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Twila Ortiz
Purdue University

Beth M. Holloway
Purdue University

Michael Harris
Purdue University

Andrea Pluckebaum
Purdue University

Leah H. Jamieson

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Twila Ortiz, Purdue University, West Lafayette

Twila Ortiz is the Director of Undergraduate Affairs in the College of Engineering at Purdue University. Ortiz works with undergraduate students and faculty to help meet the goals of the College's Strategic Plan.

Dr. Beth M Holloway, Purdue University, West Lafayette

Beth Holloway is the Assistant Dean for Undergraduate Education and Director of the Women in Engineering Program (WIEP) in the College of Engineering at Purdue University. She is the current chair of the Women in Engineering Division of ASEE. Holloway received B.S. and M.S. degrees in Mechanical Engineering and a Ph.D. in Engineering Education, all from Purdue University.

Dr. Michael T. Harris, Purdue University, West Lafayette

Michael "Mike" Harris is the Associate Dean for Undergraduate Education and the Reilly Professor of Chemical Engineering, and Professor of Environmental and Ecological Engineering in the College of Engineering at Purdue University, West Lafayette. He was a Purdue University Faculty Scholar from 2002 to 2007, served as the Programming Chair and Chair of the ASEE Minority Division (2011-2014); and was named Fellow of AIChE (2009), won the AIChE Grimes Award for Excellence in Chemical Engineering (2005), and the AIChE Minority Affairs Distinguished Service Award (2009). . He is the author of 95 peer-reviewed publications and 10 patents. He received his BS in Chemical Engineering in 1981 from Mississippi State University, and both his MS (1987) and PhD (1992) degrees in Chemical Engineering from the University of Tennessee. Dr. Harris's research is in the areas of nanomaterials, colloids and interfacial phenomena, transport phenomena, particle science and technology, microwave sensing of pharmaceutical powders, solidification of drug/excipient matrices, environmental control technology, and electrodispersion precipitation processes.

Ms. Andrea R Pluckebaum, Purdue University, West Lafayette
Prof. Leah H. Jamieson, Purdue University, West Lafayette

Leah Jamieson is the John A. Edwardson Dean of Engineering at Purdue University, Ransburg Distinguished Professor of Electrical and Computer Engineering, and holds a courtesy appointment in Purdue's School of Engineering Education. She served as the 2007 President and CEO of the IEEE. She is co-founder and past director of the EPICS – Engineering Projects in Community Service – Program. With colleagues Edward Coyle and William Oakes, Jamieson was awarded the 2005 NAE Bernard M. Gordon Prize for Innovation in Engineering and Technology Education for the creation and dissemination of EPICS. She was an inaugural recipient of the NSF's Director's Award for Distinguished Teaching Scholars and has been recognized with the IEEE Education Society's 2000 Harriet B. Rigas "Outstanding Woman Engineering Educator" Award, the Carnegie Foundation's Indiana Professor of the Year Award, the Anita Borg Institute's "Women of Vision Award for Social Impact," and the Simon Bolivar medal from the National Ministry of Education of Colombia. She was elected to the U.S. National Academy of Engineering "for innovations in integrating engineering education and community service" and is a member of the American Academy of Arts and Sciences, a Fellow of the IEEE and ASEE, an Eminent Member of IEEE-Eta Kappa Nu, an Honorary Member of Tau Beta Pi, and has been awarded an honorary doctorate from Drexel University. Jamieson received her S.B. in Mathematics from MIT and her PhD in Electrical Engineering and Computer Science from Princeton University.

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Abstract

In 2014, the *Gallup-Purdue Index Report* examined the relationship between certain collegiate experiences and workplace engagement. It found that experiences or experiential learning opportunities such as participating in a cooperative education program (co-op), internship or working on projects that developed over one semester more deeply affect the level of a graduate's workplace engagement and therefore productivity and overall well-being. While it is apparent how important experiential learning can be to the future success and well-being of students, it is more difficult to measure all of the activities that can be labeled as experiential learning and to define what constitutes a meaningful experiential learning opportunity.

This paper will examine the results of a survey, given at Purdue University, used to measure the undergraduate engineering population's involvement in experiential learning. The survey was distributed to 7712 undergraduate students. The results reflect that students are participating in a wide variety of activities that could be considered experiential learning; however the results also suggest that there is a need to refine the definition of experiential learning as it pertains specifically to engineering. For example, is a single project in a design-build course a significant experiential learning experience or is a traditional semester abroad which doesn't include any engineering focus? Additionally, this paper will discuss the development of a tool which could be shared with academic stakeholders to guide students to participation in experiences which will serve to propel them toward their career goals as well as advance their progress through their course of study. Additionally this tool could be used as a means to measure participation throughout a student's academic career rather than simply compiling a final report at the end of their academic tenure, as is currently the case.

