



October 22, 2019

RE: NOMINATION OF DR. KIMBERLY SHAW FOR THE REGENTS' SCHOLARSHIP OF TEACHING AND LEARNING AWARD

Dear Selection Committee:

I am delighted to nominate Dr. Kimberly Shaw for the Regents' Scholarship of Teaching and Learning Award. Currently, Dr. Shaw is a professor of physics in the Department of Earth and Space Sciences and a Co-Director of the UTeach Program at Columbus State University (CSU). UTeach is an innovative academic program, involving science, mathematics, and education CSU faculty who are preparing secondary teaching experts in local schools to promote STEM fields.

Through transformative teaching techniques, Dr. Shaw empowers students by utilizing constructivist theory to help them shape their own educational experiences. I have great respect for this pedagogical model and her effectiveness as a co-creator of learning. Dr. Shaw is an advocate for students who facilitates learning in a manner that communicates great care for her students' academic and professional well-being. While promoting excellent scholarly activities, she is a thorough professor who places an emphasis on persistence to degree completion. For example, Dr. Shaw 1) identifies solutions to obstacles that students may face because she is sensitive to the specialized needs of under-resourced students, 2) utilizes inclusive teaching practices and ideologies that promote student learning, in spite of socio-emotional, political, and economic barriers students may face, and 3) remains current on literature and research as it relates to access and diversification in STEM education. Similar to CSU values, Dr. Shaw embraces diversity and inclusion in its broadest sense, and she demonstrates this commitment by effectively communicating and supporting all students. Arguably, her courses can be characterized as learning environments that focus on communication, cohesion, social facilitation, decision-making, and leadership. The activities in Dr. Shaw's are excellent examples of teaching and learning. Recently, Josh Eyler, Director of the Faculty Development Center and QEP at the University of Mississippi, visited Dr. Shaw's class, and I have provided a quote from his 2018 book publication, entitled *How Humans Learn*:

"That day, I saw a whole host of innovative activities, scaffolded problems, and other evidence-based teaching from Shaw that clearly shows why she won such an important teaching award [the C.A.S.E. Georgia Professor of the Year], but her commitment to her students (and vice versa) and the caring pedagogy I observed make this experience stand out for me almost more than any other I have had while writing this book" (135-6).

In addition to her teaching, Dr. Shaw remains professionally active in select academic organizations to remain current on high-impact practices that inform her teaching and mentoring of students. Most notably, Dr. Shaw has been instrumental in improving the number of students who major and persist in STEM related fields at Columbus State University. As you review the portfolio, I thank you for considering Dr. Shaw's accomplishments, which epitomize the characteristics valued by the University System of Georgia and make her well-poised to receive the Regents' Scholarship of Teaching and Learning Award.

Sincerely,

Deborah E. Bordelon, Ph.D.
Provost and Executive Vice President

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Teaching Philosophy

Throughout my physics teaching career, I have always held one idea as a central theme: talent and interest should never be wasted. Instead, these should be nurtured and fed. To quote a friend and colleague, "Science is a verb." I believe that the best educators create an active learning environment and strive to reach and educate the struggling students as well as those who are natural learners. Wherever possible, my teaching practice revolves around finding ways for my students to "science". This means I have an ethical obligation to always seek to reach all of my students, with an understanding that if I can focus on building on a student's strengths, rather than trying to "fix" that student, they have a better opportunity to learn and succeed.

Due to this thematic interest in growing all talented students instead of gate-keeping, a further focus is my effort to increase the number of under-represented students in STEM who not only declare these majors, but persist and succeed in these fields. Improving the diversity of our STEM talent pool is widely cited as a national priority. Policy statements from the American Association of Physics Teachers¹, the American Physical Society², and the American Association for the Advancement of Sciences³ underline the importance of promoting diversity (including increasing the number of females and under-represented minorities such as African American and Hispanic students) to the future of scientific endeavors. There is a wide body of data documenting the differences in degree-earning patterns, but no silver bullet has yet been identified in addressing these disparities.

The work I do is deeply informed by constructivist philosophy. In short, as the instructor, my job is to provide the supports for a student as they are the architects of their own learning. The role of experience, whether in problem solving or hands-on active learning, and the ability to make connections between experiences, is key in aiding people to form meaningful understanding of any field. This mode of learning is often quite challenging for students. A common concern expressed is that "I had to teach the material to myself". Constructivists argue that learning is always based on a deeper exploration of personal experience, with guidance to make sense of those experiences – but requires a different kind of work from a student unfamiliar with a constructivist classroom.

My work is also informed by Terrell Strayhorn's work on belonging⁴, particularly as it fits within the theory of academic tenacity, as discussed by Dweck, Walton and Cohen⁵. An academically tenacious student is one that exhibits a sense of belonging (feels a part of the community at school both socially and academically); one that views effort positively (growth mindset) and has self-regulatory skills; they view challenge as a positive and are not derailed by difficulty; they see school as relevant to their future (possible selves); and can remain engaged academically for long terms. Note that academic tenacity, which can be seen to correlate strongly with student retention in STEM majors, is not inherent to a person, but rather a set of attitudes, ways of thinking and skills that can be taught.

These philosophical and ethical viewpoints inform research questions that I have been working to answer. Of these, the overarching question is this: What supports can be provided to best allow all students to build on their strengths to achieve their goals in STEM, in order to nurture their talents?

