Schmitz, S., Ebersole, T. E., Morrell, C., & Parker, C. (2018). Measuring the effectiveness of community college faculty learning communities on student performance. *Learning Communities Journal, 10*, 87-108.

Measuring the Effectiveness of Community College Faculty Learning Communities on Student Performance

Sonja Schmitz
The Community College of Baltimore County

Tara Eisenhauer Ebersole
The Community College of Baltimore County

Claudia Morrell
STEM Equity Initiative, Inc.

Carolyn Parker
American University

One of the challenges facing faculty learning community (FLC) programs in today's educational climate of assessment and evidence-based research is to demonstrate robust evidence of the impact of FLCs on student success. For this study, the authors defined student success as improvement in performance, persistence, and pathway indicators and used a multi-method approach to assess these outcomes following faculty participation in topic-based FLCs. The three methods included utilizing (1) a survey to assess faculty gains and satisfaction because of their participation in the FLCs, (2) a coding method developed to capture student success as reported by faculty in their final capstone presentations, and (3) a validated survey used in a longitudinal panel design to measure the change in faculties' beliefs and understandings about classroom equity. The authors discuss the implications of these methods for substantiating that FLCs have an impact on student success and believe that our coding method may be applicable to future FLC studies.

Introduction

Faculty learning communities (FLCs) are an effective professional development venue for influencing innovative and attitudinal change in faculty (Beach & Cox, 2009; Sirum & Madigan, 2010) and impacting teaching practices as measured by student evaluations (Ebersole, 2008). Providing relevant professional development to faculty teaching science, technology, engineering, and math (STEM) courses is of particular importance today, when postsecondary graduation rates in STEM-related fields in the U.S. lag behind demand, particularly for women and members of underrepresented minorities. The persistent racial and gender disparity in STEM fields points to the need for a strategy to fill these positions, which will lead to more women and members of underrepresented minorities gaining needed technical skills (Landivar, 2013; Mento, Sorkin, & Prettyman, 2008). FLCs provide a venue for faculty to explore best practices for retaining women and underrepresented groups in STEM courses.

A central component of post-secondary FLCs is the Scholarship of Teaching and Learning (SoTL) outside of the educator's discipline. SoTL is defined as the scholarly inquiry into student learning to advance the practice of teaching by making the findings of inquiry public (Richlin & Cox, 2004; Kern, Mettetal, Dixson, & Morgan, 2015). Faculty with discipline-specific credentials but who are not formally trained in education apply the research process to their classrooms. SoTL entails observing a problem, designing a classroom intervention, assessing the impact, and presenting or publishing the results. Although the debate about what differentiates scholarly teaching and SoTL is ongoing, Kern et al. (2015) offer the Dimensions of Activities Related to Teaching (DART) to provide a context for SoTL within the academy.

The work of our FLC, which is the subject of this article, falls into the continuum between scholarly teaching and SoTL in that the approach to research was systematic and the faculty members conducted literature reviews, used validated classroom assessments, and presented their work to colleagues within the college. SoTL is thriving within community colleges and universities. Faculty learning communities are often the venue through which SoTL is practiced. Assessment of FLCs shows that new perspectives on teaching and learning are rated highest among the gains made by participants at both four-year institutions (Beach & Cox, 2009; Nadelson, Shadle, & Hettinger, 2013) and community colleges (Goto, Marshall, & Gaule, 2010; Kincaid, 2009; Lightner, 2013).

A critique of SoTL research centers on the subjective nature of the methodology. This critique includes the observation that faculty investigations into student learning are not grounded in educational learning theories (Kanuka, 2011) and that the evidence is limited to faculty self-reports of student performance (as opposed to independent evaluation of outcomes); student evaluations; and qualitative evidence in the form of personal opinions, refection and anecdotal evidence (Polich, 2008). A literature review of efforts to improve undergraduate education in STEM revealed that only 21% of the studies reported strong evidence to support the claims of success or failure of the strategy studied (Henderson, Beach, & Finkelstein, 2011). In today's educational climate of assessment and evidence-based research, the paucity of publications reporting robust evidence of the impact of FLCs on student grades and retention is problematic. This is of special concern for STEM faculty, who are trained to be data driven and produce measurable results. With limited formal supportive evidence, these faculty may be hesitant to try strategies that are unfamiliar or new to their pedagogical practice.