Introduction

What makes an engineering graduate successful? One commonly accepted goal of higher education is to provide a broadly educated populous from which the job market can draw. Currently, one metric used to measure the value of a college degree is employment rates. While this does provide useful data, the *2014 Gallup-Purdue Index Report*[1] has explored this relationship in a more thorough way. The report draws connections between collegiate activities including experiential learning (EL) and engagement in the workplace stating: "Engagement is more than job satisfaction. It involves employees being intellectually and emotionally connected with their organization and work teams…" [1, p. 3] It further connects collegiate activities to overall well-being. *Gallup-Purdue* defines well-being as, "the interaction and interdependency between many aspects of life such as finding fulfillment in daily work and interactions, having strong social relationships and access to the resources people need, feeling financially secure, being physically healthy, and taking part in a true community." [1, p. 4] When a person is engaged at work and her well-being is thriving, that employee is more productive, one of a number of positive outcomes an employer would be thrilled to see in all employees.

If it is widely accepted that a goal of higher education is to provide a well-trained populous from which to select new employees, industry partners clearly are vested stakeholders in educating future engineers. This is evident by the many professional organizations such as the National Academy of Engineering (NAE), the Institute of Electrical and Electronics Engineer (IEEE), and the American Society of Mechanical Engineers (ASME) – to name a few – who provide opportunities for industry and academia to converge with publications and conferences. Industrial advisory boards counsel engineering programs and colleges across the country and are essential to the continued successful ABET accreditations which are de rigueur. Accreditation is essential for engineering graduates seeking licensure.

In addition to facing ABET accreditation every six years, engineering programs more specifically rely on their industry partners to contribute to the educational process by providing insight and counsel on the outcomes which engineering students must achieve in order to be successful upon entering the job force. At the same time industrial partners partner with institutions to provide cooperative educational opportunities and internships – critical experiential learning opportunities. Thus industry becomes an even larger stakeholder in the success of engineering students, investing in the training as well as employment of engineers.

A deeper look at the *Gallup-Purdue Index*

The *2014 Gallup-Purdue Index* (the index) surveyed over 30,000 graduates in the United States as a response to a growing desire for increased accountability for institutes of higher education. The index "examines the long-term success of graduates as they pursue a good job and a better life." [1, p. 3] The index links specific elements that students may encounter in their college experience to engagement in their employment as well as other elements of general well-being. On an institutional level, the index reports that students who feel the university experience prepared them for life outside of college and who feel the institution is passionate about their success are more likely to be engaged at work.[1]

The index shows that there are a number of factors that contribute to a student's success after graduation. In particular, the index reported on six traits of interest which, when taken together, demonstrate a supportive learning environment as well as a diverse group of experiential learning activities from which to choose. Divided into learning related and support related categories students were asked to report about their experiences with these six elements:[1]

- Internships or jobs where they were able to apply knowledge gained in the classroom
- Level of active involvement in extracurricular activities and organizations
- Work on projects that took a semester or more to complete
- Experience with professors who cared about them as people
- Professors who made them excited about learning
- Encouragement by faculty and staff to pursue a dream

Students who had a positive experience are much more likely to be engaged at work than students who didn't. Looking more deeply, the importance of good mentoring, in terms of direct faculty/student interaction is also an important factor in future workplace engagement. Students with positive interactions in the vein of mentoring were 2.3 times more likely to be engaged at work than those who didn't have those experiences.[1] The results of students who participated in experiential learning projects show that this also makes them 2.4 times more likely to feel engaged on the job.[1] This suggests that experiential learning is at least as influential on a student's workplace engagement as good mentoring and a supportive educational environment.

While experiential learning is an important factor in one's workplace engagement the index highlights that it is much less common than either good mentoring or a supportive educational environment. The index reports that only about a third of students work on projects that take a semester or more and that even fewer have an internship or job that allows them to apply what they've learned in an academic setting. It is important to clarify at this point that the index surveyed graduates from all majors, not just engineering or STEM. Currently, there isn't a means to explore differences between majors and all engineering majors at Purdue currently require the completion of a semester long design course for graduation.

