2/19/14]

- One of three reports (Karp et al., 2013a-c) that are part of the Community College Research Center's Nonacademic student supports practitioner packet. This practitioner-oriented guide has data-driven suggestions for how to design student success courses for maximum impact.

Kazis, R and Lincoln, C.A. (2013). *Advancing underrepresented minorities in STEM education and careers*. Report by Jobs for the Future and Achieving the Dream. <http://www.achievingthedream.org/resource/advancing-underrepresented-minorities-in-stem-education-and-careers> [2/6/2014]

- This paper characterizes the opportunities for underrepresented minorities in STEM fields and existing barriers to successful community college pathways. It concludes with recommendations for federal policymakers for improving preparation for the sub-Bachelor's degree STEM labor market.

Kienzl, G.S., Wesaw, A.J., and Kumar, A. (2011). *Understanding the transfer process*. Washington, DC: Institute for Higher Education Policy. <http://media.collegeboard.com/digitalServices/pdf/advocacy/policycenter/understanding-transfer-process-community-college-ihp-121217.pdf>

- Provides an overview of the current state of the transfer pathway for community college students seeking baccalaureate degrees. Identifies student, institutional, and state-level factors that accelerate or hinder transfer. Also compares community college students to their peers who start out in four-year institutions.

Kim, Y.K., and Sax, L.J. (2009). "Student-faculty interaction in research universities: Differences by student gender, race, social class, and first-generation status." *Research in Higher Education*, 50(5): 437-459.

- Findings suggest that while all students benefit from student-faculty interaction, different kinds of interaction (e.g., classroom-based vs. research-based)

Bibliography, continued

benefit students of different races, classes, and genders differently, leading to some implications for faculty practice.

Kisker, C.B. (2007). "Creating and sustaining community college-university transfer partnerships." *Community College Review*, 34(4): 282–300.

- Qualitative study of a community college-university partnership examines processes involved in creating and sustaining partnerships to enhance transfer and baccalaureate attainment. Particularly describes challenges in partnership management and governance, the importance of involving faculty in transfer-partnership programs and activities, and the utility of transfer partnerships in the future. Implications for practice are presented.

Kisker, C.B. and Carducci, R. (2003) "UCLA Community College Review: Community College Partnerships with the Private Sector-Organizational Contexts and Models for Successful Collaboration." *Community College Review*, 31(Winter): 55-74.

- Describes models of successful community college partnerships with local businesses and industry. Discusses benefits and challenges of these partnerships.

Kruse, T., Starobin, S. S., Laanan, F. S., and Russell, D. (2012). *The Influence of Financial Barriers on Transfer Decisions of Community College Students in STEM Courses*. Office of Community College Research & Policy, Research Brief No. 5. Series on STEM Student Success Literacy Project. Iowa State University. <http://www.cclp.hs.iastate.edu/research/rbriefs/occrp-brief-kruse-july.pdf> [3/25/14]

- Based on survey data of knowledge and transfer intentions among community college students enrolled in STEM courses. Finds that parents' socioeconomic status plays a large role in students' decisions to attend college and in their persistence from community college to 4-year college or university. Financial factors related to employment and number of dependents was not significantly related to transfer intentions.

Laanan, F. S. (2001). "Transfer student adjustment." In F. S. Laanan (Ed.), *New Directions for Community Colleges: No. 114. Transfer students: Trends and issues* (pp. 5–13). San Francisco, CA: Jossey-Bass. doi:10.1002/cc.16 <http://files.eric.ed.gov/fulltext/ED456889.pdf>

- Chapter discussing the trends surrounding transfer students and highlights issues affecting those students. Presents a synthesis of research on transfer students, post-transfer adjustment process, and perspectives on college adjustment.

Laanan, F.S. (2007). "Studying transfer students: Part II: Dimensions of transfer students' adjustment." *Community College Journal of Research and Practice*, 31(1): 37-59.

- Characterize the "complex transfer process" of community college students. This cross-sectional study examined a cohort of 717 students at a multicultural university in Southern California who transferred from 64 California community colleges during 1994 and 1995.

Laursen, S., Liston, C., Thiry, H., and Graf, J. (2007). "What good is a scientist in the classroom? Participant outcomes and program design features for a short-duration science outreach intervention in k-12 classrooms." *CBE—Life Sciences Education*, 6(1): 49-64.

