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# Experiential Learning in the Technology Disciplines

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## Abstract

Learning-by-doing has long been a tradition in the technology disciplines. It is the "hands-on" work, combined with student reflection, feedback and assessment, which reinforces theory into practice. Over the past 40 years, experiential learning (EL) in higher education has grown beyond in-class assignments to include internships, co-operative education, team-based learning, project-based learning, community engagement, service learning, international and study-away experiences, capstone projects and research opportunities. This paper provides an overview of experiential education theory and practice in the undergraduate technology disciplines, and presents examples of how experiential learning practices have evolved over time at a medium-sized institution in the Northeast USA. In addition, this paper offers instructors theoretical strategies to improve the hands-on work that is likely already present in their courses.

**Keywords:** experiential learning, experiential education, computer science, information technology, management information systems, technology pedagogy

### 1. INTRODUCTION

With pressure from consumers and government entities, colleges and universities have begun to transform their curriculum and student services. There is both a need and a desire to expose students to multiple experiential learning (EL) opportunities over the course of their undergraduate years and across the curriculum.

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Experiential education is not a one-size-fits-all strategy. The commitment to EL often stems from an institution's strategic plan where the planning is well-thought-out and resources are provided to bolster EL institution-wide. In many instances, EL begins from the ground up, in the classrooms of individual faculty or in a co-curricular program. Definitions of EL might stem from the institution's mission and/or strategic plan; organizations should be very purposeful in how they define EL as it will set the stage for planning and distribution of funds.

Learning-by-doing has long been a tradition in the technology disciplines. Technology disciplines in higher education include computer science, information technology, management information systems, computer information systems, information systems technology, and systems engineering to name a few. Technology majors have long benefited from applying theory to practice, such as out-of-classroom programming projects and participation in internships. But, the experience alone does not ensure that learning has occurred. Many academics have not always done it "right", particularly in accordance with proven experiential learning theory. However, there is no doubt that it is the "hands-on" work that reinforces theory into practice.

Over the past 40 years, EL in higher education has grown beyond in-class assignments to include internships, co-operative education, team-based learning, project-based learning, community engagement, service learning, international and study-away experiences, and research opportunities. In order to be truly experiential, the students' "hands-on" experiences must be combined with reflection, feedback and assessment. Merrimack College's transformation has mirrored this trend over the past decade.

In 2015, Merrimack College, a private Catholic Augistinian institution of 3500 undergraduates and 700 graduates, began an institutional push to strengthen EL across campus. With support from the Office of the President, an inaugural Dean of Experiential Education was appointed. The College was also awarded a grant from the Davis Educational Foundation to bolster EL across all academic disciplines, including co-curricular programming. Faculty have had the opportunity to apply for micro-grants to incorporate EL into their existing courses or to enhance courses that already included elements of EL. In addition, co-curricular programming was strengthened including co-op and internships, living/learning communities, global education and more.

Given the EL opportunities that the authors, faculty from CS, IT and MIS, use in their classrooms, they have found common themes among the courses. They include: 1. almost all students complete internships; 2. experiences very often utilize project- and team-based learning; 3. students widely engage in service learning or community engagement projects.

The authors have also identified the following high-impact (Kuh, 2018, 2008) learning outcomes across the EL-incorporated courses: inquiry & analysis, critical thinking, written & oral communication, internships, community engagement, service learning, and integrative and applied learning. These courses, majors, and programs have evolved over time to include critical elements of EL where they were once absent. This paper seeks to provide instructors with theoretical strategies to improve the hands-on work that is likely already present in their courses.

## 2. LITERATURE REVIEW

### Experiential Education and Learning

Experiential education dates back to Aristotle in the 4th century B.C. John Dewey, known as the "Father of Experiential Education", laid significant groundwork for the theory of EL in his 1938 book, *Experience and Education.* But it wasn't until the 1970's that experiential education surfaced as an accepted field in education, with the Association for Experiential Education (AEE) founded in 1977 (History of Experiential Learning, n.d.).

