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Cinzia Cervato
Iowa State University, cinzia@iastate.edu

David Flory
Iowa State University, flory@iastate.edu

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Disciplines
Earth Sciences | Educational Methods | Geology | Higher Education | Meteorology | Science and Mathematics Education

Comments
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Earth Wind & Fire: A Learning Community Approach to Build Ties Between Degree Programs in a Geoscience Department

Cinzia Cervato[1,a] and Dave Flory[1]

ABSTRACT

We describe the components of a learning community program for meteorology, geology, and Earth Science undergraduates in a geoscience department. The learning community provides the students with opportunities to interact with each other and with faculty, and it helps them in the transition from high school to a large public university. Enrollment data show that, in addition to being a successful community-building approach, the learning community has a positive impact in major retention to the programs and is well received by the students. © *2015 National Association of Geoscience Teachers*. [DOI: 10.5408/14-018]

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INTRODUCTION

Geoscience departments in the U.S. have traditionally been small, with an average number of eight faculty in four-year schools, down from an average of thirteen 20 y ago (Gonzales and Keane, 2011). In the increasingly competitive academic world, where larger is better, programs have merged to create larger departments that can better weather budget cuts and administrative scrutiny. The Department of Geological & Atmospheric Sciences at Iowa State University (ISU) was created when the Department of Geology and Mining Engineering (established in 1898) incorporated in 1965 the meteorology program, which had been housed until then in the Department of Physics; after this merger, the department changed its name to Department of Earth Sciences. In the late 1980s, the name was changed again to recognize both components. Currently, 11 faculty members are geologists, and seven are atmospheric scientists.

To maintain a healthy number of undergraduate majors, geoscience departments offer two or more undergraduate degrees: geology, Earth Science, meteorology, oceanography, geophysics, environmental geology, planetary science, physical geography, and more. At ISU, we offer bachelor of science degrees in geology, Earth Science, and meteorology and a bachelor of arts degree in Earth Science (for secondary education majors). Undergraduate student numbers have been gradually increasing since 2007 (Fig. 1). The increase is driven by growth in geology majors, which offsets the slight decline in meteorology enrollment. Earth Science students remain always a minority. Combined, the geology and Earth Science enrollments are today only slightly lower than the meteorology enrollment, a significant difference from fall 2007, when meteorology majors were almost four times more.

One of the biggest challenges for these hybrid departments is to develop a departmental identity in their students, a key aspect of student retention. Students identify themselves with their degree program (in our case, geology or meteorology) rather than with the department. One of the authors (Cervato) became aware of this issue when she realized that the meteorology majors in her introductory meteorology course did not know that they were in the same department, given that her primary affiliation was with geology. With the programs housed in two different buildings and essentially no overlap in the degree programs, departmental functions like the annual picnic were populated by two different groups of students who did not know each other. With a handful of exceptions, the freshman class is composed of Midwestern students who just graduated from high school. Between one half and two thirds of the students are male. One or two are older than 25, having spent time in the military, pursuing a different career, or having taken time away from college. Over the years, there have been fewer than five non-U.S. students altogether and about the same number of minority students. This is not unusual, and it generally reflects the makeup of the incoming freshman class at ISU, with the majority of students coming from Iowa.

Assuming that it would be easier for students to develop a departmental identity before they identified themselves solely with their degree program, in 2008 we established the Earth Wind & Fire (EW&F) learning community (LC) for all new freshmen and transfer students in the department. ISU has a long tradition of success in LCs. Over more than 15 y, ISU's nationally ranked LC program has involved more than 40,000 students in more than 75 LCs. Over 70% of first-year students are enrolled in an LC. One of the overarching goals for LCs is student retention: 1 y retention for students in an LC is 8% higher than for students who are not; after 6 y, the difference is 11% (Leptien and Gruenewald, pers. comm., 2013). In 2012–2013, some 85% of students in the Colleges of Engineering and Agriculture and Life Science, almost all students (97.7%) in the College of Design, and a lower but still significant fraction of students in the College of Human Sciences (81.3%) belonged to an LC. About half (45.6%) of the students in the College of Business were in an LC. The College of Liberal Arts and Sciences had the smallest percentage (38.1%), and the Earth Wind & Fire is one of the few LCs for science majors.