- Findings from a qualitative research study of a "scientist in the classroom" intervention – a common outreach model where practicing professional scientists visit K-12 classrooms to offer short duration presentations, hands on activities, or discuss specific careers. Program design elements that lead to positive outcomes are discussed.

Lenaburg, L., Aguirre, O., Goodchild, F., Kuhn, J.U. (2012). "Expanding Pathways: A Summer Bridge Program for Community College STEM Students." *Community College Journal of Research and Practice*, 36(3): 153-168.

- The paper presents the results of an evaluation of a two-week residential summer bridge program that recruited community college students from a wide range of academic, ethnic, and socioeconomic backgrounds to degree programs in science, technology, engineering, and mathematics (STEM). Results identify the factors that increase the confidence and motivation of students to pursue STEM undergraduate degrees.

Levin, J. S., Cox, E., Kisker, C. Cerven, C., Haberler, Z., Smith, M., Chang, Y. Naylor, N., Malcom, L., Montero-Hernandez, V., Roys, J., Beach, J., Silverman, J., Mulholland, S. (2010). *Promising Practices in Community Colleges*. California Community College Collaborative

Bibliography, continued

- (C4). <http://c4.ucr.edu/ejournal.html> [2/6/2014]
- Report on a field study of California community colleges, highlighting behaviors and characteristics of programs that constitute promising and effective practices. Identifies ways that these effective principles of practice could be transferred to other community colleges. Of interest: includes the example of the Accelerated Careers in Technology program at Modesto Junior College.
- Malcom, L.E.** (2008). *Accumulating (dis)advantage? Institutional and financial aid pathways of Latino STEM baccalaureates*. Unpublished dissertation, University of Southern California, Los Angeles.
- Traces the pathways of Latina/o bachelor's degree holders in STEM-related fields, particularly looking at the differences between those who earned associate degrees and those who did not, and examining the impacts of different college financing strategies. Although a pathway through community college was common for Latino bachelor degree holders, it was much less common for STEM BS degree holders. Latino STEM bachelor degree holders who earned an associate degree had lower levels of debt than non-associate degree holders.
- Malcom, L. E.** (2010). "Charting the pathways to STEM for latina/o students: The role of community colleges." *New Directions for Institutional Research*, 148 (Winter): 29–40.
- Describes ways in which community colleges have served as institutional pathways for Latina/o STEM bachelor's degree holders.
- Markowitz, D.G.** (2004). "Evaluation of the long-term impact of a university high school summer science program on students' interest and perceived abilities in science." *Journal of Science Education and Technology*, 13(3): 395-407.
- Evaluates an outreach program targeted to high school students and hosted by a research university (Summer Science Academy at University of Rochester). Based on self-report data from students, the program positively influenced their performance in advanced science courses as well as their decision to participate in other science programs and their desire to pursue a career in science.
- Mattis, M. C. and Sislin, J.** (2005). *Enhancing the community college pathway to engineering careers*. Washington, D.C., National Academies Press. <http://site.ebrary.com/id/10103979>.
- Report commissioned by the National Science Foundation, National Academy of Engineering and the National Research Council on mechanisms of successful transfer between community colleges and four-year institutions' engineering programs. Provides recommendations for enhancing the role of community colleges in educating engineers.
- Mery, P. and Schiorring, E.** (2011). "It takes an integrated, college-wide effort' and other lessons from seven high transfer colleges." *Journal of Applied Research in the Community College*, 18(2): 33–34.
- Results from the Successful Transfer Approach Research (STAR) Project investigating seven California community colleges with consistently high transfer rates. Highlights 6 transfer-promoting factors as well as strategies and approaches for implementation.
- MDC** (2012). *What we know: Lessons from the Developmental Education Initiative*. <http://www.mdcinc.org/resources/publications/what-we-know-lessons-developmental-education-initiative> [2/6/2014]
- Report on a three-year effort to identify and scale programs that increase the number of community college students who complete developmental education and successfully move on to credit-bearing studies.
- National Research Council and National Academy of Engineering.** (2012). *Community Colleges in the Evolving STEM Education Landscape: Summary of a Summit*. S. Olson and J.B. Labov, Rapporteurs. The National Academies Press: Washington, DC. http://www.nap.edu/catalog.php?record_id=13399 [3/10/14]
- Report based on a national summit, highlighting the importance of community colleges in preparation of the STEM workforce. Includes recommendations from key scholars.
- Nodine, T., Jaeger, L., Venezia, A., and Bracco, K. R.,** with research support from Public Agenda (2012). *Connection by Design: Students' Perceptions of Their Community College Experiences*. San Francisco, CA: WestEd. <http://knowledgecenter.completionbydesign.org/sites/default/files/421%20Nodine%202012.pdf> [4/22/14]