Studies have established⁶ that female and other underrepresented students that leave STEM majors, on average, have stronger STEM GPAs than male students that are retained in those majors. What factors, then, impact the retention of able students in STEM majors, and how can those factors be incorporated into my teaching? This question has been one of the predominant research themes of my career. I have been a member of the "What Works" site visit team, which investigated women's colleges and HBCUs that produced at least double the national average of female physics majors per year, in order to determine what factors promoted female success in a discipline that graduates approximately 20% female bachelor's recipients each year. This project, led by Barbara Whitten of Colorado College,

¹ <https://www.aapt.org/Resources/policy/AAPT-Statement-on-Diversity-in-Physics.cfm>

² https://www.aps.org/policy/statements/15_2.cfm

³ <https://www.aaas.org/statements>

⁴ Strayhorn, Terrell, (2012). *College Students Sense of Belonging: A Key to Educational Success for All Students*. New York, NY: Routledge.

⁵ Dweck, C.S., Walton, G.M., & Cohen, G.L. (2014). *Academic Tenacity: Mindsets and skills that promote long-term learning*. Bill and Melinda Gates Foundation.

⁶ Seymour, E., & Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Boulder, CO: Westview Press.

was able to develop a model of a supportive departmental climate, as developed and maintained together by the faculty and the students of a physics department⁷.

As I investigate this question, other questions arise from it (and indeed, in the writing of this document, three new research questions have arisen that I need to pursue). One of the most important is to learn what factors (both cognitive and non-cognitive) impact student retention in STEM majors at CSU? Are those factors the same as those reported by large research universities with different demographics? I have conducted two larger studies involving CSU students. Some of this work is published⁸, and some is in preparation⁹. I have also been interested in understanding how well support structures such as our Math and Science Learning Center tutors¹⁰, and Peer Leader course-specific programs¹¹, can have an impact on student success in STEM classes.

I have long been involved in utilizing scaffolded problem-solving and context-rich problem solving¹² in order to address problem deconstruction and student anxiety about physics. In order to create more face-to-face class time for problem solving and other active learning techniques, therefore, I have worked to flip my classroom, and have led two faculty learning communities for STEM faculty on flipped classrooms, funded by a USG STEM grant initiative I helped to author. Flipping my class can take a variety of forms, but for me it began with the creation of short lecture videos. Physics and astronomy faculty at CSU recently conducted an informal survey of our students, and found that 23.2% never purchase the textbook for the course. Further, at least 27% self-report that they never read the textbook before class. As a result, in 2019 I have introduced gamification¹³ into my introductory physics class. Gamification can offer a sense of engagement in learning and higher motivation, but also offer students a sense of challenge, control over their learning, and can provide recognition of different mastery levels. Analysis is ongoing, and preliminary results will be shared at a national conference in January 2020¹⁴.

A further concern, borne out by that survey of students, is that there are barriers to students' abilities to come to class prepared to succeed. One barrier is financial – the inability to buy a textbook, either at all, or before 3-4 weeks of the semester has passed, when financial aid funds are finally made available. Some of those barriers are motivational – not understanding the importance of physics for their goals, not having time to do readings and take notes before class due to work and family obligations. I am an early adopter of OpenStax physics textbooks, and have worked to enable other CSU faculty to do so as well. In February 2019, I was the PI on a Textbook Transformation grant to work on adoption of OpenStax physics in several other classes, along with a further set of flipped resources, and a co-PI on a Textbook Transformation grant to adopt an OpenStax Astronomy textbook and develop more active learning resources for ASTR 1105. These grants are allowing us to adopt lower cost resources and get them into the hands of students faster, and to develop and assess the effectiveness of active learning strategies in multiple classrooms.

My efforts, in every learning setting, all support my underlying philosophy: talent and interest should never be wasted, but instead should be nurtured. I have worked in a variety of ways in order to find new ways to nurture talent in STEM in general, and specifically in physics. By being creative and listening to what my students need, I hope to continue to nurture talent for years to come.

⁷ For example, "What Works for Women in Undergraduate Physics and What Can We Learn From Women's Colleges" with B. Whitten S. Dorato, M.L. Duncombe, P.E. Allen, C.A. Blaha, H.Z. Butler, K.A. Shaw, B.A.P. Taylor, B.A. Williams. *Journal of Women and Minorities in Science and Engineering*. Vol 13, issue #1, pp. 37-75, 2007.

⁸ An Analysis of Factors Expected to Impact Student End-of-Course Grades in Introductory College Science Classes," K.A. Shaw, P. Gurkas, and Z.T. Webster, *Perspectives in Learning*, Volume 13, Issue 1, pp. 4 – 16, Spring 2012.

⁹ Aebi, A., Chambers, C., Rosengrant, D., Shaw, K.A. "Characteristics of STEM Success: Surveying Undergraduate Attributes Impacting STEM Persistence". To be submitted to *Journal of College Science Teaching*.

¹⁰ "Assessing the impact of tutorial services," C.S. Ticknor, K.A. Shaw, and T. Howard, *Journal for College Reading & Learning*. Vol 45, #1, 2014, pages 52-66.

¹¹ "The Effect of Peer Leader Instruction on Introductory University Science and Mathematics Course Performance: Preliminary Results" K.A. Shaw, C. Ticknor, and T. Howard, *Perspectives in Learning*, Volume 14, Issue 1, p. 20-27, Spring 2013.

¹² <http://groups.physics.umn.edu/physed/Research/CRP/crintro.html>

¹³ Faiella, F., & Ricciardi, M. (2015). Gamification and Learning: A review of issues and research. *Journal of E-Learning and Knowledge Society (The Italian Learning Association Journal)*, 11(3), 13-21.

¹⁴ "Playing School: Pros and Cons of Gamifying Your Physics Class," K. Shaw, to be presented January 2020, American Association of Physics Teachers Conference, Orlando, FL.