The AEE regards experiential education as "a philosophy that informs many methodologies in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills, clarify values, and develop people's capacity to contribute to their communities." (What is Experiential Education, n.d.). According to Kolb (2015), "In the field of higher education, there is a growing number of educators—faculty, administrators, and interested outsiders—who see experiential education as a way to revitalize the university curriculum and to cope with many of the changes facing higher education today." (pg. 4)

Kolb's experiential learning theory (ELT) was published in 1984. He views learning as the "process whereby knowledge is created through the transformation of experience" (pg. 38) with each stage being mutually supportive of and feeding into the next. Colleges and universities, now more than ever, are clear on the importance

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of EL, with these experiences happening both in and out of the classroom. According to McRae, et. al (2017), EL is defined as, "Hands-on learning occurring in the co-curricular and extra-curricular space."

WACE, (originally Work and Cooperative Education) is an "international professional organization dedicated to developing, expanding, branding and advocating for cooperative & work-integrated education programs within industry and educational institutions", cites four attributes that are necessary to truly achieve an experiential education program (WACE, Inc. About, n.d.):

- Experience—is direct and hands on; meaningful and substantial; authentic; embraces disruptive moments and supports personal exploration
- Curriculum integration — Learning outcomes are articulated and measured; outcomes and assessment are aligned; experiential and academic learning are connected for, and by, the learner
- Student outcomes—Skills, knowledge & understanding are developed; attitudes, values and beliefs are challenged; the learner contributes to the learning environment; new meaning is constructed by connecting previous and new learning
- Reflection—must be ongoing and meaningful; is critical vs. descriptive; and is socially mediated, supported and assessed

Research has shown that students learn most when they are more engaged in the experience rather than as passive participants (Sendall, et. al, 2016). George Kuh (2008) recommends that institutions should seek to have all students participate in at least two high-impact activities over the course of their undergraduate experience. High-impact practices are becoming common-place across university programs for recruitment and retention purposes and to enhance student success. Kuh (2018), identifies 11 high-impact educational practices for undergraduate student success. They are:

- first-year seminars and experiences,
- common intellectual experiences,
- learning communities,
- writing intensive courses,
- collaborative assignments and projects,
- undergraduate research,
- diversity and global learning,
- e-Portfolios,
- service and community-based learning,
- internships, and
- capstone courses/projects.

The American Association of Colleges & Universities (AAC&U) has developed 16 VALUE (Valid Assessment of Learning in Undergraduate Education) rubrics for 16 learning outcomes as part of its Liberal Education and America's Promise (LEAP) initiative. Each rubric was "developed from the most frequently identified characteristics or criteria" of learning (Value Rubrics, 2009). They are:

- Inquiry and analysis
- Critical thinking
- Creative thinking
- Written communication
- Oral communication
- Reading
- Quantitative literacy
- Information literacy
- Teamwork
- Problem solving
- Civic engagement—local and global
- Intercultural knowledge & competence
- Ethical reasoning
- Foundations and skills for lifelong learning
- Global learning
- Integrative learning

These rubrics can serve as a valuable tool when evaluating student performance, whether in their original form or modified for individual classroom purposes.

In order for any EL program to be considered truly experiential, the National Society for Experiential Education (NSEE) recommends following the *Eight Principles of Good Practice for All Experiential Learning Activities* (Eight Principles, n.d.). According to NSEE, "Regardless of the learning activity, both the experience and the learning are fundamental." For this to happen, NSEE recommends following their 8 principles:

- Intention—represents the purposefulness that enables experience to become knowledge;
- Preparedness and Planning—Participants must be ensured a sufficient foundation to support a successful experience;
- Authenticity—the experience must have a real world context and/or be meaningful to an applied setting or situation;
- Reflection—is the element that transforms simple experience to a learning experience;
- Orientation and Training—accessible to learner and facilitator;
- Monitoring and Continuous Improvement—process continues to provide the richest learning possible, including learner affirmation & feedback loop
- Assessment and Evaluation—develop and refine specific learning goals and objectives; and

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- Acknowledgment—recognition of learning by reflective and monitoring processes.

According to McMurtrie (2018), "Real-world engagement can help promote student success. Research shows that activities such as service learning, study abroad, internships, and collaborating on projects with a professor deepen learning and enhance intellectual development" (pg. 20).