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[1]Department of Geological & Atmospheric Sciences, Iowa State University, 253 Science I, Ames, Iowa 50011, USA

[a]Author to whom correspondence should be addressed. Electronic mail: cinzia@iastate.edu. Tel.: +1-515-294-7583.

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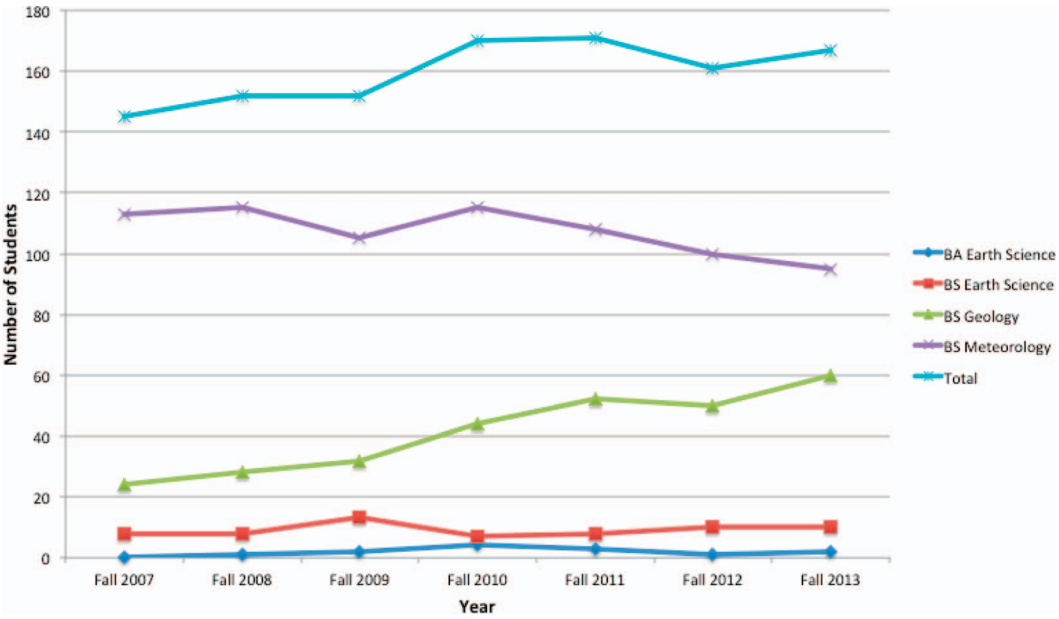

FIGURE 1: Total number of majors in the department by degree program since 2007 as reported by Office of the Registrar on the 10th day of the fall semester. The LC started in fall 2008 and the orientation course was introduced in fall 2009. These numbers include transfer students, who make up a significant portion of the geology and Earth Science majors. The LC enrolls primarily freshmen, and the ratio of meteorology to geology + Earth Science students is currently approximately 3:1.

What is a Learning Community?

Starting in the 1990s, pedagogical research increasingly emphasized the importance of the development of "communities of practices" in higher education (Lave and Wenger, 1991). Pioneered at Evergreen State College in 1984 with a focus on interdisciplinarity (Bonk et al., 2004), LCs are becoming increasingly common in U.S. universities. The *National Learning Commons* directory includes more than 250 LC initiatives at U.S. colleges and universities, and the National Resource Center for Learning Communities at Evergreen also publishes a journal (*Journal of Learning Community Research*, http://www.evergreen.edu/washingtoncenter/index.html). While learning communities can also be created for faculty or other professionals, in this paper, LC refers to student learning communities.

Arguably, the main goals of university learning communities are to assist students in the often traumatic transition from high school to college and increase retention. There are multiple models of learning communities (Kellogg, 1999; Tinto, 2003). The five basic nonresidential LC models are: linked courses, learning clusters with three or more connected courses, freshman interest groups for students in the same major, federated LCs with learning clusters and a seminar course to connect the clusters, and coordinated studies. Residential LCs integrate academic interactions with daily socialization among students living in the same residence hall (Brower and Dettinger, 1998).