Selected Evidence of the Impact of SOTL on Student Learning

Retention and Diversity in STEM

One of the more important questions facing society presently is in determining how to support a more diverse STEM workforce. Presently we find that, across STEM disciplines, the number of female students that graduate with even a bachelor's degree is far less than half. In contrast, women earn over 60% of bachelor's degrees. Further, the percentage of STEM degrees earned by African American and Hispanic students is far less than their percentage of the American population as a whole. Studies have established that female and other underrepresented students that leave STEM majors, on average, have stronger STEM GPAs than male students that are retained in those majors. What factors, then, impact the retention of able students in STEM majors, and how can those factors be incorporated into my teaching? This question has been one of the predominant research themes of my career.

To address this research theme, I have conducted work with various colleagues for many years. I have been a member of the "What Works" site visit team¹⁵, which investigated women's colleges and HBCUs that produced at least double the national average of female physics majors per year, in order to determine that a supportive departmental climate promoted female success in a discipline that graduates approximately 20% female bachelor's recipients each year. This project, led by Barbara Whitten of Colorado College, was able to develop a model of this supportive STEM department climate¹⁶, as developed and maintained together by the faculty and the students¹⁷.

At CSU, I partnered with Dr Zo Webster and Dr Pinar Gurkas to examine factors that might predict end of course grades in STEM courses in college¹⁸, with the understanding that, according to Seymour and Hewitt's work¹⁹, underrepresented students are more likely than traditional STEM students to interpret a grade as an indication that they should change majors. Our project examined factors commonly believed by students or faculty to be predictive of success, including critical thinking, scientific reasoning, reading comprehension, age, number of hours worked at a job, classroom environment, temperament, self-efficacy in STEM, and self-regulation. Demographic variables were also included in the analysis. The results of data analysis indicate several factors that create a positive attitude toward STEM studies and increase likelihood of student success in STEM studies: positive classroom climate, student perception of STEM as relevant to their desired life, and the student perception that the material being studied was relevant. It was also determined that students who are less adept at deciphering the instructor's lectures to identify main ideas are less successful. Making course outcomes explicit for all students may help them succeed as it may help them "know what they need to know." Students may also need more explicit guidance in how to distinguish main themes from details in college lectures; for example as part of freshman-learning communities and first-year seminar courses.

I pursued further work, explicitly examining factors that may impact a student's decision to either persist in a STEM major or to switch out of one. This work was started as an exploratory qualitative work²⁰, interviewing individual students that had declared a STEM major as freshmen. The analysis of themes from the interviews was then used in order to develop a survey, which was administered and analyzed for themes. Self-efficacy in STEM, as well as mindset, were found to be statistically significant

¹⁵ "What Works? Increasing the participation by women in undergraduate physics." *Journal of Women and Minorities in Science and Engineering*. Volume 9, issue 3-4, 2003. Barbara L. Whitten, Suzanne R. Foster, Margaret L. Duncombe, Patricia E. Allen, Paula Heron, Laura McCullough, Kimberly A. Shaw, Beverley A.P. Taylor, Heather M. Zorn.

¹⁶ "Like A Family: What Works to Create Friendly and Respectful Student-Faculty Interactions," *Journal of Women and Minorities in Science and Engineering* vol. 10, pp. 229-242, 2004. Author list: Barbara L. Whitten, Suzanne R. Foster, Margaret L. Duncombe, Patricia E. Allen, Paula Heron, Laura McCullough, Kimberly A. Shaw, Beverley A.P. Taylor, Heather M. Zorn.

¹⁷ "What Works for Women in Undergraduate Physics and What Can We Learn From Women's Colleges" with B. Whitten S. Dorato, M.L. Duncombe, P.E. Allen, C.A. Blaha, H.Z. Butler, K.A. Shaw, B.A.P. Taylor, B.A. Williams. *Journal of Women and Minorities in Science and Engineering*. Vol 13, issue #1, pp. 37-75, 2007.

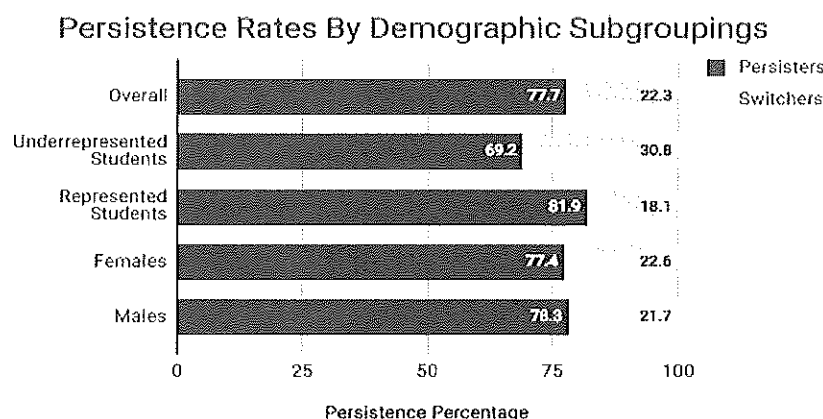
¹⁸ "An Analysis of Factors Expected to Impact Student End-of-Course Grades in Introductory College Science Classes," K.A. Shaw, P. Gurkas, and Z.T. Webster, *Perspectives in Learning*, Volume 13, Issue 1, pp. 4 – 16, Spring 2012.

¹⁹ Seymour, E., & Hewitt, 1997.

²⁰ "Why Undergraduates Are Leaving STEM", C. Chambers and K. Shaw, February 20, 2017, American Association of Physics Teachers Conference, Atlanta, GA.

in differences for students persisting in STEM majors and students that switched away from STEM. Self-efficacy²¹, as well as a thematic group we have termed “belonging” based on Strayhorn’s work²², were significant for under-represented ethnic groups as compared to traditionally represented groups.