This article describes a faculty professional development program that included an eight-month long faculty learning community. Three instruments were used to support the claim that faculty participation in FLCs can be linked directly to student success indicators. The goal of our topic-based FLC was to increase the performance, persistence, and pathway indicators of under-represented students, especially women, in gateway feeder courses that lead into the College's STEM programs. The National Alliance for Partnerships in Equity (NAPE) developed a rigorous faculty professional development (PD) program titled "Micromessaging to Reach and Teach Every Student™" (https://www.napequity.org/professional-development/teacher-training/). Working with the Community College of Baltimore County (CCBC), NAPE secured funding through the National Science Foundation (DUE # 1104163) to implement and assess the effectiveness of a program, the Educator's Equity in STEM Academy (EESTEM) that was implemented during one academic year among STEM faculty representing engineering, information technology, chemistry, physics, and mathematics programs. Faculty began the program by participating in five days of intensive PD during a summer academy, followed by eight monthly FLC meetings. After completing the program, faculty members presented their project to highlight the impact of their intervention on student success.

To guide faculty in scholarly research, participants were asked to follow NAPE's Program Improvement Process for Equity. This process mirrors research designs promoted by SoTL (Dickson & Treml, 2013) and classroom action research (Mettetal, 2000). Participants were provided with three semesters of classroom data from the CCBC Office of Planning, Research and Evaluation reporting grade distributions and retention disaggregated by gender and race. During this initial phase, faculty also explored their biases using Project Implicit, an online instrument to measure social biases (https://implicit.harvard.edu) (Greenwald, McGhee, & Schwartz, 1998), and peer observations of classroom micromessaging, unconscious behaviors that favor one group over another—performed by members of their FLC or by their FLC facilitator. Based on these results, faculty identified what they believed to be the challenges and opportunities for improvement in their unique classrooms and selected evidence-based strategies learned during the workshop that would improve student performance, persistence, or pathway indicators of their attitudes toward and interest in STEM. This meant that no single outcome measure could be used for measuring impact. However, the team hypothesized that impact should be measurable no matter what the intervention. Faculty were tasked with identifying a classroom challenge in the first semester and then choosing and implementing an intervention during the second semester. We called this intervention their "capstone project" because it represented the culmination of the extensive work they had accomplished during the FLC. Using a PowerPoint template, faculty presented their capstone projects to the EESTEM cohort and invited administrators. The use of a template facilitated the subsequent data collection and coding.

In order to tie student success indicators to the participation of the faculty in the FLC, this study measured impact by triangulating three sources of data: (1) a survey to assess faculty gains and satisfaction because of their participation in the FLCs, (2) a coding method developed to capture student success as reported by faculty in their final capstone presentations, and (3) a validated survey used in a longitudinal study to measure the change in faculty beliefs and understandings about issues of equity and classroom practices (Parker, Morrell, Morrell, & Chang, 2016). The faculty learning community survey and the coding method to analyze results of the faculty members' capstone presentations are the focus of this article. We report our results with the intention of providing methods that can be used to demonstrate evidence of the impact of FLC participation on student success.

Literature Review

As a primary paradigm of educational theory, constructivism includes both social and situational learning. As part of the social learning process, communities of practice (CoP) are defined as including a common learning goal, a group of learners, and shared actions or practices (Wenger, 1998).

Faculty learning communities meet all three criteria and are specifically designed, through the active engagement, collaboration, and interaction of their members, to enable the construction of greater knowledge and, therefore, greater application of and to the practice of teaching (Jimenez-Silva & Olson, 2012). FLCs were pioneered at Miami University in 1979 and have since been adopted by hundreds of post-secondary institutions as a means of providing continuous opportunities for information sharing and reflection (Richlin & Essington, 2004).

Although the scholarship of teaching and learning is a valued outcome of FLC participation, there is a dearth of publications reporting robust evidence that FLCs have an impact on student outcomes. Brew and Ginns (2008) demonstrated a statistically significant increase between faculty participation in SoTL and student course experiences as measured by the Student Course Experience Questionnaire (SCEQ). Likewise, results from a New Faculty Learning Community (NFLC), a learning community for full-time faculty from all disciplines in their first year of employment at the Community College of Baltimore County (CCBC), demonstrated a statistically significant correlation between NFLC participation and student evaluations (Ebersole, 2008). The same study showed a significant difference between pre- and post- student learning outcomes assessments (LOAs) from English faculty engaged in the NFLC. Although veteran faculty not participating in a FLC also showed significant pre/post results, this is one of the few studies published that link FLC participation with an independent evaluation of student learning outcomes (Ebersole, 2008). Individual faculty accounts of self-reported data are also promising. Lightner's (2013) chapter on "Collecting Evidence on What Works" includes quantitative data from selected faculty in the FLCs on the self-reported success of their projects. Likewise, faculty participating in a STEM FLC at Howard University also published promising results, although there were only three faculty doing classroom research (Smith et al., 2008). Otherwise, the assessment of the relationship between FLC participation and the impact on student success is often limited to reporting faculty perceptions of student learning outcomes (Cox, 2004; Beach & Cox, 2009; Goto et al., 2010; Kincaid, 2009; Lightner & Sipple, 2013; Sirum & Madigan, 2010).