## 3. EXPERIENTIAL LEARNING IN TECHNOLOGY DISCIPLINES

The technology disciplines have inherently incorporated hands-on learning into the curriculum. In recent years, scholars in the technology disciplines have written about the incorporation of a variety of EL activities into their courses. For example, Hoxmeier & Lenk (2003) and Petkova (2017) have written about their successful incorporation of service learning in their information systems courses. Croes & Visser (2015) and Lang & Ceccucci (2014) used a Google Online Marketing Challenge to teach analytics using real companies and data from Google Analytics. Lawler & Joseph (2019) utilized e-portfolios and web design team collaboration in a community engagement project. Podeschi (2016), partnered with a variety of local businesses and nonprofit organizations who needed to convert spreadsheet data into a relational database. Students worked in teams to develop a database solution using Microsoft Access. Students developed "both technical and professional skills through this client project experience." Pollard (2012), had students apply "formal project management knowledge to gain real-world experience" while managing a client project for 12 weeks of the semester. Jewer & Evermann (2015), utilized open-source enterprise and process management systems in a MIS course that was required of all business majors. This was done without a large investment into commercial software.

The literature indicates EL is an essential component of tech curricula. Tsang & Park (2016) argue that an undergraduate student's education benefits significantly from EL as they "develop skills to assess their own learning and development", "explore the relationship between theory and practice", and "gain experiences...that position them to meet employer expectations" by developing "skills to transition into the workforce." Faggiani, et al. (2018) discuss the continued need for industry-academic partnerships to strengthen even as teaching modalities may change, presenting a framework for project-based learning using third party industry partners in an undergraduate online program for information technology majors.

In examining EL in the technology disciplines holistically, several themes and modalities emerge, including team-, project-, and service-based learning, especially across disciplines. Pulimood, Pearson & Bates (2016) describe a community outreach program that used group work that paired computer science students with journalism students to work for Habitat for Humanity. Their findings demonstrate that, when presented with team-based EL, "computational thinking appears to have increased most among students in science majors." Hulshult & Krehbiel (2019) discuss how adapting various agile development practices enhances group work in an online information technology course. Christov & Hoffman (2019) tackle the issue of development software project management skills through the use of an experiential framework that builds a collaboration over two undergraduate courses: an introductory software development course, and a senior-level project-management course, providing younger students with learning guidance and older students with experience managing subordinate students.

One of the most ubiquitous EL techniques for computer science students is the use of "hackathons," which have been adopted into formal instructional processes by authors such as Gama, Gonçalves, & Alessio. (2018). A hackathon is a timed computer programming test which pits teams against each other in a race to solve several problems. Hackathons can increase student engagement and enhance team based learning outcomes.

## 4. EXPERIENTIAL LEARNING AT MERRIMACK COLLEGE

Within the School of Science & Engineering, the technology disciplines include Computer Science (CS) and, until recently, Information Technology (IT). In the School of Business, Management Information Systems (MIS) is taken by all business majors and upper level MIS courses are offered through the Management concentration and Department of Organizational Studies & Analytics.

These disciplines have traditionally incorporated hands-on EL all along as an integral part of their curriculum including: internships, team-based learning, community engagement, service learning, directed study, directed research and

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project-based learning. Examples of EL in the technology disciplines are discussed below.

**School of Science & Engineering: Computer Science and Information Technology**

Prior to 2015, EL opportunities for CS and IT students were limited to occasional independent studies and internships they sought out on their own. Through years of curricular and culture changes, both small and sweeping, students in these areas now have a plethora of opportunities, both curricular and extracurricular. These include: access to traditional on- and off-campus internships, access to independent studies, and a senior capstone project. Moreover, a large portion of courses in the curriculum offer a small-to-significant experiential component.

Students may elect to work one-on-one with a faculty member on a project of their choosing as part of credit-bearing independent studies. Prior to 2015, independent studies were not common in the department. To increase participation in independent studies a conscious effort was made to demonstrate their importance through faculty advising and advertising, thus increasing EL opportunities. This practice resulted directly in increased student involvement both within pure computer science projects as well as interdisciplinary projects. Independent studies topics have included game design and development, geographic information science, security, data mining, mobile app development, among others.