This thread of research deeply impacts my teaching. In understanding how better to create a classroom and departmental culture that allows students to feel a valued part of a community (as is indicated by my site visit studies as well as this work), I have worked to create a supportive community culture within my classroom. I work to ensure that I am better communicating the goals of a class session, and what work students should be doing in order to get the most out of the class session, both on a daily and a semesterly scale. I also work to use micro-messaging each day so that students understand that I know their names, and know something about who they are outside of the classroom. I often assign projects with the intent of allowing students to showcase something that they find of both intriguing and relevant in that course’s material, allowing students to showcase their interests and strengths in a way that exams cannot. This in turn works to support student self-efficacy via a different form of mastery activity and vicarious persuasion than an exam can provide. All of these things, based on my investigations, have an impact on each student – but a larger impact on female students and on other under-represented groups²³.



We do see (in the figure above) that there are differences in persistence patterns for underrepresented ethnic groups in STEM majors at CSU, but strikingly, not across genders²⁴. Further examination of survey responses highlighted a thematic pattern: a sense of belonging in the STEM departmental culture at CSU. Students persisting in a STEM major were found to be more oriented towards growth mindsets. Persisters had significantly higher mindset scores ($M = 24.86$, $SD = 4.72$) than switchers ($M = 23.42$, $SD = 2.77$), $M = 1.44$, 95% CI [0.19, 2.69], $t(137) = 2.28$, $p = .024$. Self-efficacy scores were also found to be statistically significant between persisters/switchers, in addition to underrepresented/represented students. Persisters had higher levels of self-reported self-efficacy ($M = 34.33$, $SD = 4.72$), than students who switched out of a STEM major ($M = 31.61$, $SD = 5.66$) $p = 0.008$. Represented students also reported higher levels of self-efficacy ($M = 35.05$, $SD = 3.67$), than their underrepresented counterparts ($M = 31.92$, $SD = 6.15$) $p = .001$. In addition to underrepresented students having, on average, lower self-efficacy scores than represented students, belonging was also identified as being significantly different across ethnic and racial subgroupings. Underrepresented students reported lower belonging scores ($M = 28.12$, $SD = 5.41$) than their represented counterparts ($M = 32.94$, $SD = 5.12$). However, there was no statistically significant variance between genders in regards to

²¹ Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY, US: W H Freeman/Times Books/ Henry Holt & Co.

²² Strayhorn, Terrell L., (2012). *College Students Sense of Belonging: A Key to Educational Success for All Students*. New York, NY: Routledge.

²³ Seymour and Hewitt, 1997.

²⁴ Aebi, A., Chambers, C. Rosengrant, D., Shaw, K.A. “Characteristics of STEM Success: Surveying Undergraduate Attributes Impacting STEM Persistence”. To be submitted to *Journal of College Science Teaching*.

mindset, self-efficacy nor belonging. Instead, the model appears to indicate significance when these factors are combined, but not separately.

	Self-efficacy, Mindset and Belonging Findings across Subgroupings					
	Average Self-efficacy	Significance (p=)	Average Mindset	Significance (p=)	Average Belonging	Significance (p=)
Persistence		0.012		0.05		0.113
Persisters	34.32		24.83		31.37	
Switchers	31.82		23.61		29.55	
Gender		0.129		0.15		0.575
Male	34.65		25.09		30.54	
Female	33.27		24.27		31.13	
Ethnicity		0.001		0.176		<.0005
Represented	35.05		24.88		32.94	
Underrepresented	31.92		24.14		28.12	

The impact of this work can be seen in the classroom climate that I work to establish. I work to establish a climate through micro-messaging that shows each student that their presence, and their learning, matters. I work to ensure that there is a level of challenge, and then provide appropriate support mechanisms so that students can reach our learning outcomes. It is critical to challenge our students, as STEM students value being challenged – but we must structure classes so that these challenges are not completely out of reach. It doesn't matter if my students love a challenge if they don't yet have the background to realistically achieve the marks I set for them (i.e., asking them to derive General Relativity in the first week of first semester physics). Providing my students the support they need to develop and maintain a level of academic tenacity²⁵ does not require me to water down my course, but rather find different ways to support my learners.

Impacts of interventions in supporting STEM students

During my tenure at CSU, I had the privilege of being the founding Director of our Math and Science Learning Center (MSLC), whose primary mission was to provide tutoring and a study space for STEM students. During that 3 year term, I worked with others to develop a database used to collect information regarding which students were using these services, and we were able to use this data in order to determine the effectiveness of the center²⁶. Data from the center, along with data on DFW rates and end of course grades collected by Institutional Research, tell an interesting story about our drop-in tutoring center. Students attending the MSLC were compared with students in the same courses who did not utilize the tutoring center in any way. The tutoring center was able to decrease the number of DFW grades in STEM courses, which in turn increased the number of Cs awarded. The number of B grades was observed to decrease. This appears, however, to be explained by an increase in the number of A grades earned.

A USG-supported STEM grant, on which I was a co-author, also provided financial support for the use of Peer Instruction Leaders in high DFW courses in order to improve student outcomes. Here, data indicated that attendance at between 4-5 peer leader sessions correlated to an end-of-course grade improvement of at least half a letter grade, and that this result was statistically significant²⁷.

Assessment of active learning techniques in introductory physics

Throughout my teaching, I work to incorporate appropriate active learning strategies in order to support my students in learning challenging course materials. Through a USG-funded STEM grant that I helped to author, I was able to co-lead two faculty learning communities for STEM faculty themed around flipping courses, and the use of active learning techniques. Some of these are techniques that I have used for over a decade, including cooperative group problem solving using scaffolding for problem deconstruction²⁸. Students are also able to actively engage in concept tutorials²⁹, designed to elicit their initial ideas of physics concepts that are likely to be incompletely understood, and to aid them in

²⁵ Dweck, C.S., Walton, G.M., & Cohen, G.L. (2014). *Academic Tenacity: Mindsets and skills that promote long-term learning*. Bill and Melinda Gates Foundation.