Bibliography, continued

- Report from focus groups of current and former community college students in four states who discuss their desires for and perceptions of their community college experiences. Includes a discussion of students' ideas of how to improve college completion rates.
- Ohland, M.W., Sheppard, S., Lichtenstein, G., Eris, O., Chachra, D., and Layton, R.A. (2008).** "Persistence, engagement, and migration in engineering programs." *Journal of Engineering Education*, 97(3): 259-278.
- This paper examines engagement factors and educational outcomes of undergraduate students in engineering majors compared to other fields of study. Aims to discover new insights regarding college outcomes for engineering students, the extent to which these outcomes and engagement factors are engineering specific, and how to improve desirable outcomes and remediate undesirable ones.
- Packard, B.W. (2003a).** "Student training promotes mentoring awareness and action." *The Career Development Quarterly*, 51(4): 335-345.
- Describes a "composite mentoring" program implemented for college women pursuing science careers. Discusses implications for advising, career counseling, and mentoring program design.
- Packard, B.W. (2003b).** "Web-based mentoring: Challenging traditional models to increase women's access." *Mentoring and Tutoring*, 11(1): 53-65.
- Review of the literature and evidence for web-based mentoring, especially for women pursuing non-traditional careers such as those in the sciences.
- Packard, B.W. and Hudgings, J.H. (2002).** "Expanding college women's perceptions of physicists' lives and work through interactions with a physics careers web site." *Journal of College Science Teaching*, 32(3): 164-170.
- Experimental study: students at an all-women's 4-year college show increased career knowledge of physics after interacting with a website that profiles women working professionally in physics.
- Packard, B.W. and Nguyen, D. (2003).** "Science career-related possible selves of adolescent girls: A longitudinal study." *Journal of Career Development*, 29(4): 251-263.
- Based on interviews with 41 female high school graduates from diverse ethnic and socioeconomic backgrounds, who had enrolled in an intensive math and science program while in high school. Mentoring relationships, developed through intensive summer programs or work-related internships, were critical to ongoing career development.
- Packard, B.W. (2004-2005).** "Mentoring and retention in college science: Reflections on the sophomore year." *Journal of College Student Retention: Research, Theory, and Practice*, 6: 289-300.
- Study of upper-level undergraduates enrolled in science majors at a research university. Finds that psychosocial and career mentoring may contribute to persistence in different ways. Students who received more career mentoring (sponsorship, challenge, coaching) were more likely to continue to major in science but differences in psychosocial mentoring did not predict either staying in a science major or switching to a non-science major.
- Packard, B.W. (2011).** *Improving Faculty Student Interaction: Research-based, time-effective tips to engage students.* Engaging Students in Engineering. <http://www.engageengineering.org/?page=137> [2/11/2014]
- Brief report on the link between faculty engagement or mentoring and student satisfaction and degree completion.
- Packard, B.W. (2012).** "Effective Outreach, Recruitment, and Mentoring into STEM Pathways: Strengthening Partnerships with Community Colleges." In National Research Council and National Society for Engineering, *Community Colleges in the Evolving STEM Education Landscape: Summary of a Summit*.
- Commissioned paper for the Summit, focuses on summarizing research evidence and presenting the author's own suggestions about outreach, recruitment, and mentoring.
- Packard, B. W., Gagnon, J. L., LaBelle, O., Jeffers, K., and Lynn, E. (2011).** "Women's experiences in the STEM community college transfer pathway." *Journal of Women and Minorities in Science and Engineering*, 17(2): 129-147.
- Thirty women who transferred from community college to four-year institutions in STEM fields were

Bibliography, continued

interviewed once while finishing community college and again one semester later. Results illustrate both facilitators of successful transfer and barriers.