The scope of LCs is vast and includes cross-curricular groups (students taking the same class or cluster of classes, but who are not necessarily in the same degree program), individual academic programs (e.g., students majoring in genetics or sociology), student interest groups (e.g., veterans, international students, lesbian–gay–bisexual–transgender), or community engagement (e.g., service-learning LCs) (Lenning et al., 2013). The implications of LCs are equally broad and related to the learning outcomes that guide them. Lenning et al. (2013) provide a detailed summary of the literature on LCs and guidelines for their development.

THE EARTH WIND & FIRE LEARNING COMMUNITY

As part of ISU's institutional effort to increase first-year student retention, LC structure and funding are highly flexible and allow departments and programs to create LCs that fit best with their needs. The university, through the central administration of the learning communities, provides funds for peer mentors (upper-level undergraduates hired to mentor students in the LC) and programmatic activities. Each LC is administered by one or two coordinators, usually staff (e.g., advisors) or faculty members, who submit yearly funding requests and proposals to the central administration. Coordinators are responsible for submission of course requests in fall and spring, administration of funds, hiring and supervision of peer mentors, reporting to the central LC office, and every activity in which LC students are involved.

The goals of the Earth Wind & Fire (EW&F) LC: (1) develop a departmental identity in new and transfer students by fostering faculty and student interactions; (2) increase student numbers; and (3) improve first-year student retention. The structure of the LC, as determined by these goals, does not fit in any of the five basic nonresidential models of Brower and Dettinger (1998), but it blends and adapts two of them: learning clusters with three or more courses enrolling LC students and the creation of "freshman interest groups" for students in two programs (geology and meteorology) and four majors. The goals of the LC were

TABLE I: Learning outcomes and assessment plan for the LC.

Intended Learning Outcome	Corresponding Department/ College Outcomes	Specific LC Experiences that Promote this Outcome	Assessment Plan: Evidence or Artifacts to Determine Whether Outcome Has Been Achieved
1. Students in the degree programs offered by the department will build stronger connections and develop an increased sense of belonging	Promote collegiality and collaboration within the department Increase recruitment of students to the program Improve retention of students within the department	Learning and social activities open to all students in the LC within the new required orientation course: - Fall picnic and field trip - American Meteorological Society (AMS) Student Chapter and GeoClub monthly meetings - Coffee with faculty - Interactions with peer mentors	Observation of students
2. Students will develop familiarity with the broad scope of the geoscience field from the freshman year	Possess familiarity with the broad scope of the field of the discipline	Faculty, students, and guest speaker presentations as part of orientation course Field trips	Student surveys Peer mentor assessment
3. Students will achieve mastery in chemistry, physics, and mathematics that will aid them in solving discipline-specific problems	Use appropriate tools from chemistry, physics, biology, mathematics, and computing to solve discipline-specific problems	Tutoring sessions with peer mentors and AMS Student Chapter members prior to math, chemistry, and physics exams Study groups	Increased student retention into sophomore year Better grades Decreased student anxiety towards the learning of ancillary course material
4. Students will become familiar with appropriate techniques and field methods	Use with competence appropriate techniques and field methods	Faculty, students, and guest speaker presentations during orientation course Field trips	Observation of students Follow-up discussion on field trips

outlined in the first request for funding submitted by the authors (Table I, first column).

The First Year of the EW&F LC

The first incarnation of the EW&F LC was coordinated by two lecturers/advisors assisted by six peer mentors recruited from the best junior and senior undergraduates in geology/Earth Science and meteorology. Each peer mentor was assigned a group of students: Given the larger number of incoming meteorology majors, some geology peer mentors were assigned meteorology students. Peer mentors were tasked with making initial contact with their mentees and to keep in touch, providing them with assistance in settling in the university environment and encouraging them to attend student club meetings and to participate in activities organized by the LC. Students interacted with faculty at the fall departmental picnic and at regular, informal lunchtime gatherings where faculty presented their research.