Ideally, we would like to measure student success resulting from faculty participation in an FLC using some of the defined indicators, such as grades and retention. But as Sirum and Madigan (2010) point out, "valid and reliable measures of student learning would need to be available for comparison of student learning in different courses," and "there are too many confounding variables that may impact student learning to attribute any gains directly to participation in an FLC" (p. 6). In addition, quantitative assessment of classroom data is challenging because the number of subjects participating in the FLC is usually low (averaging 6-10 participants per learning community), therefore requiring several years of applying consistent assessment to obtain sufficient data to perform a statistical analysis. Because the subject matter of topic-based FLCs often varies from group to group, collecting sufficient data for analyzing the impact of FLC participation on student learning outcomes is extremely difficult.

Defining the construct of student success is itself challenging. Kuh, Kinzie, Buckley, Bridges, and Hayek (2006) established seven components of student success based on an extensive literature review: "(1) engagement in educationally purposeful activities, (2) satisfaction, (3) acquisition of desired knowledge, (4) skills and competencies, (5) persistence, (6) attainment of educational outcomes, and (7) post-college performance" (p. 5). A more recent literature review by York, Gibson, and Rankin (2015) attempted to define academic success and found an overlap of components like the definition of student success provided by Kuh et al. For this study, we defined student success with three components: (1) performance, which aligns with the variable that Kuh et al. labeled as "attainment of educational outcomes," (2) persistence, and (3) pathways indicators that align with the Kuh et al. label "engagement in educationally purposeful activities" (pp. 5, 75).

Measuring the effectiveness of faculty professional development on student outcomes is challenging. Saroyan and Trigwell (2015) suggest that triangulating data would help establish a clearer relationship between the initiatives and their impact on professional learning. Triangulation of qualitative data reduces systematic bias and distortion during data analysis, thereby increasing credibility (Patton, 2015). Sample sizes and data sources also require greater attention. Our project combines the results of six topic-based FLCs, thereby increasing the sample size. We provide faculty with historical data on grade distributions and retention from the CCBC Office of Planning, Research, and Evaluation (OPRE), permitting faculty to report trends in grades and retention. Finally, we triangulate data from three sources to demonstrate the impact of FLC participation on student success.

Methodology

The CCBC multi-campus system is the largest community college in Maryland, with approximately 64,748 students enrolled in fiscal year 2015. STEM faculty teach in the School of Math and Science or the School of

Applied Information Technology and represent approximately one third (143) of the 459 full-time faculty employed by the college. In 2012, CCBC became the site to pilot a professional development program entitled Micromessaging to Reach and Teach Every Student. The focus of the program was to use intensive training, resource-based strategies, resources, and participation in FLCs to address potential biases related to gender, disability, culture, ethnicity, and race in STEM (Parker et al., 2016).

Over three years, the faculty development program recruited 34 faculty from CCBC, of whom 32 completed the yearlong study (see Table 1). This number represents 20% of CCBC's STEM faculty. The demographics of the faculty completing the program are described in Table 2. Fifty-two percent of the faculty were male and 48% were female. One faculty member (4%) identified as Hispanic or Latino, while the rest identified as not Hispanic or Latino (96%). Sixty-five percent identified as White, 8.7% as African American, 13% as Asian, and 13% chose not to identify their race. Faculty representation by STEM discipline was as follows: Technology (Computer Science) = 52.2%, Math = 30.4%, Science (Biology, Chemistry and Physics) = 13.1%, and Engineering = 4.3%.

Faculty Learning Community Survey

The external evaluator of the grant conducted a faculty learning community survey with 10 multi-level questions (plus demographics questions). The survey was administered online five months following completion of the FLC program, once in November 2013 (Group A) and again in November 2014 (Group B) to assess faculty gains from and satisfaction with the FLCs. The first survey question asked participants to agree/disagree with the definition of an FLC (Cox, 2004) and was scored on a 4-point Likert scale from 1 (*strongly disagree*) to 4 (*strongly agree*). The second question asked participants to report on 12 activities and characteristics that changed during their time in the FLC. These items were reported on a scale from 1 (*decreased*) to 3 (*increased*) with 0 (*not sure*).

Six survey questions asked participants to "select all that apply" to a listing of possible items based on the following: (1) the barriers encountered to having a successful FLC experience; (2) aspects that enabled them to have a good experience; (3) the most important activity, outcome, or result of participation; (4) best use of time during the FLC; and (5) what they gained because of participation and (6) what else the facilitator could be providing. These data are reported as both the number and percentage of participants who chose a particular response.