Packard, B.W., Babineau, M.E., and Machado, H.M. (2012a). "Becoming job-ready: Collaborative future plans of Latina adolescent girls and their mothers in a low-income urban community." *Journal of Adolescent Research*, 27(1): 110-131.

- Seventeen high school juniors and their mothers were interviewed about pursuit of a trade during high school and postsecondary plans in the nursing field. Findings include a perceived separation between nursing education and math and science education and an idea that a job such as nursing might facilitate the pursuit of college. Cases highlight the importance of family involvement, ethnic background, and socioeconomic status in the construction of college plans. Interventions are discussed.

Packard, B. W., Gagnon, J. L., and Senas, A. (2012b). "Navigating community college transfer in science, technical, engineering, and mathematics fields." *Community College Journal of Research and Practice*, 36(9): 670-683.

- Authors analyze the delay experiences of students navigating community college transfer pathways in STEM fields in Massachusetts. Three central institutional delays are highlighted: 1) informational setbacks from unsatisfactory advising, 2) imperfect program alignment with 4-year institutions, and 3) college resource limitations. Accumulation of delays was particularly detrimental to students pursuing STEM fields. Implications are discussed.

Packard, B. W., Tuladhar, C., and Lee, J. (2013). "Advising in the classroom: How community college STEM faculty support transfer-bound students." *Journal of College Science Teaching*, 42(4): 54-60.

- Study of the advising practices of STEM faculty from three Massachusetts community colleges who were identified by students as being supportive of their transfer efforts. Commonly named faculty members were significantly more likely to discuss transfer during class time than infrequently named faculty.

Palmer, R.T. and Wood, J.L. (2013). *Community Colleges and STEM: Examining Underrepresented Racial and Eth-*

nic Minorities. Hoboken: Taylor and Francis, 2013.

- Edited volume. Contributors discuss the role of community colleges in facilitating access and success for racial and ethnic minority students in STEM. Chapters explore how community colleges can and do facilitate the STEM pipeline, as well as the experiences of these students in community college, including how psychological factors, developmental coursework, experiential learning, and motivation affect success. Provides recommendations to help increase retention and persistence.

Perin, D. (2012). "Teaching academically underprepared students in community colleges." In *Understanding Community Colleges*, Editors: John S. Levin and Susan T. Kater. New York, NY. Routledge.

- Discusses the challenges faced by academically underprepared community college students and developmental education approaches designed to improve achievement. Contextualization is suggested as an alternative to traditional format developmental education. Concludes with recommendations regarding the structure of developmental education and interdisciplinary professional development.

Perin, D. (2011). "Facilitating Student Learning through Contextualization: A Review of Evidence." *Community College Review*, 39(3):268-295.

- This is a review of evidence for contextualization, defined here as an instructional approach connecting foundational skills and college-level content. Two forms of contextualization are identified, contextualized and integrated instruction. Despite methodological limitations, the available studies suggest that contextualization has the potential to accelerate the progress of academically underprepared college students.

Project Quantum Leap Sampler (2008). <http://www.lagcc.cuny.edu/ctl/pql/sampler/> [2/25/14]

- A collection of contextualized math projects and assignments developed by LaGuardia Community College faculty that adapts the SENCER (Science Education for New Civic Engagements and Responsibilities) approach specifically for community college students taking developmental math.

Rassen, E., Chaplot, P., Jenkins, P.D., and Johnstone, R. (2013). *Understanding the Student Experience Through*

Bibliography, continued

The Loss/Momentum Framework: Clearing the Path to Completion. Community College Research Center, Teachers College, Columbia University. <http://dx.doi.org/10.7916/D8N58JC7> [2/20/14]

- One of a series of 3 “inquiry guides” sponsored by the Completion by Design Initiative. This guide proposes a new framework, the “loss/momentum framework” as a means to better understand community college students’ experiences and the specific areas that might be targets for reform and redesign. The concrete, practitioner-oriented guide offers information and tools to explore students’ educational journeys with the goal of identifying areas for transformation and further inquiry.

Sablan, J.R. (2013). “The Challenge of Summer Bridge Programs.” *American Behavioral Scientist*. First published online: December 23, 2013.

- This article presents a synthesis of research on Summer Bridge Programs (SBPs), including the range of methodologies used and outcomes studied. It provides a characterization of the breadth of SBPs, reviews the extant literature on SBPs, and discuss implications of these reviews for the future of SBPs.