Several of these projects have been group-based, including app development. A non-negligible portion of these experiences have been interdisciplinary. For example, a business major with an information technology minor worked on a project to develop best practices for a business to implement compliance to the Sarbanes-Oxley act. An additional semester-long experience paired two computer science majors with digital design majors developing an iOS photography app. The CS students worked on app development, design, and database management, while the digital design students built art assets, designed the user interface, and took charge of marketing. Students were required to apply for the independent study, providing resumes and applications.

In all independent studies the instructors emphasize communication skills and self-exploration in the field. Self-exploration is assured by the student selecting the project and finding primary sources of information to complete the project. The communications skills of the student are enhanced using a dissemination component. This requires a formal presentation of the work as well as a poster presentation at a college-wide student conference. Formal presentations for independent work take the form of student symposia at the end of each semester, a new initiative implemented by the department faculty. These symposia offer students the chance to present their work to their peers, as well as hear what interesting and rewarding work others in the department are engaged in. This aligns well with the EL learning outcomes described in section two.

During the summer of 2019 the Computer Science department piloted a summer research experience for undergraduates. These students were fully funded for six weeks of intensive project-based work under an internal grant. Students participated in events which introduced them to the nature of research. Following EL best practices, the students were required to deliver a post experience reflection.

The summer research experience not only placed an emphasis on the enrichment of technical skills but the enrichment of soft skills. Soft skills were developed through weekly round table meetings that required students to briefly explain their work. At the final round table a “post mortem” discussed the state and remaining challenges of each project. The faculty observed a positive impact on the students. This experience is especially valuable for students considering graduate study in computer science or any related discipline. It was observed, during the pilot, that students working in pairs had a more fruitful experience, reaffirming an EL best practice of collaborative work. Future offerings will mandate work be conducted in small groups.

A majority of the CS majors participate in a paid internship. Traditionally these occur during the summer months after their sophomore and junior years. These internships are registered with the college’s Career Services Center, and students are required to write a reflection paper at the conclusion.

Senior CS majors must take part in a semester-long capstone experience during their senior fall semester. These are traditional software engineering experiences. The capstone is a hybrid traditional lecture course and software engineering project, with the first half of the semester being dominated by the lecture and the second half by the project. Students are grouped according to their relative skill levels and allowed

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to choose from a list of potential clients and projects. Prior to 2015, these projects were created and administered by the course instructor. However, to facilitate experience authenticity, these project ideas are now solicited from staff and faculty members over the summer by the course instructor, providing both a service component and an experience that authentically mimics real life team-client interaction. The instructor works with these clients to guarantee that the projects are of the appropriate scope and challenge level. Then, the course focuses on various aspects of software engineering, including requirements gathering, system design and documentation, project management, debugging, agile development principles, and source control. The course is also part of Merrimack's writing intensive curriculum, meaning that the technical writing takes center stage. The course reinforces several soft skills, as students are required to present and create posters for their work, an important component of EL (Kuh 2008, AAC&U, 2009).

In addition to various club activities, student teams also partake in annual Hackathon competitions at local conferences, a key aspect to experiential curricula. Some students seek individual experiences, such as the NASA Robotic Mining Competition (Heiney, 2015). Prior to 2016, this practice had been discontinued for several years and revitalized as part of the push for EL opportunities.

The IT major had a mandatory internship that required the completion of four one-credit internships with Merrimack's Information Technology Services (ITS) division. A faculty member in the department oversees the submission of weekly reflection journals and an internship supervisor in ITS oversees the student workers while on shift. The evaluation of the students is based on reports from the internship supervisor and the faculty member. Most students in the internship have the responsibilities of working the ITS help line, filing tickets, resetting passwords, backing up and imaging laptops, installing hardware and software around campus, and correcting minor network issues. A portion of this work is done in large teams collectively solving a problem. This internship was shown to improve student performance in computer networking courses, which have a lab component. The on-the-job training that interns received allowed the instructor to delve deeper into topics as well as allowing the IT students to demonstrate their abilities to be peer leaders.

These experiences collectively afford students opportunities to hone the following skills: communication, both oral and written, both technical and informal; information visualization; problem solving; and teamwork. These skills are deemed vital by the tech industry. In general, the faculty of the department take advantage of any EL opportunity they can practically incorporate, and those that succeed are maintained. Additionally, Kolb's (2015, 1984) scaffolded approach of each stage supporting and feeding the next stage in students' EL education is ingrained throughout these applications. Students hone soft skills during class and club activities while also learning about development processes from their capstone experience and their internships. All components of the curriculum are designed around the ideas presented in the EL literature.