Table 1
EESTEM Program Completion

	Cohort 1	*Cohort 2*	*Cohort 2A*	*Cohort 3*	*Total* N
EESTEM program completion	**January 2013**	**June 2013**	**June 2014**	**June 2014**	
No. of Faculty Learning Communities	2	2	1	1	6
N Started PD	12	12	6	4	34
N completed PD	11	12	5	4	32
Capstones Coded	11	9	5	2	27

Table 2
Faculty Professional Development and FLC Survey Respondent Demographics

	Completed EESTEM		*FLC Survey*	
Gender	***N***	*%*	***N***	*%*
Female	14	44%	11	48%
Male	18	56%	12	52%
TOTAL N	32		23	
Ethnicity				
Hispanic or Latino	1	3%	1	4%
Not Hispanic or Latino	31	97%	22	96%
Race				
White	27	84%	15	65.2%
Black or African American	3	9%	2	8.7%
Asian	2	6%	3	13%
Undeclared			3	13%
STEM Specialty				
Science	5	16%	3	13.1%
Technology	16	50%	12	52.2%
Engineering	1	3%	1	4.3%
Math	8	25%	7	30.4%
CTE	2	6%	0	0%
TOTAL *N*	32	100%	23	100%

The final two survey questions asked participants to evaluate their FLC's facilitator and their overall experience in the FLC on a 4-point scale from 1 (*poor*) to 4 (*excellent*).

Capstone Project Coding Instrument

The true test of the FLC's impact was whether there was an improvement in the indicators of student success because of faculty members' participation in the FLC. Because of the diverse strategies used by faculty in their capstone projects, the capstone project-coding instrument was developed to measure student impact. A coding rubric was designed by the project team: the professional investigators, the researcher, and the lead FLC facilitator of the grant. In the interest of accuracy and fidelity, more than one person from the team coded all 27 presentations. Consensus was reached on the choice of micromessaging super strategies through discussion in multiple meetings among the independent analysts.

Each presentation was scored on an Excel spreadsheet for the following: (1) subject; (2) class level (first year or sophomore); (3) number of females in class; (4) number of non-white students; (5) presence of other cultures, ethnicities, and races besides white and African American; (6) age range of students; (7) PD unit and super strategy used; (8) reports of performance, persistence, or pathway indicator; and (9) outcome.

The first six parameters were easily obtained from the capstone presentation PowerPoints (which followed a template the faculty were given). Coding the type of intervention was achieved by designating a primary identifier for each unit created for the PD. A secondary identifier was assigned for the Micromessaging Super Strategies, from which participants chose their intervention. The consolidated list of units and their corresponding strategies are shown in Table 3. Some faculty worked together and provided one capstone presentation to represent their team.

Measurable outcomes were classified into three categories: *performance, persistence,* and *pathway indicators*. Performance was reported as exam or end-of-semester grades. Persistence was linked to the course withdrawal rate or attendance. Pathway indicators were measurements of interest and attitudes toward enrollment in further STEM courses and a possible career or a post intervention declaration of a STEM major. Each of these represents an indicator of student success based on the work of Kuh et al. (2006). Outcomes were scored for both (a) quantitative measures of percentage increase in performance, persistence, or pathway indicators and (b) reports of qualitative, anecdotal evidence.

Results

Faculty Learning Community Survey

Twenty-three (71%) of faculty completing the PD responded to the FLC survey. Evidence that the FLCs in our program met the overall expectations of a faculty learning community experience comes from participants' agreement with the statement:

Table 3
Micromessaging Super Strategies Used as Classroom Interventions to Improve Equity

Workshop Unit	*Super Strategies Code*	*Description of Super Strategy*
Micromessaging	2.4.1	Provide micro-affirmations that support student self-efficacy
	2.4.2	Encourage every student to explore their options and opportunities using micro-affirmations.
Neuroscience The Learning Process	3.1.1	Provide students with opportunities to practice new skills and exercise their increased knowledge.
	3.4.1	Teach visual-spatial skills by integrating activities in your classroom that build student skills such as: 1. Lego sets 2. Block building exercises 3. 3D puzzles 4. Sims computer programs and games
Social Learning Theories	4.2.1	Provide feedback that is specific to each student.
	4.2.2	Identify difficult concepts and provide specific support to help students master them.