Salm, S., Goodwyn, L., van Loon, N., Jayant, L., and DeLeon, P. (2008). “Learning benefits of a summer research program at a community college.” *The American Biology Teacher*, 70(4): e18-e22. http://www.nabt.org/websites/institution/File/pdfs/american_biology_teacher/2008/070-04-0018.pdf [3/5/14]

- Report on the outcomes of a five-week summer research program focused on basic molecular biology and tissue culture techniques at Borough of Manhattan Community College. Offers insights to practitioners who might design a similar summer workshop. The majority of students expressed interest in scientific careers and graduate school and reported increased confidence in themselves as academicians.

Scrivener, S. and Coghlan, E. (2012). *Opening doors to student success: A synthesis of findings from an evaluation at six community colleges*. MDRC Paper. <http://www.mdrc.org/publication/opening-doors-student-success>

- Rigorous evaluation of demonstration projects at six community colleges across the country focused on improving student academic outcomes. Strategies were

based on focus groups with low-income students, discussions with college administrators, and an extensive literature review. There are four distinct programs based on the following approaches: financial incentives, reforms in instructional practices, and enhancements in student services.

Seymour, E., Hunter, A.-B., Laursen, S., and DeAntoni, T. (2004). “Establishing the benefits of research experiences for undergraduates: First findings from a three-year study.” *Science Education*, 88: 493-594.

- Descriptions of student-identified benefits of undergraduate research experiences drawn from an analysis of 76 student interviews gathered from four liberal arts colleges.

Shore, M., Shore, J., and Boggs, S. (2004). “Allied Health Applications Integrated into Developmental Mathematics using Problem Based Learning.” *Mathematics and Computer Education*, 38.2: 183-189.

- Description and evaluation of a project to incorporate health examples into the developmental mathematics curriculum. Results show that students in sections that involved problem based learning and allied health examples performed significantly better than control group students.

Silva, E. and White, T. (2013). *Pathways to Improvement: Using psychological strategies to help college students master developmental math*. Carnegie Foundation for the Advancement of Teaching. http://www.achievethegoal.org/sites/default/files/resources/PathwaysToImprovement_0.pdf [2/6/2014]

- Describes Carnegie’s Pathways to Improvement model (and successful results) for improving developmental mathematics instruction in community college settings. The model focuses on “psychological strategies for student success” – addressing student mindsets and motivation.

Starobin, S. S. (2004). *Gender Differences in College Choice, Aspirations, and Self-Concept Among Community College Students in Science, Mathematics, and Engineering*. Unpublished doctoral dissertation, University of North Texas.

- Investigates the influences of students’ pre-college experiences on their college choice, aspirations, and self-concept among public community college stu-

Bibliography, continued

dents who aspire to study science, mathematics, and engineering. Also examines gender differences of these factors.

Starobin, S. S. and Laanan, F. S. (2008). “Broadening female participation in science, technology, engineering, and mathematics: Experiences at community colleges.” In J. Lester (Ed.), *New Directions for Community Colleges*, No. 142: *Gendered Perspectives on Community Colleges* (pp.37-46). San Francisco: Jossey-Bass.

- This chapter presents findings from interviews with female community college students in science, technology, engineering, and mathematics fields regarding their learning experiences, interaction with faculty, and educational and career aspirations.

Strayhorn, T. L. (2012). *College students’ sense of belonging: A key to educational success*. New York, NY: Routledge.

- Reports from a series of studies on the impact of sense of belonging on various groups of college students.

Strawn, C. and Livelybrooks, D. (2012). “A Five-Year University/Community College Collaboration to Build STEM Pipeline Capacity.” *Journal Of College Science Teaching*, 41(6): 47-51.

- This article investigates the mechanisms through which undergraduate research experiences for community college students can have second-order and multiplier effects on other students and home community college science, technology, engineering, and mathematics (STEM) departments and thus build STEM pipeline capacity. Findings from focus groups with science faculty at five of the participating community colleges document positive changes. These include an improved sense of student–faculty community within departments and participants serving as aspirational role models for other students.

Summers, M.D. (2003). “ERIC Review: Attrition Research at Community Colleges.” *Community College Review*, 30(4): 64-84.