²⁶ "Assessing the impact of tutorial services," C.S. Ticknor, K.A. Shaw, and T.Howard, *Journal for College Reading & Learning*. Vol 45, #1, 2014, pages 52-66.

²⁷ "The Effect of Peer Leader Instruction on Introductory University Science and Mathematics Course Performance: Preliminary Results" K.A.Shaw, C.Ticknor, and T.Howard, *Perspectives in Learning*, Volume 14, Issue 1, p. 20-27, Spring 2013.

²⁸ <http://groups.physics.umn.edu/physed/Research/CRP/crintro.html>

²⁹ <http://umdperg.pbworks.com/w/page/10511238/Tutorials%20from%20the%20UMd%20PERG>

understanding where those ideas need to be refined. At times, students are provided with active challenges in class. One such challenge occurs when my first semester physics students learn about projectile motion: after firing a spring gun horizontally across the classroom, we work as a class to determine the initial speed of the ball that is fired. We then tilt the spring gun so that it is aimed at an upward angle, and student groups are challenged to work to determine the new range (distance from the launch spot) of the ball, based on the same speed and a different angle. Bragging rights and points are given, based on the accuracy of the results.

Each time any physics faculty member teaches a first-semester physics course, one of the measures we take is that we administer the Force Concept Inventory, or FCI, as a pre-test during the first week of the semester and as a post-test at the end of term. We then examine both post-test scores and normalized gain scores. Recently, we have begun to calculate effect sizes as well, but I am not including that here as that analysis has not yet been completed for the past decade of data.

Typically, faculty using traditional lecture techniques will see an average normalized gain (calculated as $(\text{posttest} - \text{pretest}) / (\text{potential gain})$) of no more than 20%, no matter the quality of the students or the lecturing faculty. Further guidance indicates that a score of 60% or higher indicates that students reliably use Newton's laws in understanding forces. A score on the post test of 80% or higher indicates mastery at a level typically found among first year physics graduate students.

Data presented below are for the last four completed courses in which I taught a first semester physics course in a regular (non-summer) term. Note that in each semester the average normalized gain score for the class was over 25% of the material in forces (an important subset of the course material) that could have been learned, and that the percentage of students consistently applying Newtonian thinking and achieving mastery has increased. Also note that in Spring 2019, I began to apply gamification principles to this course, in addition to other techniques (to be discussed in detail below).

semester	course	DFW %	FCI post-test (%) class avg	FCI gain (normalized)	# students between 60-80% in post-test	# students over 80% in post-test	% students over 60%
Fall 2015	PHYS 1111	25	46.67	27.63	8	13	30.4%
Fall 2016	PHYS 1111	35.3	45.1	43.21	12	7	27.1%
Spring 2018	PHYS 2211	19.6	54.2	43.01	13	12	53.2%
Spring 2019	PHYS 2211	37.5	53.42	32.38	11	4	38.5%

Because of my expertise with active learning techniques in STEM classrooms, I have long been a committee member of our Teaching and Learning Excellence (TaLE) committee here at CSU, and have been happy to ensure that colleagues are able to learn about and try these techniques for themselves.

Gamification

One mode of active learning that has not been widely explored in physics education, but which has been explored in fields like medical education, is that of gamification. At its best, gamification can offer a sense of engagement in learning and higher motivation, but also offer students a sense of challenge and control over their learning, and can provide recognition of different mastery levels³⁰. Literature on this technique often ties to online learning, but the principles involved are readily adaptable to a lower tech and face to face setting. Added "challenge" activities have been developed, as well as gamification strategies to incentivize productive study strategies, which are being implemented this semester. I am collecting data on student exam scores, daily Kahoot quiz scores (which incentivize coming to class prepared), as well as collecting data on reading notes (date submitted, how many students, level of quality) in order to determine if such interventions are effective. I will also compare Force Concept Inventory post-test scores and gain scores against prior years (all physics faculty currently use this nationally normed instrument as a pre/post test each semester) and will compare

³⁰ Faiella, F., & Ricciardi, M. (2015). Gamification and Learning: A review of issues and research. *Journal of E-Learning and Knowledge Society (The Italian -Learning Association Journal)*, 11(3), 13-21.

productive grade rates over prior years.

While this gamification project is in its first few iterations, there are some early indications that student learning and retention may be positively impacted by this approach. The mean score on Exam 1 for this class in Spring 2018 was 73.3 with a standard error of 2.38. The mean score on Exam 1 for Spring 2019 was 80.4, with a standard error of 2.16. Data is being collected in several other categories (# of reading notes submitted, quality of notes, dates of submission; # of successful students, comparison of FCI scores as discussed above); other exam scores; and a student survey of satisfaction and engagement with the gamified learning experience in order to better inform my future teaching practice.

	Spring 2018	Spring 2019
Exam 1	73.3 \pm 2.38	80.4 \pm 2.16
Exam 2	63.24 \pm 2.13	68.10 \pm 2.87
Exam 3	64.61 \pm 1.88	56.86 \pm 3.09

There is a much larger DWF rate in the gamified course than in the course the year before (see above), and the normalized gain for the class is lower. However, the FCI post test average is nearly identical. Given the number of students in the non-gamified class scoring over 80% on the post-test, this may indicate a stronger than average group of students in Spring 2018.

Gamification was repeated in a PHYS 1111 course (with pre-calculus prerequisite instead of Calculus 1) in a 5 week summer term, and is being implemented in PHYS 1112 in Fall 2019. Data for all three of these classes will be further analyzed, and preliminary analysis will be reported at the American Association of Physics Teachers conference in January 2020³¹.