While some university programs might benefit only minimally from experiential learning opportunities, students in STEM fields will benefit greatly from a wide variety of experiential activities such as design-build classes, co-ops, long term projects, internships, laboratory research, and program specific study abroad programs.

In addition to the educational value added by experiential learning, through the student participation, institutions of higher learning build relationships with industrial partners something which serves to facilitate future opportunities for students. Furthermore, in the relationships formed through these learning experiences industrial partners benefit from broader channels for recruiting purposes and opportunities to interact with students through non-curricular pathways such as involvement with student organizations. Additionally, industry partners are helping fund and advise project-based courses to assist with another aspect of experiential learning.

Defining experiential learning

Sweitzer and King[2], in 2004, wrote about experiential learning:

> Programs falling under the general rubric of *experiential education* take a number of forms […] In general they all involve students in activities that look rather different from more traditional classroom-based methods: the formal lecture and discussion, the reading assignment and the sit-down examination. Although these experiential activities go by different names in different program formats, they share the core characteristic of students' direct engagement in productive work outside the classroom. (2, p. 11)

Sweitzer and King lay out an excellent place to begin a discussion about experiential learning. Experiential learning is then, clearly delineated as work outside an academic setting which provides an academic benefit. But exactly what kinds of activities fit that description? David Thornton Moore[3] writes in his essay *Forms and Issues in Experiential Learning* that there are essentially three central experiential activities: Internships, service learning and cooperative education. However, the categorization of activities as either experiential or not will undoubtedly vary by institution.

The title "internship" is applied to a wide variety of activities. In its simplest application, the term denotes work not done by a student in a classroom, but which does receive course credit.

The internship may be a stand-alone experience with no classroom component, but in all cases it should require some level of reflective practice. This reflection could take many forms from close mentoring by a faculty member to maintaining a journal of experiences and the learning opportunities provided by those activities.

At the same time, some internships may require an in-class component where the student learns in a traditionally academic classroom about the theories and practices of their profession. This classroom activity would serve as a foundation for the skills the student acquires in the field-based component of the internship. The internship is of particular importance because as Lynch and Russell[4] wrote in 2009:

> "…in a period of rapid technological change, many items of professional importance are being recognized and distilled first in practice, and only thereafter in more scholarly terms in the academy. In such a practical setting, a strategy that relies on infusing new knowledge *solely* via university preparation of entry-level recruits, cannot keep pace with professional demands." [4, p. 31]

Lynch and Russell's observations are particularly apt for STEM fields, which are likely to rely on technology and its use as part of their day-to-day operations.

Service learning might be seen as an extension of this in-class/in-the-field combination. However the experience has the added benefit of meeting some communal need. Espino and Verani[5] explain:

> "The most convenient projects are the ones that focus on the community needs because they are in constant development. These projects last much more than a year, this fact gives undergraduate students the opportunity to spend a lot of time developing the desired abilities. Also, since those projects demand much quality and perfection, they can potentially provide experiences for the students' learning." [5, no page number listed]

Service learning activities are rarely, if ever, stand-alone experiences. Usually, this type of experiential learning occurs as a component of a larger course offering. Service learning is sometimes offered as an optional unit in humanities courses allowing the student to opt-out of some classroom activities for participation in a community service project.

In cooperative education (co-op), the student is typically alternating between time almost exclusively spent in the classroom with time almost exclusively spent in the field. This structure might be repeated during several successive academic terms. The benefit of this arrangement is summarized by Janet Eyler[6], who says:

> Students are prepared for learning and gain ownership through planning their academic goals. Classroom time is conserved by building reflection into other settings, and the process encourages continuous iterative reflection rather than a single paper or event at the end of the field experience. This is particularly important…where regular classroom meetings are difficult to arrange. [6, p. 30]

Cooperative education, then, is similar to an internship serving to deepen the students' practical skills as well as their knowledge base.

There are, of course, other forms of experiential learning. Increasingly, research is becoming an area of interest for experiential learning. Students might work in conjunction with a faculty member who is engaged in his or her own studies, or students might be employed as research assistants in any number of different practical applications.

In addition to research, study abroad programs are working to serve as experiential learning opportunities as well. A student might take classes in their area of study from a university outside the US while being granted credit at their home institution, allowing them to experience different aspects of their chosen field of study than what they might encounter in a more familiar environment. Certainly this experience could encourage growth in global competency.