Table 3 (*continued*)
Micromessaging Super Strategies Used as Classroom Interventions to Improve Equity

Workshop Unit	*Super Strategies Code*	*Description of Super Strategy*
Influence of Culture	5.3.1	Create opportunities for students in safe groups to assume different positions or roles so they can test them out and see others in new roles.
	5.2.2	Involve like-minded peers in programs to foster a sense of belonging in the academic community.
STEM Careers	6.3.1	Conduct the STEM Career Activity (lesson plan and worksheets) with your students.
	6.4.3	Expose students to scientists, technologists and engineers from different demographic and cultural lenses through posters, books, and websites.
Equitable Learning Environments	7.3.3	Utilize real-life examples that are relevant to your students.
	7.3.6	A diversity of learners will benefit from the implementation of multiple strategies for conveying information in the classroom such as: 1. Problem-based learning 2. Non-directive (facilitative) teaching 3. Self-esteem building 4. Self-efficacy building 5. Group investigations or learning 6. Role playing

> An effective faculty learning community has the capacity to promote and sustain the learning of all faculty and other staff in the community with the collective purpose of enhancing student learning.

All of the participants, except one, responded either "strongly agree' or "agree" that their experience of the FLC aligned with this statement. The responses scored a mean of 3.3 on a 4-point Likert scale.

Based on the responses of the faculty themselves, the FLC supported knowledge and skill building for creating more equitable learning environments for their students. Sharing ideas about faculty teaching and student learning were rated as the highest motivators by 81% of participants ($n = 18$) and as the most valuable outcome of their experience in the FLC by 62% ($n = 13$) (see Table 4). These results are further supported by 69.6% ($n = 16$) of the participants reporting an increase in their development of new or improved solutions to teaching and learning challenges (see Table 5). Increases in other components of the scholarship of teaching and learning were also achieved: the setting of common learning goals and targets related to the retention and success of STEM students (65.2%; $n = 15$), using data to monitor or better understand students' progress and learning (60.5%; $n = 14$), and seeking out and using external research that is relevant and practical to inform professional practice (52.2%; $n = 12$). In terms of building the capacity of faculty to create equitable learning environments in their classrooms, 82% ($n = 14$) of respondents marked an increase in "the importance of micromessaging" and "how to use micromessaging," and 59% ($n = 10$) marked "self-awareness in the classroom" and "awareness of my students" (see Table 4).

Coding Capstone Presentations for Student Outcomes

Impact on students because of faculty participation in the FLC was obtained by analyzing students' capstone presentations for the type of intervention and its effect on student performance, persistence, and indicators of STEM pathways. In terms of student impact, 23 of the 27 projects (85%) analyzed produced "small and measurable" results, which is defined as achieving at least a 2% increase in grades, retention, improved attitudes, or STEM interest (see Table 6). More than half of the projects (67%) resulted in a 5% or greater increase. Faculty reports on student grades varied by project. Most reported course pass rates as the number of students achieving A-C and A-D, while a few reported shifts in exam grades. Persistence was reported by some faculty as a decrease in rates of course withdrawal and failure, while others reported attendance rates. STEM pathway indi-

Table 4
FLC Survey Results
(*N* = 17)

	N	%
A. Please tell us what you see as the most important or valuable activity, outcome, or result of your participation in the FLC. Please select all that apply.	N	%
Sharing ideas about teaching and learning	13	62%
Networking, meeting new people	8	38%
Collaboration, working together	8	38%
Sense of community	5	24%
Sharing ideas about equity	5	24%
Reinforcement of workshop content	3	14%
Help with capstone project	1	5%
B. What are you walking away with that you didn't know or have before? Please select all that apply.	N	%
The importance of micromessaging	14	82%
How to use micromessaging	14	82%
Self-awareness in the classroom	10	59%
Awareness of my students	10	59%
New pedagogical techniques	6	35%
I'm not walking away with anything new.	0	0%

cators were reported as the number of students declaring a STEM major post intervention or a shift in attitudes toward choosing STEM programs and careers. Some of the results in the >5% group may be statistically significant, but in many cases the *N* was too small to calculate significance.

Discussion

To show that FLC participation led to student success, we used an FLC survey to show faculty gains and satisfaction because of their participation in the FLCs, a capstone presentation coding method to measure student success, and results from Parker et al. (2016) on change in faculty attitudes and beliefs. We are confident that our results, taken together, provide robust evidence that faculty's experience in the FLC resulted in an increase in student performance, persistence, or pathway indicators in STEM.

Table 5

Responses to the Activities and Characteristics That Changed During the FLC Experience

How did the following activities and characteristics change over the course of your FLC?	*% Increased*	*% No Change*	*% Decreased*	*% Not Sure*
Development of new or improved solutions to teaching & learning challenges.	69.6%	26.1%	0%	4.3%
Setting of common learning goals and targets related to retention and success of STEM students.	65.2%	34.8%	0%	0%
The value of everyone's contribution within the FLC.	60.9%	30.4%	8.7%	0%
Use of data to monitor or better understand student progress & learning.	60.9%	39.1%	0%	0%
Trust and mutual respect among colleagues & peers in the FLC.	56.5%	39.1%	4.3%	0%