Making Learning Resources More Available

As early as 2007, I became aware that it was not uncommon for students to have neither their textbook nor other required learning resources until the third or fourth week of school – after students have their financial aid released. Knowing how much more difficult this makes it for students to succeed in an already challenging content area, I became an early advocate for Open Educational resources. In February of 2019, I was a PI on a successful Textbook Transformation grant entitled “Flipping Introductory Physics 1 and Principles of Physics 1 in order to implement active learning strategies,” with my colleague, Andy Puckett. He and I are developing parallel flipped videos for both courses, using different levels of prerequisite math, as well as a set of flipped example videos, serving a desire frequently stated by our students to have more worked examples. This project is still in the initiation phase, and these revised courses will be taught in Spring 2020.

I was also the co-PI on a second Textbook Transformation grant, entitled “Transformation Solar System Astronomy courses using OER and Active Learning Techniques” with Rosa Williams. We redesigned this course in order to facilitate more active learning opportunities and incorporate the OpenStax Astronomy textbook. This revised course is being taught in the current semester. My role is that of aiding in development of active learning strategies and in the assessment of student engagement. Our preliminary results indicate that students have higher homework completion rates, and a higher course average for their first exam, than in prior years. In addition, student satisfaction about the course appears to be higher.

Conclusion

This work informs not only my teaching, but my service commitments here at CSU as well. As the co-Director for our UTeach program, I am able to provide future STEM teachers with opportunities to understand pedagogies that will aid their own students as well as supporting their learning. My willingness to not only take risks and try new techniques, but to systematically assess the effectiveness of those techniques and share them with others, means that I greatly value my work with our Teaching and Learning Effectiveness Committee, and work on successive STEM grants from the USG, and efforts from both groups to promote faculty development.

³¹ “Playing School: Pros and Cons of Gamifying Your Physics Class,” K. Shaw, to be presented January 2020, American Association of Physics Teachers Conference, Orlando, FL.

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Education

- Florida State University, Tallahassee, FL. Ph.D. Experimental Condensed Matter Physics, 1997.
- Florida State University, Tallahassee, FL: M.S. in Physics, 1993.
- Vanderbilt University, Nashville, TN Degree: B.S. in Physics, 2nd major - Math. 1991.

Academic Appointments and Other Significant Work Experience

- Columbus State University, August 2007 to present. Rank: Full Professor.
 - Co-Director, UTeach Columbus, July 2011 to present.
 - Director, Math and Science Learning Center, July 2008 – June 2011.
 - Tenured, July 2009.
- Southern Illinois University Edwardsville, 1997 to August 2007.
 - Promoted to Associate Professor and Tenured, August 2003.
 - Assistant Professor of Physics, August 1997 – July 2003.

Selected Scientific, Honorary, and Professional Societies

- Member, American Association of Physics Teachers.
 - Member, National Committee on Women in Physics 2004 - 2007.
 - Member, National Committee on Minority Issues in Physics, 2008 – 2011.
 - Chair, Committee on Minority Issues, 2011.
- Member, Project Kaleidoscope, Fall 2002 – present

Selected Special Awards and Other Honors

- 2019 Scholarship of Teaching and Learning Award, Columbus State University
- 2018 – TALE Committee was awarded the "Living Our Values" inaugural award
- 2015 Council for the Advancement and Support of Education Georgia Professor of the Year.
- 2015 Rod Nave Award, Southeastern Association for Science Teacher Education, given to a person who represents a significant connection between the sciences and the science education community.
- Project Kaleidoscope STEM Leadership Institute Member, Pendle Hill, PA, July 2014.

Selected Committees

- Teaching and Learning Education (TALE) Committee, support for the CSU Faculty Center
- MCSD – CSU Partnership Task Force, 2016.
- STEM Mini-grant committee

Selected Professional Growth and Development

- Verified Certificate, The Data Scientists's Toolbox, Coursera MOOC, earned May 31, 2015.
- Statement of Accomplishment, An Introduction to Evidence-Based Undergraduate STEM Teaching, Coursera MOOC, earned December 1, 2014.
- Founding Director, Math and Science Learning Center, Columbus State University. Developed and evaluated math and science tutoring program, conducted faculty development workshops, developed and delivered in-service workshops to K-12 in-service teachers. Requires close work with Math and

Science Secondary Teacher Preparation Task Force on campus, including faculty from math, science, computer science, and education.

Publications and Ongoing Research

ONGOING SOTL PROJECTS

- *Flipping Introductory Physics 1 and Principles of Physics 1 in order to implement active learning strategies*, Textbook Transformation Grant, Spring 2019 – 2020, K.Shaw and A.Puckett, funded for \$10,800.
- *Transforming Solar System Astronomy courses using OER and Active Learning Techniques*, Textbook Transformation Grant, Spring 2019 – 2020, R. Williams and K.Shaw, funded for \$10,800.
- STEM Mini-grant: "Gamification of 1st Semester Physics Concepts," funded in Spring 2019 for \$3200. Gamified course is being taught in Spring 2019 semester.
- STEM Mini-grant: "Math Intervention Development to Promote Student Success in Physics Courses" for \$2900. Data collection ongoing.
- "Investigating how grit, mindset and narcissism correlate with student success in introductory science and math classes" in collaboration with Clint Barineau and Tim Howard. Data was collected in 2015, but analysis is not complete at this time.

In Preparation

Aebi, A., Chambers, C. Rosengrant, D., Shaw, K.A. "Characteristics of STEM Success: Surveying Undergraduate Attributes Impacting STEM Persistence". To be submitted to Journal of College Science Teaching.