Methods

A survey (Appendix 1) was distributed to 7712 undergraduate engineering students at Purdue University. Those surveyed included students from every engineering discipline in the College of Engineering. This was an effort to get as representative a sample, in terms of curricula, as possible. The survey was intended to gather information about students' participation in different kinds of experiential learning activities available to them at Purdue University. All completed surveys were entered into a drawing for one of three mini iPads. A survey was considered complete if all questions were answered and the student identification number matched in both the response at the beginning of the survey and at the end. The winners were then selected using a random number generator. 1146 returned surveys were considered complete and considered in the results, which corresponds to a 14.9% response rate. While the survey asked for self-reported race/ethnicity, the number of responses from underrepresented minorities was too small to properly analyze. The distribution of responses from the various engineering disciplines is representative of the population distribution, and the split of responses from domestic and international students also closely aligns with the population distribution.

The categories of experiential learning that were included in the survey reflect a broad range of activities available to students at Purdue. They range from internships and work experiences, both domestic and international, to research opportunities, both domestic and international. Also included are curricular experiences such as EPICS (Engineering Projects in Community Service). There was also the opportunity for subjects to consider responding with what they determined to be an experiential learning opportunity (other category).

Data and analysis

Table 1 shows the distribution of participation in experiential learning activities by year in school as indicated by the respondents. It is interesting to note that there is an increase in participation by grade classification. This seems logical as most students in the first year at Purdue are not able to participate in many experiential learning programs because they are discipline based, and the transition from the first year to the specific engineering disciplines happens at the end of the second semester, usually spring, for most students. This would preclude them from the traditional recruiting period in the fall at internship, co-op, and job fairs. Additionally, first year students are not able to move to their discipline without completing a prescribed number of courses and participation in a spring internship would set them back from progressing into their discipline by potentially an entire semester and in some cases an entire year.

	Students reporting *NO* participation in EL activities	Students reporting participation in EL activities	Percentage of students participating in EL activities
First Year	101	95	49%
Sophomores	72	182	72%
Juniors	63	257	80%
Seniors	50	326	87%
Total	286	860	75%

Table 1: Participation in experiential learning activities as reported by students at all levels

It is also interesting to note the shift in activity type from the first year to senior year. Figure 1 in Appendix 2 show the participation in the varying categories of experiential learning activities. In the first year, students who reported experiential learning activities participated primarily in activities that are closely aligned with an on-campus credit-bearing option of EPICS or the Global Engineering Program (GEP). Students who listed "other" as their response wrote in activities such as: Engineering Learning Community and AFROTC. There is also a large portion of students who didn't participate in any experiential learning activities.

Again it is not surprising to see as students move through their programs that there is a shift in the type of experiential learning activity in which they participate. The number of participants in internships and co-ops increases dramatically. The number of participants in research also increases.

By the senior year, the vast majority of the students surveyed had participated in some form of experiential learning and the majority of those participated in either co-ops, internships or research. It is interesting to note the variety of activities students listed in the "other" category, such as: start-up business, VIP (Vertically Integrated Projects), ASCE Steel Bridge.

Table 2 presents the distribution of participation in experiential learning activities by engineering discipline. Note that this data includes only sophomores, juniors, and seniors, as no first year students have yet moved to an engineering discipline.

Discipline		Students reporting *NO* participation in EL activities	Students reporting participation in EL activities	Percentage of students participating in EL activities
Construction Engineering Mgmt	CEM	0	11	100%
Biomedical Engineering	BME	7	81	92%
Mechanical Engineering	ME	13	149	92%
Agricultural / Biological Eng	ABE	8	49	86%
Chemical Engineering	ChE	17	103	86%
Industrial Engineering	IE	9	53	85%
Electrical / Computer Eng	ECE	26	116	82%
Inter- / Multi-disciplinary Eng	IDE/MDE	5	19	79%
Civil Engineering	CE	24	90	79%
Materials Science Engineering	MSE	7	25	78%
Aeronautical / Astronautical Eng	AAE	24	72	75%
Nuclear Engineering	NE	8	23	74%
Environmental and Ecological Eng	EEE	4	7	64%
Average of Disciplines	Average	152	798	84%

Table 2: Participation in experiential learning activities as reported by students in engineering disciplines

Note that Construction Engineering Management has a participation rate of 100%. This is expected as that particular degree program requires that students participate in three internships before graduation. The first internship starts before the sophomore year. It is also perhaps expected that the lowest student participate rate in experiential learning activities is reported by students in the College's newest degree program – Environmental and Ecological Engineering, as this discipline does not yet have extensive and long-standing ties to industry partners who might hire these students as co-ops and interns. Figure 2 in Appendix 2 presents this data graphically.