- Reviews the literature regarding the scope and significance of community college student attrition and models to explain and predict it.

Tehan, L. (2007). “Advising the Single Parent College Student.” *The Mentor*. [http://dus.psu.edu/mentor/](http://dus.psu.edu/mentor/old/articles/070207lt.htm)

[old/articles/070207lt.htm](http://dus.psu.edu/mentor/old/articles/070207lt.htm) [2/4/14]

- Suggestions for advisors and mentors of single-parent college students.

Thompson, M. D. (2001). “Informal Student-Faculty Interaction: Its Relationship to Educational Gains in Science and Mathematics Among Community College Students.” *Community College Review*, 29(1): 35-57.

- Investigates the effect of informal student-faculty interaction on the differential patterns of science and math gains of male and female community college students. Higher levels of informal interaction with faculty was positively associated with the effort students exert in science courses and with science and mathematical educational gains. However, the gains for women were significantly lower despite similar patterns of informal interaction with faculty.

Townsend, B. K. and Wilson, K. B. (2006). “‘A hand hold for a little bit’: Factors facilitating the success of community college transfer students to a large research university.” *Journal of College Student Development*, 47(4): 439–456.

- Interview-based study with 19 students who transferred from community college to a large state research university. Findings indicate that transfer students need more assistance navigating a large university and more information about faculty and student behavior at research institutions.

Treisman, U. (1992). “Studying students studying calculus: A look at the lives of minority mathematics students in college.” *College Mathematics Journal*, 23(5): 362-372.

- Lecture outlining Treisman’s experiences developing a model of challenging, collaborative, non-stigmatizing, support for students struggling in math but who do not see themselves as underprepared (the Mathematics Workshop Program). For a more formal evaluation see Fullilove and Treisman 1990.

Tsui, L. (2007). “Effective strategies to increase diversity in STEM fields: A review of the research literature.” *The Journal of Negro Education*, 76(4): 555-581.

- Review of the literature on common undergraduate retention strategies in STEM fields (not CC specific), including mentoring, summer bridge, tutoring, undergraduate research, career counseling, learning

Bibliography, continued

- centers, academic advising, college skills workshops and seminars, financial support, and curricular reform. Also reviews empirical support for three model intervention programs: Meyerhoff program, Minority Engineering Program (MEP), and the Mathematics Workshop.
- Urias, M.V., Johnson, R.M., and Wood, J.L. (2013).** “The effect of non-cognitive predictors on academic integration measures: a multinomial analysis of STEM students of color in the community college.” In Palmer and Wood (eds.) *Community Colleges and STEM: Examining Underrepresented Racial and Ethnic Minorities*. Hoboken: Taylor and Francis.
- Evaluated the effects of self-efficacy and locus of control on academic integration. Greater self-efficacy – especially math self-efficacy – led to lower levels of academic integration (e.g., visiting faculty) whereas higher levels of internal locus of control led to higher levels of academic integration.
- Vogt, C.M. (2008).** “Faculty as a critical juncture in student retention and performance in engineering programs.” *Journal of Engineering Education*, 97(1): 27-36.
- Study of the effects of academic environment on undergraduate students studying engineering at four research universities. Results showed that faculty distance lowered students’ self-efficacy, academic confidence, and GPA. Academic integration had a positive effect on self-efficacy, which in turn had strong positive effects on effort and critical thinking.
- Wachen, J., Jenkins, D., and Van Noy, M. (2010).** *How I-BEST Works: Findings from a Field Study of Washington State’s Integrated Basic Education and Skills Training Program*. Community College Research Center, Columbia University. <http://ccrc.tc.columbia.edu/publications/how-i-best-works.html> [2/28/14]
- Study of Washington State’s I-BEST (Integrated Basic Education and Skills Training) program. I-BEST combines basic skills and technical instruction so that basic skills students can enter directly into college-level coursework. Basic skills instructors and professional-technical faculty jointly design and teach college-level occupational classes that admit basic skills-level students.
- Walton, G.M., Cohen, G.L., Cwir, D., and Spencer, S. (2012).** “Mere belonging: The power of social connections.” *Journal of Personality and Social Psychology*, 102 (3): 513-532.
- A series of experiments demonstrating that even minimal cues of social connectedness raise motivation, including persistence on domain-relevant tasks.
- Walton, G.M. and Cohen, G.L. (2011).** “Brief Social-Belonging Intervention Improves Academic and Health Outcomes of Minority Students,” *Science* 331 (6023): 1447-1451.
- Randomized control trial of a social belonging intervention among White and African-American first year college students. Over the observation period, African Americans’ GPAs rose significantly compared to control groups. African-Americans’ self-reported health and well-being improved.
- Wang, X. (2013).** “Modeling entrance into STEM fields of study among students beginning at community colleges and four-year institutions.” *Research in Higher Education*, 54(6): 664-692.
- Factors shaping the decision to pursue STEM fields of study is examined among students entering community colleges and four-year institutions. Results suggest specific points of intervention. The study also reveals differences in the impacts of these factors on community college vs. four-year students.
- Winters, K.M., and Streveler, R. (2010).** “How Student-Faculty Interactions Influence Student Motivations: A Longitudinal Study Using Self-Determination Theory.” *Proceedings of the American Society for Engineering Education 2010*, Annual Conference Session AC 2010-1107.
- Four-year study using interviews with undergraduate students at a public research university to explore students’ perceptions of interactions with faculty and how such interactions impact students’ autonomy, competence and beliefs of group belonging. Findings suggest gaps between current classroom practices and student’s needs.
- Yeager D., Walton, G., and Cohen, G.L. (2013).** “R&D: Addressing achievement gaps with psychological interventions.” *Phi Delta Kappan*, 94(5): 62-65.
- Discusses research and practice in using psychological interventions to improve the performance of underachieving students. Based on a “student view-