**School of Business**

Business majors have access to a variety of EL opportunities. In the School of Business, there is no Management Information Systems major. However, all students are required to take the sophomore-level Management Information Systems course. Upper level MIS courses are offered in the context of the Management concentrate through the Department of Organizational Studies and Analytics. Courses include e-Business, Database Management Systems, Systems Analysis & Design, Project Management, Internship and Directed Research. Many of these courses include project- and team-based learning, community engagement and service learning. Below are examples of EL projects that are assigned across these courses.

Gaming has become an important source of EL in the MIS class. *Innov8* is a 3D simulation by IBM to support learning about business process improvement (BPI) and service-oriented architectures (SOA) (Lali, 2008; Pavaloiu, et al, 2016). Players assume the role of a BPI expert in a fictitious company where they use technology and outsourcing to improve the current call distribution at their corporate contact center in three different scenarios. These include a situation after merger with another company, green initiative, and customer self-service. Step-wise gameplay involves business process discovery, i.e. AS-IS process and performance benchmarking, BPI tooling, business process reengineering, i.e., TO-BE process, simulation, and deployment. Players design TO-BE business processes for various scenarios modifying or deleting wasteful steps. Each newly designed process is then tested for the right mix of parameters to achieve targets for average cost

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per call, average time per call and carbon footprint, etc. Based on the performance the player gets a score.

Around 150 Merrimack sophomore-level undergraduate students played the IBM *Innov8* game in a lab setting as part of the MIS course offered in 2019. Groups of 2-3 students were provided a 20-minutes briefing on objectives, gameplay and controls. Grouping the students supported team-based learning; diverse thinking lead to final decisions and frequent feedback and reflection among peers. Expected game duration was around 90 minutes.

Specific prompts were set up to guide the students through each step of the BPI cycle and contact center operations. At the end, each team was required to submit a completed document with outputs at each step of the game and notes on their reflection activities. They were also to provide targeted feedback.

Analysis of their submissions and scores revealed core aspects of EL, i.e. gathering concrete experiences, reflection, abstraction, and active experimentation (Kolb, 1984). It is evident that students knew very little about BPI, CRM or SOA at the beginning. Interacting with virtual employees, collecting performance data and BPI tooling and capturing the AS-IS process helped them gather concrete experiences about the company, its employees' roles and current operations. Most students developed full understanding of BPI lifecycle.

The game stimulated group discussions and joint conclusions. Reflective observation as a strong tenet of EL and team-based learning is very much evident here. Students actively used observations to generate abstractions and integrated concepts of how BPI and contact centers work and/or should work. One notable aspect is the constructivist aspect of EL.

Finally, active experimentation helped the students solidify their newly generated knowledge. They applied their abstractions from earlier scenarios to the simulated real life scenarios in ways that actually improved the key performance indicators (KPI). This goes to Kolb's scaffolded approach to experiential learning.

Another project- and team-based learning assessment in the MIS course was studying implementation of an enterprise information system (IS) in a business. Each group was assigned a unique case study of enterprise IS design and implementation, normally Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Supply Chain Management (SCM) or Business Intelligence (BI) Systems. The project was spread over two weeks of desk research, team discussion and reflection, culminating in a presentation to the class. A presentation template guided student learning on six major topics including company introduction and business challenge, business-IT alignment, system architecture, project management (costs, timelines, implementation and hosting, roll-out), and the impact of IS.

Submissions revealed adequate effort and achievement of learning objectives by most groups. However, it was apparent that the case study method might not be the best source of immersing students into the presented managerial experience. Only after adding desk research and video supplements to enhance students' understanding of the context, they could fully get into the "manager's shoes" and use the managerial tools for business-IT alignment. The final recommendations and underlying analysis demonstrated that most groups were still able to work out the solutions based on team discussions. In a reflection of their work, many students noted creating realistic abstractions and making good decisions would have been difficult if it was assigned as individual work. Teamwork in problem-solving and decision-making were reinforced.