Table 3 presents the distribution of participation in experiential learning activities by nationality. Note the marked difference between the domestic and international students. Domestic students have a much higher reported rate of participation in experiential learning activities. This is not surprising as it is more difficult for international students to obtain paid work experiences, such as internships and co-ops, due to their visa status.

	Students reporting *NO* participation in EL activities	Students reporting participation in EL activities	Percentage of students participating in EL activities
Domestic	187	734	80%
International	83	142	63%

Table 3: Participation in experiential learning activities as reported by domestic and international students

Conclusions and Recommendations

Affording students the opportunity to participate in a cooperative education program, providing access to internships, research programs, and removing obstacles to increase participation in study abroad programs all contribute significantly to the employability of engineering students because those experiences impart knowledge as well as skills. Additionally, as indicated by the *Gallup-Purdue Index Report,* participation in experiential learning is valuable beyond the goal of getting a first job. It has far-reaching implications for employee and employer satisfaction.

This initial survey gave a very broad view of some experiential learning activities in which students are participating. In the future, if this were to be replicated, additional clarification or definition of the types of activities listed would be helpful. Current literature may help provide broadly defined and widely accepted experiential learning activities, however there are also gaps in the literature particularly in the area of entrepreneurial activities as experiential learning. It may also be relevant to learn more about how students define experiential learning as it may provide additional areas for further research and study.

Developing a tool or protocol to measure experiential learning is a next step at Purdue. This will involve using both existing data that can be pulled from course rosters in student information systems and developing a simple survey that can be administered in the fall of the junior year. This tool can then be used by academic advisors or faculty mentors to help guide students toward meaningful experiential learning activities that can help prepare them for the future. This particular process could then strengthen a future employee's engagement at work further by encouraging a mentor/mentee relationship between a faculty member and student and by having the experiential learning opportunity.

Appendix 1

Undergraduate Experiential Learning Survey

The information collected in this survey will be used to help enhance existing experiential learning tools in the College of Engineering and to create new opportunities continuing a strong tradition of providing top quality innovative education. You will be helping shape the future of The College of Engineering.

Your student ID number an purdue.edu email address will only be used for verification purposes and will not be associated with the aggregate data.

Please enter your University ID (00XXXXXXXX) this is a 10-digit number that can be found on your student ID card.

Select your year in school

- First Year
- Sophomore
- Junior
- Senior

Select your nationality

- Domestic student (US Citizen)
- International student, please list country

Select your race or ethnicity

- White
- Hispanic
- Black
- Asian
- Native American
- Two or more races
- Other
- Prefer not to answer

Select your major

- Agricultural Engineering
- Biological Engineering
- Aeronautics and Astronautics
- Biomedical Engineering
- Chemical Engineering
- Civil Engineering
- Construction Engineering
- Electrical and Computer Engineering
- Environmental and Ecological Engineering
- Industrial Engineering
- Interdisciplinary Engineering
- Materials Engineering
- Mechanical Engineering
- Multidisciplinary Engineering
- Nuclear Engineering

In which programs did you participate and for what length of time?

For the purposes of this survey, please consider the summer as a semester

	One Semester	Two Semesters	Three Semesters	Four Semesters	Five Semesters	I did not participate in this program
Co-Ops (Cooperative Education Program)	●	●	●	●	●	●
Internships (within US)	●	●	●	●	●	●
Internships (outside US)	●	●	●	●	●	●
EPICS	●	●	●	●	●	●
Summer Undergraduate Research Fellowship (SURF)	●	●	●	●	●	●
Research in the U.S. (excluding SURF)	●	●	●	●	●	●
Global Engineering Program (GEP)	●	●	●	●	●	●
Research outside the U.S. (excluding GEP)	●	●	●	●	●	●
Service Learning Project (not based in the College of Engineering)	●	●	●	●	●	●
Other, please list	●	●	●	●	●	●