Table 5 (*continued*)
Responses to the Activities and Characteristics That Changed During the FLC Experience

How did the following activities and characteristics change over the course of your FLC?	*% Increased*	*% No Change*	*% Decreased*	*% Not Sure*
Collaboration with my colleagues & peers in the FLC.	52.2%	43.5%	4.3%	0%
Seeking out and using external research that is relevant and practical to inform professional practice.	52.2%	39.1%	0%	8.7%
Identification and sharing of valuable resources & materials.	50.0%	50.0%	0%	0%
Sharing of a common core of educational values.	47.6%	42.9%	4.3%	4.3%
Widespread sharing of ideas, strategies and joint problem solving.	43.5%	47.8%	8.7%	0%
Learning within the group setting versus as an individual.	39.1%	52.2%	4.3%	4.3%
Links with other departments seen as valuable, productive and important.	30.4%	65.2%	0%	4.3%

Table 6
Summaries of Capstone Coding Results (*N* = 27)

All CCBC Coded Capstones		N	*Percent*
Any positive change		23	85%
No change		4	15%
Small & measurable greater than 5%	> 5%	18	67%
Grades	> 5%	15	83%
Retention	> 5%	5	28%
STEM Interest	> 5%	3	17%

Three different questions from the evaluator's survey captured evidence that members of our FLCs clearly participated in the scholarship of teaching and learning. Sharing ideas about faculty teaching and student learning were rated as the highest enablers (81%) and the most valuable outcome (62%) of participants' experience in the EESTEM FLC. Nearly 70% of the participants reported an increase in the development of new or improved solutions to teaching and learning challenges.

Our results compare favorably to four other surveys relevant to our study, in which increase in "perspectives on teaching and learning" because of FLC participation was also rated highest. In the large Fund for the Improvement of Postsecondary Education (FIPSE) survey conducted by Beach and Cox (2009), faculty (*n* = 395) rated perspectives on teaching and learning beyond their discipline as a mean of 3.93 on a 5-point Likert scale (78.6%). Mesa Community College FLC's rating for the same question was a mean of 8.7 out of 10 (Kincaid, 2009). Howard University's STEM FLC rating was of 7 out of 10 (Smith et al., 2008) and 54% of Sirum and Madigan's (2010) STEM FLCs rated "valuing teaching as an important form of scholarship" as gains from their FLC experience. Using a Likert scale in future surveys will allow us to better compare our results to those of surveys from other FLC programs.

In our efforts to measure the academic performance of students taught by FLC participants, we used the capstone-coding instrument to show that faculty in the FLCs collectively improved student grades, course retention, and increased student interest in STEM. There are concerns about the accuracy and validity of using grades as indicators of student success because of the variability in faculty styles and emphasis in course content

(Sirum & Madigan, 2011). Yet grades are the most readily available assessments for faculty and institutions. Academic achievement, defined as course grades or GPA, was the most frequent measure of student success in a recent review of the literature on defining and measuring academic success (York, Gibson, & Rankin, 2015).

We found that 85% of FLC participants experienced small and measurable improvements in one or more of the student success indicators, and 67% had more significant increases and improvements in these indicators. Most faculty compared at least three semesters of pre-intervention data provided from the CCBC Office of Planning, Research, and Evaluation to post-intervention grades and retention. This is consistent with classroom action research, wherein test scores, final course grades, or retention from similar classes are used to assess student achievement (Mettetal, 2000). In addition, some faculty compared attendance records from previous semesters with attendance during the semester of the intervention. Two faculty members used formative assessments to measure change in students' interest in STEM and reported an increase in STEM major declaration as a result.

The faculty interventions were chosen from the micromessaging super strategies presented during the five-day workshop. The strategies are ultimately derived from the literature on creating more inclusive classrooms, improving teacher/student interactions, and active learning. Several faculty introduced collaborative strategies such as group work during lectures or assigning study groups. Others created inclusive classroom climates by implementing first/second week activities to improve course retention, team-building exercises, and activities and discussions on growth mindset, self-efficacy, careers, and goal-setting into their lecture time. Some computer science faculty focused on increasing faculty/student communications by using text messaging, academic advising, and programs to provide regular academic progress reports. One particularly successful project incorporated STEM career commercial breaks several times during her college algebra course as a way of introducing students to STEM careers in mathematics.