Other EL experiences in the Management concentrate included the following:

Service, team- and project-based learning was applied in the Database Management Systems course. Students designed and developed database prototypes using Microsoft Access for non-profits in the surrounding community. They were required to use systems analysis techniques which included visiting the companies, making observations and conducting interviews. Some student projects converted spreadsheet data into a relational database; other projects created relational databases from paper files. The project incorporated team-based learning approaches, community engagement and service. Similar to Podeschi's (2016) findings, students developed "both technical and professional skills through this client project experience."

e-Business—students were required to build a web presence for small businesses or non-profit organizations in the community using the skills they learned about e-commerce and web design. They used a front end tool or cloud based web design service such as Wix, SquareSpace, etc.

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Systems analysis & design techniques, project and team-based learning, and depending on the project, service learning were incorporated into the course. Soft skill competencies were gained by incorporating writing assignments within the project, client interviews and communication, and a required project presentation at the end of the semester. During one semester, the professor taught this course abroad incorporating intercultural competencies. While the course had learning outcomes, there were no reflection exercises embedded into the project cycle. Other than examination and project evaluation by the faculty member, there was no other formal project or course assessment utilized. Future classes will incorporate EL best practices.

Project Management—Students managed a project for a non-profit in the surrounding community. They worked in teams with a culminating term project. This course incorporated service learning and team-based learning. The students spent 3 hours in the classroom each week learning project management theory and one hour per week out in the field. No formal reflection assignments were given but students shared their experiences with their professor and their teams during class time. This course was taught prior to 2015; therefore, EL best practices will be embedded in future classes.

Internships—individual students are placed in paid or unpaid technology internships in companies that may or may not be high-tech. Students are required to complete bi-weekly reflection assignments that include instructor feedback. The semester includes other assignments that incorporate self-reflection and evaluation, analysis of the industry, career goals and assessment, elevator pitch, and supervisor evaluation. Students met face-to-face at midterm to discuss the pros and cons of their internships. The purpose of this meeting was for students to learn from each other and to offer strategies for improvement. Prior to 2015, the only feedback students received was via an employer evaluation at the end of the internship. This gave the student no time to re-calibrate if they were struggling. In addition, there was no required reflection. After 2015, several EL best practices were added to the course.

Directed Study / Independent Research has long been an option for students but has not been a requirement; students tend not to seek faculty members out for these independent opportunities. In the business school, Business Strategy serves as the capstone course and is not technology focused. In the past, tech-based directed studies have involved 1:1 DBMS projects that incorporated community service. Most recently an MIS professor supervised a student for a capstone honors independent research project on blockchain technologies. Under the direction of the faculty, the student did independent research, which included a traditional literature review and interviews with industry experts. In addition to the formal research paper, the student was required to disseminate his findings through a poster presentation at the annual campus-wide student conference. While no formal reflection assignments were required, the student met with his faculty mentors weekly where reflection was part of the meeting.

Big data analytics and data-driven decision-making are hot these days. Several companies expect their new employees to demonstrate critical thinking, analysis, problem-solving and presentation skills before employment. Since 2017, School of Business has showed strong interest in integrating data analysis and decision-making skills into undergrad curriculum especially MS-Excel skills for data processing and analysis. To that end, designing and implementing a real Business Intelligence Dashboard for an HR Manager to improve talent retention in their company has been a major hands-on project for MIS students since Fall 2018. Data cleaning, data analysis and data visualization experiences embedded in this exercise were based on an HR dataset comprising 20,000 employee records acquired from IBM Watson's datasets freely available on the web. Students were required to employ statistical analysis techniques to find inter-relationships between employees' leaving (or staying) decisions and various factors such as demographics, compensation, performance, learning and satisfaction. Not only were the requirements for a formatted dashboard were clearly laid out in a 60-minutes briefing before them but students were also provided extensive hands-on tutorials on statistical analysis and charting functions in Microsoft Excel software before starting their work. Overall, the project targeted several EL criteria such as inquiry and analysis, critical thinking, quantitative literacy, information literacy, teamwork, and problem solving (Value Rubrics, 2009). Moreover, this work can be considered a comprehensive EL project since it involved experience in the form of personal exploration, it was well-integrated into school curriculum, clear student outcomes were targeted, and the students reflected deeply on their work. The students were able to find unique inter-relationships among several variables which they interpreted before recommending HR strategies and their implementation in ways that were clearly helpful in bolstering talent retention.