Selected Peer Reviewed Publications

1. Ticknor, C.S., Gober, D., Howard, T., Shaw, K.A., Mathis, L., "The Influence of the CSU Robert Noyce Teacher Scholars," Georgia Educational Researcher. Vol 14, Issue 1, 7/2/17, pp. 69-97.
2. "Assessing the impact of tutorial services," C.S. Ticknor, K.A. Shaw, and T.Howard, Journal for College Reading & Learning. Vol 45, #1, 2014, pages 52-66.
3. "Peer Mentoring Communities of Practice for Early and Mid-Career Faculty: Broad Benefits from a Research-Oriented Female Peer Mentoring Group," A.Rees and K.Shaw. Journal of Faculty Development, Vol 28, #2, May 2014, pages 5-17.
4. "The Effect of Peer Leader Instruction on Introductory University Science and Mathematics Course Performance: Preliminary Results" K.A.Shaw, C.Ticknor, and T.Howard, Perspectives in Learning, Volume 14, Issue 1, p. 20-27, Spring 2013.
5. Pedagogy and/or technology: Making Difference in Improving Students Problem Solving Skills", Z.Hrepic, K.Lodder, and K.A.Shaw, 2012 Physics Education Research Conference, AIP Conference Proceedings volume 1513, p.182-185, editors: P.Engelhart, A.Churukian, S.Rebello, Philadelphia, PA, 1-2 August 2012. Published by AIP, Melville, NY, 2013.
6. "An Analysis of Factors Expected to Impact Student End-of-Course Grades in Introductory College Science Classes," K.A.Shaw, P.Gurkas, and Z.T.Webster, Perspectives in Learning, Volume 13, Issue 1, pp. 4 – 16, Spring 2012.
7. "Publish or Perish: Can Scholarship and Teaching Coexist?", Jan G. Burcham and Kimberly A. Shaw, Perspectives in Learning: A Journal of the College of Education and Health Professions, Vol 11, Issue 1, Spring 2010, pages 47-52.
8. Z.Hrepic and K.Shaw, "Open Policy for Wireless Computers in Classrooms: What Makes it a Good or a Bad Idea?", The Impact of Tablet PCs and Pen-based Technology on Education, Purdue University Press, 2010, p.83-92.
9. "What Works for Women in Undergraduate Physics and What Can We Learn From Women's Colleges" with B.Whitten S.Dorato, M.L.Duncombe, P.E.Allen, C.A.Blaho, H.Z.Butler, K.A.Shaw, B.A.P.Taylor, B.A.Williams. Journal of Women and Minorities in Science and Engineering. Vol 13,

issue #1, pp. 37-75, 2007.

10. "Like A Family: What Works to Create Friendly and Respectful Student-Faculty Interactions," Journal of Women and Minorities in Science and Engineering vol. 10, pp. 229-242, 2004. Author list: Barbara L. Whitten, Suzanne R. Foster, Margaret L. Duncombe, Patricia E. Allen, Paula Heron, Laura McCullough, Kimberly A. Shaw, Beverley A.P. Taylor, Heather M. Zorn.
11. "What Works? Increasing the participation by women in undergraduate physics." Journal of Women and Minorities in Science and Engineering. Volume 9, issue 3-4, 2003. Barbara L. Whitten, Suzanne R. Foster, Margaret L. Duncombe, Patricia E. Allen, Paula Heron, Laura McCullough, Kimberly A. Shaw, Beverley A.P. Taylor, Heather M. Zorn.

Selected Presentations and Posters

1. "Playing School: Pros and Cons of Gamifying Your Physics Class," K. Shaw, to be presented January 2020, American Association of Physics Teachers Conference, Orlando, FL.
2. "Characteristics of STEM Success: Surveying Undergraduate Attributes Impacting STEM Persistence," K.Shaw, A.Aebi, C.Chambers and D.Rosengrant, January 15, 2019, American Association of Physics Teachers Conference, Houston, TX.
3. "Why Undergraduates Are Leaving STEM", C.Chambers and K. Shaw, February 20, 2017, American Association of Physics Teachers Conference, Atlanta, GA.
4. "Comparison of Success Rates for Peer Instruction and Drop-In Tutoring," K.A. Shaw, T.Howard, C.Ticknor, March 5, 2015, Georgia Scholarship of STEM Teaching & Learning Conference, Statesboro, GA. <http://digitalcommons.georgiasouthern.edu/stem>
5. "Gauging Effectiveness of Pen-based Computing for Collaborative Introductory Physics Problem Solving," D.Cantrell, Z.Hrepic, K.A.Shaw, January 6, 2014, AAPT Conference, Orlando, FL.
6. "Summer Honors Camp Promotes STEM and Teaching," K.Shaw, T.Howard, presented January 6, 2014, AAPT Conference, Orlando, FL.
7. "Assessing the Impact of Tutorial Services," C.Henning, K.A.Shaw, T.Howard, presented March 9, 2012, Georgia Scholarship of STEM Teaching and Learning Conference, Statesboro, GA.
8. "Relations Between Cognitive and Affective Factors in Predicting Performance in Introductory Science," K.A.Shaw, Z.Webster, and P.Gurkas, poster, presented at Physics Education Research Conference, Ann Arbor, MI, July 29-30, 2009.
9. "An Analysis of Scientific Reasoning Skills in Introductory Science Success," K.A.Shaw, Z.Webster, and P.Gurkas, poster, presented at the national American Association of Physics Teachers conference, Ann Arbor, MI, July 28, 2009.
10. "Measuring Reasoning to Enhance STEM Success," Z. Webster and K.Shaw, Georgia STEM Conference, Atlanta, GA, September 2008.