The qualitative assessment of the LC conducted at the end of the first year identified two major issues with the initial format: (1) Students that were paired with a peer mentor from a different program did not report any perceived benefit from the LC; and (2) attendance at the informal gatherings was sparse. The fact that there is essentially no overlap between the degree requirements for the meteorology and geology programs made it impossible to enroll all LC students in the same courses. After a meeting with the directors and staff of the university LCs, we agreed that for the success of the LC, all students needed to be enrolled in the same course, so we created a new one-credit fall orientation course required for all incoming students, Geoscience Orientation: Welcome to Planet Earth (Meteorology/Geology 112). We also scheduled a presemester field trip where all new students, peer mentors, and faculty in the department had the opportunity to meet and learn something new about the local area.

Current LC Structure: Student Mentoring and Orientation Course

As in all new programs, our initial plans needed to be adapted and modified over time. By actively participating in LC coordinator meetings in our college and biannual LC institutes, we learned what other LCs did, what worked and what did not, and adapted their best practices to our unique setting. After 4 y, we have reached a format that satisfies both our students and our goals.

Starting in 2009, the number of peer mentors was increased to seven, five from the meteorology program and two from the geology/Earth Science program. This reflects the different makeup of the student population in the two programs: While most meteorology students enter the university declaring their major, about 50% of the geology/Earth Science majors transfer from a different major after attending one of our introductory courses, as is the case in many other geology departments (Ormand, 2014). This means that the meteorology/geology freshmen ratio has changed over time from about 8:1 in the first year to the current 3:1. Peer mentors are assigned only students from

TABLE II: Orientation course syllabus (with group presenting in parentheses).

Week 1	Introduction, LC purpose (all)
Week 2	Cy-Ride bus tour and ice-cream social (all)
Week 3	Peer mentor panel (peer mentors)
Week 4	Geocaching, GPS treasure hunt (all)
Week 5	Degree programs, probation/warning, general education requirements, meetings with peer mentors (peer mentors)
Week 6	Faculty interview presentations (students)
Week 7	Time management skills (Academic Success Center)
Week 8	Study-abroad opportunities (Study Abroad Office presenter)
Week 9	How do I register for classes? (peer mentors)
Week 10	Resume-building seminar (college career service presenter)
Week 11	Faculty presentation: paleoclimate (faculty)
Week 12	Faculty presentation: glacial geology/hydrology/hydrogeology (faculty)
Week 13	Faculty presentation: severe weather and storm chasing (faculty)
Week 14	Careers (invited graduate students)
Week 15	Evaluations and assessment (all)

their major. One geology peer mentor is assigned to the gradebook management of the new orientation course.

The goal of the orientation course is to introduce the new students to life at ISU and to their peers. The syllabus includes: practical activities like using the city bus system and learning how to register for classes; team-building activities like a global positioning system (GPS) "geo-caching" exercise on campus and coffee with faculty members; and academic activities like presentations on study-abroad opportunities, time-management and learning styles, and faculty presentations on their field of research that can appeal to the different interests of the students (Table II).

Current LC Structure: The Team-Building Presemester Field Trip

The challenge of the field trip is the fact that the student population has interests that overlap only slightly: Meteorology majors are passionate about the weather; geology majors like rocks and fossils. To ensure that all field trip participants, students and faculty, learn something from the field trip, for 3 y, we have asked guest scientists to lead a local field trip with the goal to learn something about the environment around the campus: In 2010, we visited a local river and learned about its ecosystem shortly after a major flood; in 2011, we learned about reconstructed and native prairies; in 2012, we engaged in an activity on the solar system at a local park and attempted to explore the sky, but clouds prevented us from doing so. In 2013, we visited the local water reservoir and collected data from groundwater monitoring wells. At each field trip, small groups of one faculty member, 3–4 new students, and one peer mentor or coordinator completed a field-based activity designed by the field trip leader or the coordinators.