## 5. DISCUSSION

In examining Merrimack College's technical curricula's use of EL holistically, several themes and modalities emerged. Common high-impact (Kuh, 2018, 2008) learning themes across the tech disciplines included; 1. internships; 2. project- and team-based learning; 3. service learning or community engagement; 4. integrative and applied learning. Other themes that emerged were; collaborative assignments and projects, undergraduate research, and capstone courses/projects. In addition, the communication skills of the students were enhanced using a dissemination component, both written and oral, in many of the courses.

The experiences were all direct, hands-on, and impactful. They included occasion for disruptive moments and supported personal student exploration. Some, not all, were situated/authentic, that is, conducted in the place where the learning was to be used. In the absence of that, faculty included experiences such as simulations that mirrored the "real world" environment and tasks-at-hand.

Of the 16 AAC&U LEAP learning outcomes, the authors identified the following themes in all or most of their technology courses when applying EL assignments: inquiry & analysis, critical thinking, written & oral communication, information literacy, teamwork, problem solving, civic engagement, foundations for life-long learning, and integrative learning.

What may have been missing in some of the courses, however, were some key elements of experiential education, particularly mandatory reflection exercises, feedback loops across all EL opportunities, and embedded assessment.

Regarding internships, courses that were for-credit embedded learning outcomes, reflection and academic exercises. However, some of the internships are not-for-credit; the CS majors tended to work full time, for pay, in the summer. These were non-academic experiences and did not include reflection exercises, feedback loops, learning outcomes or assessment. Unfortunately, the student culture in CS is such that the students may not see the value in registering their internships. The CS department is working to change this culture.

**Limitations of study**
Noted limitations to this study were: Merrimack College does not have a Management Information Systems major. Merrimack College no longer offers an IT major. In addition, some of the older projects, prior to approximately 2015, did not incorporate proven EL fundamentals such as reflection. Finally, data collection on student internships and reflective components has only begun in recent years.

**Future study**
The authors plan to survey other institutions who offer majors in CS, CIS, MIS, IT, etc. to gather data on how they incorporate EL into their technology majors. This study will look at types of EL experiences and how EL best practices are incorporated across courses.

## 6. CONCLUSIONS

According to Podeschi (2016), "Information systems curricula are increasingly using active learning methodologies to help students learn through technology rather than just about technology." It is evident that experiential education has become ubiquitous across the technology disciplines. EL is a relatively new field in higher education only having been recognized as a legitimate field of study in the 1970's. While technology disciplines have long practiced "hands on" learning that is not to say that we were doing it right. In order for learning to be truly experiential, certain structural elements must be implemented. The experience must be active, direct and hands-on. The learning must be integrated into the curriculum including learning outcomes and assessment. There must be a connection between the experience and the curriculum. In addition, the learner must contribute to their learning. EL must take on a scaffolded approach to learning, that is, where knowledge is built on prior learning and experiences. Finally, the student must reflect on the experience. Reflection must be ongoing and meaningful and the faculty member must provide student feedback that is "socially mediated, supported and assessed", where reflection does not fall into a meaningless black hole. According to the AAC&U, "The most critical factor for achieving powerful learning outcomes from experiential-learning programs is the inclusion of opportunities for feedback and reflection." (Eyler, n.d.).

EL is not a one-size-fits-all proposition. Some colleges and universities have formalized their commitment to experiential education across the institution while others are still trying to figure out

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the best way to put a structure in place. Many faculty, particularly those in the technology disciplines, have long incorporated EL into their curriculum. However, in some cases, in order for the student experience to be truly effective, structure needs to be put into place that includes curriculum integration, assessment, reflection and feedback loops.

George Kuh (2008) recommends that all institutions should seek to have all students participate in at least two high-impact activities over the course of their undergraduate experience. In order to ensure that our students remain life-long learners and are career-ready upon graduation, it is incumbent upon us to create meaningful, innovative EL opportunities for our students. We must also ensure that not only are students learning-by-doing, but that we are providing them with on-going feedback as they apply theory to practice.

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