Selected other relevant grant funding

1. STEM IV Grant : STEM Success Through Connections and Communities, K.Shaw and T.Howard, co-PIs. Funded for \$50,000 per year from AY 2020-AY 2022.
2. STEM III grant, funded for \$129,000 from 2016 – 2019. PI T.Hackett, co-PI K. Shaw.
3. Complete College Georgia Innovate 2015 program, Incubate track: "Building a Faculty Learning Community to Support Flipped Classroom Pedagogies and Improve Learning Outcomes in STEM Classrooms,". Funded by USG for \$25,000, for 2015 – 16 Academic Year.
4. "UTeach Columbus", PI K.Shaw and D.Gober. Funded 2011 – 2015 for \$1.4 million.
5. "CRAFT-STEM" PI T.Howard, Co-PIs C.Ticknor, D.Gober and K.Shaw. Funded 2011-2015 for \$1.2 million.
6. "TIME" Robert Noyce Teacher Scholarship grant from NSF, PI M.Dentzau, co-PI K.Shaw, H.Fleenor, Y.Peker, B.Conway for \$1.1 million, awarded 2019.



COLUMBUS STATE UNIVERSITY

The Faculty Center for the Enhancement of Teaching and Learning

October 17, 2019

To the Regents' Awards Selection Committee:

Dr. Kimberly Shaw is one of Columbus State University's finest classroom teachers, and a leading scholar of teaching and learning. Winner of the Georgia state C.A.S.E. U.S. Professor of the Year award in 2015, Dr. Shaw has continued to pursue an impressive agenda of SOTL-based research projects.

In 2019 alone, Dr. Shaw has been awarded two STEM mini-grants through the University System of Georgia and two Textbook Transformation Grants from Affordable Learning Georgia, each of which target introductory Physics and Astronomy courses to increase student success. In early 2020, she is slated to present "Playing School: Pros and Cons of Gamifying Your Physics Class" at the American Association of Physics Teachers conference.

Dr. Shaw's research and practice has far-reaching impact through her role as co-director of the outstanding UTeach Columbus program, which prepares math and science majors to become teachers at the high school level. Dr. Shaw has been a primary investigator or co-P.I. of approximately \$3.7 million in external funding through Race to the Top funds and a Robert Noyce Teacher Scholarship program grant from the National Science Foundation. She has been recognized with a Rod Nave Award, Southeastern Association for Science Teacher Education, given to a person who represents a significant connection between the sciences and the science education community.

In addition to her exceptional SoTL research and teaching practice, Dr. Shaw has demonstrated a firm commitment to supporting colleagues and encouraging the pursuit of SoTL at the institutional level. She has led a Faculty Learning Community to support flipped classrooms in STEM courses with the support of a \$25,000 Innovate/Incubate grant from Complete College Georgia. She is a long-standing member of an interdisciplinary women's research and writing group on campus, and has co-authored an article on peer mentoring based on that experience. As a key member of the Teaching and Learning Enhancement Committee, which serves as an advisory board for our Faculty Center, Kim has been an important voice in advocating for streamlined IRB procedures to support and encourage SoTL research.

I've observed Dr. Shaw in action with a large introductory Physics class, and I can testify to the high level of engagement, effort, and persistence she elicits from our students. I urge the committee to recognize with the Regents' Scholarship of Teaching and Learning Award the tremendous achievements of Dr. Kimberly Shaw for her continuous contributions to evidence-based teaching practices and for her dedication to improving STEM teaching at both the undergraduate level and in Georgia's public high schools.

Sincerely,

Susan E. Hrach, PhD

Professor of English and Director, Faculty Center for the Enhancement of Teaching and



October 14, 2019

Selection Committee
Regents' Scholarship of Teaching & Learning Award
Atlanta, Georgia

Dear Committee Members,

It gives me great pleasure to write this letter of support for Dr. Kimberly Shaw's Regent's SOTL Award portfolio. I have known Dr. Shaw since she came to Columbus State University in 2007, when I was the Associate Dean of the College of Science, and I have worked closely with her as a teacher, researcher and advocate for STEM education. She is a talented, outstanding teacher who believes deeply in scholarly teaching and has made profound impact undergraduate science education at our institution. A quick review of her curriculum vita would reveal her many activities in administration, teaching and research that qualify her for this award, so I will restrict my comments to specific examples of her work that best illustrate the excellence of her teaching and leadership.

As the Dean of the Honors College, I have literally heard my students say in the hallway, "Dr. Shaw is teaching the course?! I can't wait to take it!" After watching her work with students in physics lab, I can see why they are excited. She designs problems and tasks that allow students to explore, develop questions, and challenge misconceptions. During lab interactions, Dr. Shaw rarely provides answers but instead will guide students to test and discover relationships. She has the reputation of holding students to high expectations while devoting time outside the classroom or lab to clarify concepts. In addition, Dr. Shaw has developed deep mentoring relationships with several female STEM major relationships, providing extra encouragement and support as they progressed through undergraduate courses and they have remained in contact with her as they continued to graduate schools across the country.

Embedded in her work is always a deep attention to scholarly teaching and the use of best practices to design learning activities. I have co-authored presentation and research articles, and rely on her expertise in motivational theory, particularly on the impact with at risk groups in STEM. As a former director of the Math & Science Learning Center she provided professional development for tutors, K-12 teachers, and professors. Our campus has also benefited from her work on several grants, including the National Science Foundation Robert M. Noyce Grant that

provides scholarships for future STEM teachers and other federally and privately funding grants that support our replication of the UT Austin's UTeach Program.

Our campus and community has been deeply impacted by her leadership in STEM education and modeling of scholarly teaching. Her particular work on self-efficacy and mindset, have not only informed her teaching, they have translated in strategies that support underrepresented groups, especially women, to pursue fields in the sciences. That is why Dr. Shaw deserves this award.

With respect and sincerity,

A handwritten signature in blue ink that reads "Cindy Ticknor". The signature is fluid and cursive, with a large loop at the end.

Dr. Cindy S. Ticknor
Dean, Honors College
Professor, Mathematics Education