Finally, Parker et al. (2016) demonstrated statistically significant increases in faculty change in attitudes and beliefs in (1) how to achieve more equitable learning environments and (2) how to evaluate the effectiveness of classroom interventions. The design of their study included administering a validated survey three times over the course of the EE-STEM PD: pre-workshop, post-workshop (after 5 days), and follow-up, which occurred after participation in the eight-month FLC and faculty members' presentation of their capstone project. Interestingly, only after participation in the FLC and presentation of the capstone project was there a statistically significant shift in faculty members' understanding of how to implement and evaluate strategies to create more equitable learning environments. It could be argued that the process of faculty members' implementing their classroom intervention and seeing positive outcomes alone led to the change. While we think this step was instrumental in changing faculty beliefs and intentions, it is unlikely that they would have followed through with this rigorous process without the support of the FLC facilitator and the other participants. This is consistent with communities of practice theory derived from the sociocultural perspective, wherein people construct and develop their identities and understanding through their active participation and engagement with others in cultural practices that are situated in particular social communities (Jimenez-Silva & Olson, 2012; Wenger, 1998).

This study involved the work of 32 community college faculty, each of whom participated in one of six topic-based FLCs. The triangulation of data from three sources strengthens our claim that faculty participation in FLCs led to measurable student outcomes captured from the coding of the PowerPoint presentations. We piloted the coding process to provide another tool to support data collection and analysis of student success indicators. We believe this study adds to the discussion of how to tie FLC participation to student success.

Limitations of the Study

Saroyan and Trigwell (2015) make the point that "while small-scale studies with robust methodologies have their own merit and value, especially if they use multiple data sources, they still require complementary large-scale correlational studies to render findings generalizable." Our study could be improved by employing a quasi-experimental design for casual inference using a comparison group who attend the professional development workshop, design and implement a classroom intervention, but do not participate in an FLC. The access to historical data from institutional departments of research and evaluation would also allow the use of methods like regression-discontinuity that address some of the concerns of quasi-experimental designs (Murnane & Willet, 2011). Additional work would also benefit from using a more rigorous FLC survey like the Participant Assessment of Learning Gains (PALG), which builds on the commonly used FLC survey from Beach and Cox (2009) and on the development of specialized assessments for aligning the impact of FLCs and student success. Given the current climate of assessment in academia, building consensus on the definitions of student success and the techniques to measure them would greatly improve the robustness of research involving FLCs.

References

Beach, A., & Cox, M. (2009). The impact of faculty learning communities on teaching and learning. *Learning Communities Journal*, *1,* 7-28.

Brew, A., & Ginns, P. (2008). The relationship between engagement in scholarship of teaching and learning and students' course experiences. *Assessment and Evaluation in Higher Education*, *33*(5), 535-545.

Cox, M. D. (2004). Introduction to faculty learning communities. In M. D. Cox & L. Richlin (Eds.), *Building faculty learning communities* (pp. 5-23). New Directions for Teaching and Learning, No. 97. San Francisco, CA: Jossey-Bass.

Dickson, K., & Treml, L. (2013). Using assessment and SoTL to enhance student learning. In R. A. R. Gurung & J. H. Wilson (Eds.), *Doing the scholarship of teaching and learning: Measuring systematic changes to teaching and improvements in learning* (pp. 7-16). New Directions for Teaching and Learning, No. 136. San Francisco, CA: Jossey-Bass.

Ebersole, T. (2008). The impact of a new faculty learning community on perceived and actual student learning outcomes. *Journal of Faculty Development*, *22*(1), 71-80.

Goto, S., Marshall, T., & Gaule, S. (2010). Assessment of faculty learning communities: Considering social dimensions of participant choice. *Learning Communities Journal*, *2*(1), 5-26.

Greenwald, A. G., McGhee, D. E., & Schwartz, J. K. L. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology*, *74*, 1464-1480.

Henderson, C., Beach, A., & Finkelstein, N. (2011). Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature. *Journal of Research in Science Teaching*, *48*(8), 952-984.

Jimenez-Silva, M., & Olson, K. (2012). A community of practice in teacher education: Insights and perceptions. *International Journal of Teaching and Learning in Higher Educ*ation, *24*(3), 335-348.

Kanuka, H. (2011). Keeping the scholarship on the scholarship of teaching and learning. *International Journal for the Scholarship of Teaching and Learning*, *5*(1). doi:/10.20429

Kern, B., Mettetal, G., Dixson, M., & Morgan, R. (2015). The role of SoTL in the academy: Upon the 25th anniversary of Boyer's scholarship reconsidered. *Journal of the Scholarship for Teaching and Learning*, *15*(3), 1-14. doi:// 10.14434

Kincaid, B. (2009). Connecting and engaging faculty and staff to promote scholarly teaching in community colleges. *Learning Communities Journal*, *1*(2), 75-95.

Kuh, G. D., Kinzie, J., Buckley, J. A., Bridges, B. K., & Hayek, J. C. (2006). *What matters to student success: A review of the literature* (Commissioned Report for the National Symposium on Postsecondary Student Success: Spearheading a Dialog on Student Success). Washington, DC: National Postsecondary Education Cooperative.