Bibliography, continued

point” approach, argues that even when all students are treated similarly they can experience classrooms very differently. Reviews a few promising approaches with practical applications.

Zeidenberg, M., Jenkins, P.D., and Calcagno, J.C. (2007). *Do Student Success Courses Actually Help Community College Students Succeed?* Community College Research Center, Teachers College, Columbia University. <http://academiccommons.columbia.edu/item/ac:157602> [2/7/2014]

- Reports findings from a preliminary in-depth analysis of the relationship between student success courses and student outcomes in Florida community colleges. Based on their analysis, enrollment in a student success course has a positive marginal effect on a student’s chances of earning a credential, persisting, or transferring.

Zeidenberg, M., Cho, S. W., and Jenkins, P.D. (2010). *Washington State's Integrated Basic Education and Skills Training program (I-BEST): New evidence of effectiveness.* Community College Research Center, Columbia University. <http://ccrc.tc.columbia.edu/publications/i-best-new-evidence.html> [2/28/14]

- Analyzes the effects of the I-BEST program (for a description, see Wachen et al., 2010) on educational outcome variables including credit accumulation, persistence, basic skills point gains, and certificate or degree completion. Enrollment in I-BEST had positive impacts on all educational outcomes but persistence.

Additional Resources

Reports and evidence-based tools for increasing student success in community colleges:

Community College Research Center

- <http://ccrc.tc.columbia.edu/>
- Conducts research on the issues affecting community colleges and works with colleges and states to improve student success and institutional performance.
- Selected resources: <http://ccrc.tc.columbia.edu/Resources/selected-audience-resources.html>
- They also have brief, evidence-based papers and reports available on the Columbia University Academic Commons: <http://academiccommons.columbia.edu/catalog/browse/departments/Community+College+Research+Center>

Completion by Design

- <http://www.completionbydesign.org>
- Pathways analyses toolkit: This Toolkit describes the process and model analyses that CBD colleges use to analyze students' pathways, and design and evaluate their reforms. Filled with practical tools, templates, ideas and instructions. <http://www.completionbydesign.org/our-approach/step-3-diagnose-the-issues/pathway-analyses-toolkit>
- Knowledge center with resources related to student connection with, entry into, progress through, and completion of community college. <http://knowledgecenter.completionbydesign.org/knowledge-center>
- The Completion by Design (CBD) initiative is designed to help community colleges increase completion rates for large numbers of students while holding down college costs and maintaining the quality of programs and services.