The presemester field trip, held the weekend before classes begin, provides the students with an opportunity to rekindle acquaintances built during summer orientation and to establish a community with department faculty, staff, and other students in their academic class before the semester even begins. While no formal assessment has been done of the field trip alone, comments from students to peer mentors suggest that the timing of the trip has helped incoming classes more easily transition to the university setting.

ASSESSMENT

To assess the success of this LC experiment, we evaluated three sources of information: student participation in the orientation course, student feedback at the end of the orientation course, and retention data. At the end of the second year of the LC, the department considered eliminating the program because of changes in the teaching load assigned to one of the two coordinators. When students, mostly from the very active American Meteorological Society Student Chapter, found out about it, they contacted the department chair urging him to reconsider, describing the LC as "the best thing that had happened in the department over the last 10 years" (Jacobson, pers. comm., 2010). In fact, the student chapter noticed increased participation of freshmen in their activities and had attributed this to the LC. To ensure the survival of the LC, the senior author, who had created it, volunteered to share the coordination activities and the teaching of the orientation course. Informal feedback from faculty who teach upper-level courses in the majors, especially in geology, for which majors at the most would have been enrolled in the same large enrollment introductory course, testify to a better student environment in those courses because the vast majority of students know each other already and have created their own study groups.

The orientation course is graded, and grades are based on class attendance, attendance in eight out-of-class activities, and participation in required class-related activities: geocaching, coffee with a faculty member, discussion of a 4 y plan with a peer mentor, and creation of a resume. The out-of-class activities are in three categories: academic success (e.g., tutoring or supplemental instruction, career fairs), talks (departmental seminars, any science, engineering, technology, or math talk), and social (departmental picnic, student club meetings). Each student is required to participate in at least two activities in each category. A

TABLE III: Grade distribution for the orientation course since its first offering in 2009.

	Enrollment (*N*)	A Grades (%)	Lower than B Grades (%)
Fall 2009	34	11 (32.4)	8 (23.5)
Fall 2010	52	31 (59.6)	5 (9.6)
Fall 2011	42	26 (61.9)	4 (9.5)
Fall 2012	41	27 (65.9)	5 (12.2)
Fall 2013	49	28 (57.1)	7 (14.3)

completed activity sheet, signed by a faculty member, graduate student, or peer mentor, is submitted as evidence of attendance. One third of a letter grade is deducted for each unexcused class absence, incomplete assignment, or missed activity.

The grade distribution over the 5 y of offering shows that between 76.5% and 90.5% of students earned at least a B in the class, suggesting a very good to excellent level of participation (Table III). If we leave out the first year of offering (2009), when we were still figuring out the format of the course and the roles of the peer mentors, more than 85% of students earned a B or better, and on average more than 60% of students completed all of the requirements between 2010 and 2013.

At the end of the orientation course, students are encouraged to submit anonymous, written feedback on the benefits of having a peer mentor and of the LC. The rate of response is usually 100% since feedback forms are completed during the required final exam period. We have collected this qualitative feedback since 2011. Students find a peer mentor beneficial because: they answer their questions on the degree program and careers; provide guidance on campus life, including assistance with the financial aid office and the student success center; help choose electives and help with course registration; become a friend, give study tips, and are an expert resource less intimidating than a professor. Suggestions on how the peer mentor could have done a better job were practically nonexistent: A couple of students wished they could have spent more time with their peer mentor.

When asked why the LC was beneficial or not to them, they unanimously responded that they found it beneficial and would recommend it to other students. When asked if they found the presemester field trip useful, each year, more than 90% of the students who could attend it were positive about it, both for the social and learning aspects of it. Similarly, very few students had suggestions on how to improve the orientation course, e.g., fewer speakers, more activities, more pizza. Overall, student feedback on all components of the LC is overwhelmingly positive.

One of the main goals for the creation of the Earth Wind & Fire LC was student retention. Since students are more likely to switch majors in their first 2 y at a university, we focused our assessment on 1 and 2 y retention data. Retention rates for students coming to ISU declaring a major in one of the two programs (i.e., not including students who transfer to the major later, either from undeclared or another major) before (2000–2007) and after (2008–2013) the LC show that the LC is indeed having a positive impact in both the retention to the major and the university (Table IV). However, only the 1 y retention to the institution is significantly different; the 1 y retention to the major is not significantly different.