Appendix 2

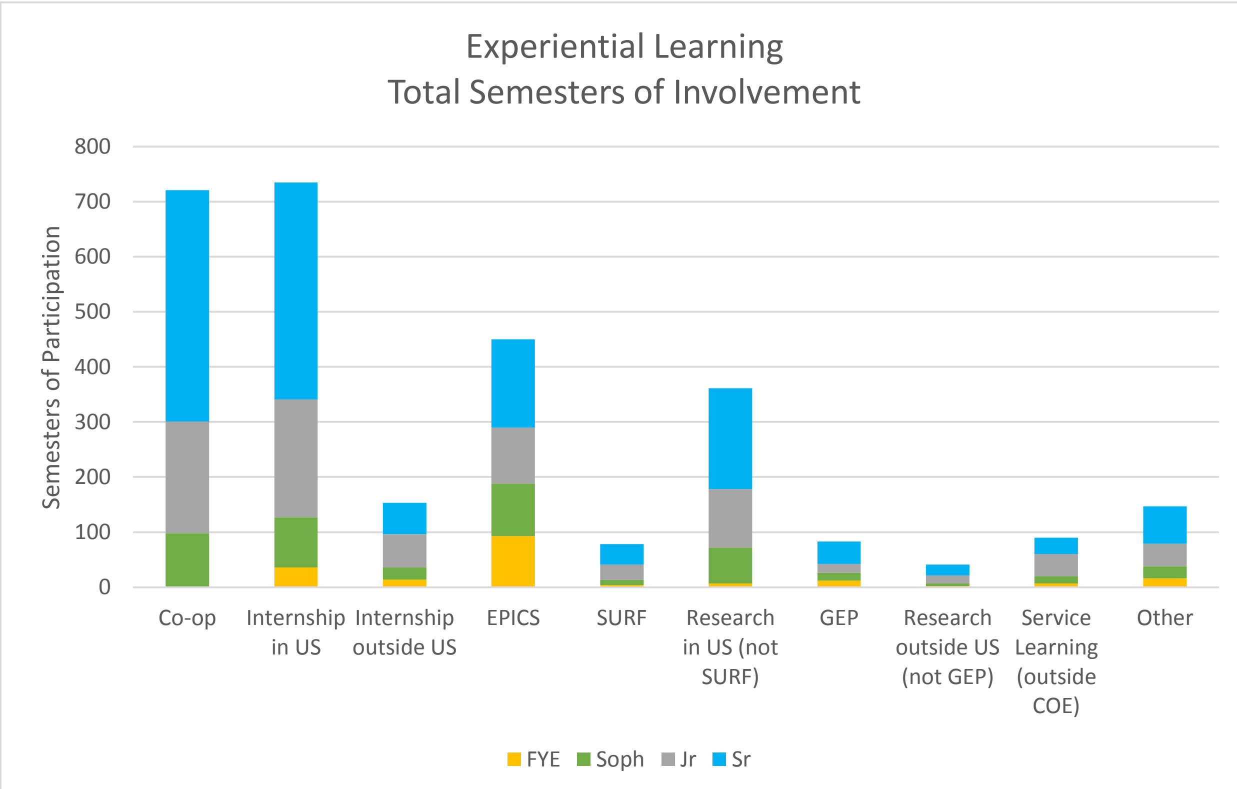

Figure 1: Total semesters of involvement in experiential learning activities, disaggregated by classification.

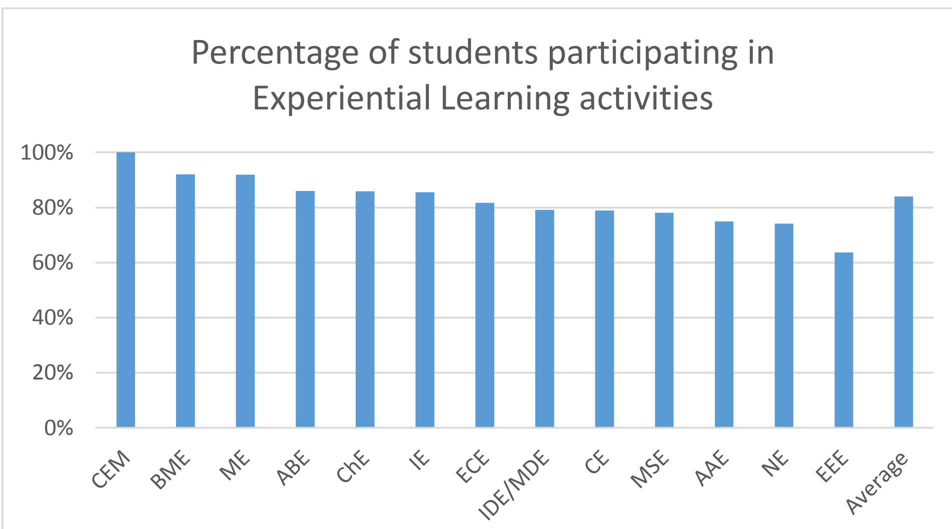

Figure 2: Percentage of Students Participating in Experiential Learning Activities, by Discipline

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