WestEd's Game Changers Series

- The Game Changers series is designed to help community colleges significantly increase student completion rates. The series' three reports highlight reforms aimed at increasing the number of students graduating from community college. They are designed for use by colleges to generate discussion about innovative models for increasing completion rates substantially.
- <http://www.wested.org/news-events/the-game-changers-series/>

MDRC – Higher education

- Research on developmental education, student services, instruction and curricula, financial aid and institutional reform specifically for community colleges. <http://www.mdrc.org/issue/higher-education>

Models of STEM programs in community colleges

See Costello 2012 profiles of 7 Community College STEM programs:

- The Scholars Program in Math and Computer Science, Community College of Baltimore County, MD
- The South Carolina Advanced Technological Education Center, Florence-Darlington Technical College, SC
- Integrated Basic Education and Skills Training (I-BEST), Washington State
- California Mathematics, Engineering, and Science Achievement Program
- Regional Center for Next Generation Manufacturing, Connecticut Community Colleges College of Technology, Hartford, CT
- California WomenTech Extension Services Project, Alameda, CA
- STEM Equity Pipeline, Cochranville, PA >>

Additional Resources, continued

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CAITE (Commonwealth Alliance for Information Technology Education)

- Has a repository of best practices for educators
<http://caite.cs.umass.edu/educators/index.html>
- Has a web site for students to explore IT careers
<http://www.takeitgoanywhere.org/>

STEM ENGINES program

- A model for involving community college students in undergraduate research
- Main web page: <http://www.stemenginesurc.com/>
- Some papers about the program:
 - * <http://www.cur.org/assets/1/7/Fall08Brothers.pdf>
 - * <http://www.cur.org/download.aspx?id=2723>

Miami Dade College's Tools for Success Program

- An integrated program of academic and financial support for CC students interested in STEM, supported by an NSF grant – includes transfer scholarships.
- Tools for success.org

Instructor Resources

- **Applied Math and Science Education Repository (AMSER)**, a portal of free educational resources and services built specifically for use by instructors at community and technical colleges.
 - * ENGAGE – Engaging students in Engineering
 - * <http://www.engageengineering.org/>
 - * Has “Everyday Examples in Engineering” – lesson plans, demonstrations and ideas that can be used to illustrate various topics in Engineering.
 - * Also has resources for improving faculty student interaction: <http://www.engageengineering.org/?page=138> and a resource kit for assessing the quality of these interactions.
- **Teaching For Retention in Science, Engineering, and Math Disciplines: A Guide For Faculty**” Center for Research on Learning and Teaching, The University of Michigan, 2009.
 - * http://www.wskc.org/documents/281621/307235/EN-GAGE_KendallBrownHershockFinelli2009.pdf/3901b794-b7b0-4628-95a6-5959909945d7?version=1.0 [2/11/14]
- **Southern Regional Education Board** has developed two readiness courses to bridge the gap between high school and college level math and reading – their website offers details on the curricula, modules, and sample assignments.
- **Board on Science Education (BOSE)** Promising practices in undergraduate STEM education – white papers on the effectiveness of various pedagogical strategies http://sites.nationalacademies.org/dbasse/bose/dbasse_080106.

Additional Resources, continued

Administrator Resources

- **Community College outreach toolkit** from Broadening Advanced Technological Education Connections (batec.org)
 - * Guides for transfer and outreach, working with industry.
- **MentorNet.org**
 - * Online career-based mentoring system.
 - * For a review, see Packard, B.W. (2003b). Web-based mentoring: Challenging traditional models to increase women's access. *Mentoring and Tutoring*, 11(1), 53-65.
- **Council on Undergraduate Research**
 - * Resources for Community Colleges to help integrate undergrad research: http://www.cur.org/projects_and_services/special_projects/community_colleges/
 - * They also run a listserv dedicated to the discussion undergraduate research at community colleges (http://www.cur.org/projects_and_services/special_projects/community_colleges/).
- ***Teaching by choice, cultivating exemplary community college STEM faculty.***
 - * Patton, M. (2006). NSF sponsored resource for CCs on recruiting, training and retaining STEM faculty. Available at : <http://www.aacc.nche.edu/Resources/aaccprograms/Documents/stemfaculty.pdf>

Evaluating student outcomes

- ITest (soon to be STELAR): a database of instruments to assess student learning and other STEM-relevant outcomes http://itestlrc.edc.org/STEM_education_instruments

Collaboration and Community of Practice

- Student Success Centers – see this report from Jobs for the Future <http://www.jff.org/publications/education/joining-forces-how-student-success-centers/1553>