Landivar, L. (2013). *Disparities in employment by sex, race, and Hispanic origin* (American Community Survey Reports). Washington, DC: U.S. Department of Commerce, U.S. Census Bureau. Retrieved from http://www.epscorideafoundation.org/media/docs/acs-24.pdf

Lightner, R., & Sipple, S. (2013). Scheduling scholarship: Promoting faculty engagement in two-year colleges. *Community College Journal of Research and Practice*, *37*(6), 453-466.

Lightner, R. (2013). Collecting evidence about what works: Scholarship of teaching and learning FLC. In S. Sipple & R. Lightner (Eds.), *Developing faculty learning communities at two-year colleges* (pp. 21-32). Sterling, VA: Stylus.

Mento, B., Sorkin, S., & Prettyman, T. (2008). Encouraging women and minorities to attain degrees in computing and related fields. *Information Systems Education Journal*, *6*(13). Retrieved from http://isedj.org/6/13/

Mettetal, G. (2000). The what, why, and how of classroom action research. *Journal of the Scholarship for Teaching and Learning*, *2*(1), 6-13.

Murnane, R., & Willet, J. (2011). *Methods matter: Improving causal inference in educational and social science research*. New York, NY: Oxford University Press.

Nadelson, L., Shadle, S., & Hettinger, J. (2013). A journey toward mastery teaching: STEM faculty engagement in a year-long faculty learning community. *Learning Communities Journal*, *5*, 97-122.

Parker, C., Morrell, C., Morrell C., & Chang, L. (2016). Shifting understandings of community college faculty members: Results of an equity-focused professional development experience. *Journal of Faculty Development*, *30*, 41-47.

Patton, M. (2015). *Qualitative research and evaluation methods*. Thousand Oaks, CA: SAGE.

Polich, S. (2008). Assessment of a faculty learning community program: Do faculty members really change? *To Improve the Academy*, *26*, 106-118.

Richlin, L., & Cox, M. D. (2004). Developing scholarly teaching and the scholarship of teaching and learning through faculty learning communities. In M. D. Cox & L. Richlin (Eds.), *Building faculty learning communities* (pp. 127-135). New Directions for Teaching and Learning, No. 97. San Francisco, CA: Jossey-Bass.

Richlin, L., & Essington, A. (2004). Overview of faculty learning communities. In M. D. Cox & L. Richlin (Eds.), *Building faculty learning communities* (pp. 25-40). New Directions for Teaching and Learning, No. 97. San Francisco, CA: Jossey-Bass.

Saroyan, A., & Trigwell, K. (2015). Higher education teachers' professional learning: Process and outcome. *Studies in Educational Evaluation*, *46*, 92-101.

Sirum, K., & Madigan, D. (2010). Assessing how science faculty learning communities promote scientific teaching. *Biochemistry and Molecular Biology Education*, *38*(3), 193-202.

Smith, T. R., McGowan, J., Allen, A. R., Johnson, W. D. II, Dickson, L. Jr., Najee-ullah, M., & Peters, M. (2008). Evaluating the impact of a faculty learning community on STEM teaching and learning. *The Journal of Negro Education*, *77*(3), 203-226.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity.* Cambridge, UK: Cambridge University Press.

York, T., Gibson, C., & Rankin, S., (2015). Defining and measuring student success. *Practical Assessment, Research, & Evaluation*, *20*(5). Retrieved from http://pareonline.net/getvn.asp?v=20&n=5

Dr. **Sonja Schmitz** *is an Associate Professor of Biology at the Community College of Baltimore County. She is currently the coordinator of the Biology Department. She also works as an internal evaluator for STEM grants and continues to facilitate faculty learning communities for the Center for Excellence in Teaching and Learning. Dr.* **Tara Eisenhauer Ebersole** *is a retired Professor of Biology from The Community College of Baltimore County, where she worked for 28 years. As a faculty member and administrator, Dr. Ebersole directed STEM education initiatives, professional development, learning outcomes assessment, and global education.* **Claudia Morrell** *is the CEO of the STEM Equity Initiative. She has a proven history of success in developing and applying research-based models and tested practices to improve student outcomes in secondary and post-secondary education. She has published numerous peer-reviewed articles in partnership with faculty from multiple post-secondary institutions in an effort to improve access and equity for marginalized and traditionally underrepresented students in STEM.* **Carolyn Parker** *is the Director of Graduate Teacher Education at American University. Dr. Parker's current research focus is twofold, focusing on teacher education and issues of equity and access in STEM education. She has authored numerous book chapters, technical reports, and peer-reviewed papers. Her work appears in the* Journal of Research in Science Teaching, Science Education*, and, now, the* Learning Communities Journal.