FUTURE PLANS

While the LC is planned as a year-long project, the orientation course is offered only in the fall. Our attempts to organize seminars and social events in the spring have been largely unsuccessful. Starting in 2015, we will begin to offer a 0.5-credit spring orientation course. This will consist of biweekly presentations on financial literacy and career planning, building on the momentum created by fall activities and maintaining student activity in the LC.

Because of the limitation in the budget and our choice to have seven peer mentors, recognizing their crucial role in the success of the LC (e.g., Minor, 2007), the average hourly commitment of each peer mentor is 3 h in the fall and 1.5 h in the spring semester. Since peer mentors are required to attend the orientation class and our biweekly meetings, the amount of time left is dedicated to mentoring activities.

Our goal to better assist students in ancillary courses (Table I, #3) has been left to the voluntary tutoring provided by the American Meteorological Society (AMS) Student Chapter for meteorology majors. After assessing the impact of the results in math courses on students' decision to leave the major (especially meteorology), we added two peer mentor positions funded by the department for the academic year 2013–2014. These two peer mentors, selected for their superior success in advanced math and their personal skills, conduct weekly tutoring sessions for all levels of math (from

TABLE IV: One- and two-year retention rate to the institution and the major, with the standard deviation in parentheses. The *p* values for a *t*-test comparing the pre-LC (2000–2007) and post-LC (2008–2013) retention data are given in the last row.

Time Interval	*N*	One-Year Retention to ISU	One-Year Retention to Major	Two-Year Retention to ISU	Two-Year Retention to Major
2000–2007	327	81.9% (4.5)	57.4% (8.4)	73.0% (5.6)	41.4% (5.3)
2008–2013	216	88.7% (3.8)	66.1% (9.5)	79.2% (5.6)	47.2% (6.0)
t-value		$t = -2.0053$	$t = -1.9175$	$t = -1.4199$	$t = -1.1717$
p-value		$p = 0.034$	$p = 0.0529$	$p = 0.1430$	$p = 0.2452$

algebra to advanced calculus) for all students who wish to attend them. In the future, when we have a sufficiently large sample of students, we will assess the impact of the math tutoring by comparing retention rates and math scores prior to and after fall 2013.

We also plan to continue a *Strengths*-based leadership exercise (Rath and Conchie, 2009) with our peer mentors, initiated during the 2012–2013 academic year. Coordinators and peer mentors currently hold biweekly meetings throughout the academic year, starting a couple of weeks before the beginning of the fall semester. Part of these meetings is set aside for a discussion on *Strengths*. The first meeting is dedicated to the *Strengths* philosophy, with the second focused on sharing peer mentors' and coordinators' top five talents, and discussing new perspectives gained from the assessment. Subsequent meetings are focused on encouraging peer mentors to become better leaders and mentors, not only individually, but as a team, through application of the *Strengths* philosophy.

By focusing on the leadership and training aspects of *Strengths*, we hope our peer mentors will not only learn about their talents and improve themselves as leaders by focusing on them, rather than on their weaknesses, but also leverage those strengths as a member of an LC team to help it run more smoothly and efficiently. Efficient execution of a quality LC should improve the LC experience for the students, increase retention, and hopefully inspire some of them to take on a future leadership role as a peer mentor.

CONCLUSIONS

The LC has been a success on many fronts and is having a positive impact on the student population in the Department of Geological & Atmospheric Sciences at ISU. Departmental picnics no longer have "geology" and "meteorology" clusters but students who socialize regardless of their major. The two student clubs share fundraising events and ideas. The orientation course is an added responsibility for the faculty, but the student satisfaction is well worth it. The increased retention of students to the program and the university is a tangible reward for these efforts. Students who graduate from the LC are eager to apply for the peer mentor positions and ensure continuity and fresh ideas every fall.

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