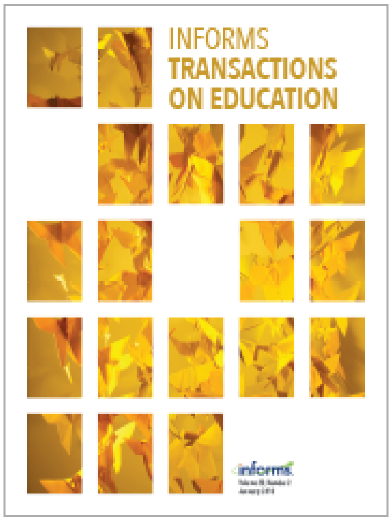

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Leveraging Experiential Field Projects—Discovery Learning in a Masters in Analytics Program

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Abstract. In this paper, we present the theoretical rationale behind positioning a field project concurrent with students entering into a master's program in analytics as well as the pedagogical approach to make such an experience successful. The inclusion of such a project creates a discovery learning "scaffold" that facilitates stronger development of and connections between a student's skills, experiences, and analytics mindset. Implementing a field project before and concurrent with student skill development presents some significant challenges that are different from a capstone field project and which must be addressed to create a successful learning experience. After five years of introducing and enhancing this experience at Michigan State University, we believe that other institutions can learn from this experience. The field project learning process and outcomes as well as challenges are highlighted.

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Keywords: field project • discovery learning • inductive learning • analytics • data scientist

1. Introduction

The heightened attention to applying predictive analytics within organizations has led to a significant increase in degree programs across universities to address what is believed to be an insufficient supply of talented data scientists to fill organizational demand for such roles (Schoenherr and Speier-Pero 2015). This attention is particularly true in the OR/MS arena where techniques and approaches taught in OR/MS courses can be leveraged to solve an array of business problems (Grossman et al. 2016, Hazen et al. 2016, Schoenherr and Speier-Pero 2015). Similar to many universities, Michigan State University developed a Master's of Science in Business Analytics (MSBA) program to address this demand. The MSBA is a 1 year, 3 semester (spring, summer, fall) program where students participate in experiential field projects each semester. In this paper, we describe what we believe to be a unique field project approach, yet one that provides significant value for all program stakeholders.

Imagine having applied to and accepted into a master's in business analytics program where before you spend one day in class, you are introduced to a semester-long field project where you and your team are charged with applying analytical techniques to address a business problem and your final results will likely be presented to the firm's CEO. While there is assuredly a sense of exhilaration (This is exactly what I will be doing once I graduate!), there must also be a complete and utter sense of discomfort or perhaps even horror (Excuse me, Professor, don't we need to learn things in our classes so that we can perform such an activity?). Although some believe that those pursuing an advanced analytics degree program are already well trained in data science, recent research indicates that this is not true: The existing workforce has insufficient training to fulfill these data scientist roles with a possible shortage of up to 190,000 professionals by 2018 (Manyika et al. 2011, p. 3). This insufficient training is an outcome of the disparate but necessary skills that data scientists need to develop: business (or some other area of focus such as healthcare), data management, math/operations research, programming, and statistics (Harris et al. 2013). We have no doubt that our students simultaneously experience exhilaration and panic (and perhaps every other emotion) , and yet we believe that this field learning experience is essential to the learning and career development success of these students.

In this paper, we present the theoretical rationale behind positioning a field project concurrent with students entering into a master's program as well as the pedagogical approach to make such an experience successful. A detailed characterization of the project experience is provided later,, but a basic initial description might be useful here. The project is a semester-long curricular (no explicit course credit) experience with a corporate project sponsor. All students in the entering cohort (e.g., 35) work on the project in teams of 4–5.

2. Discovery Learning

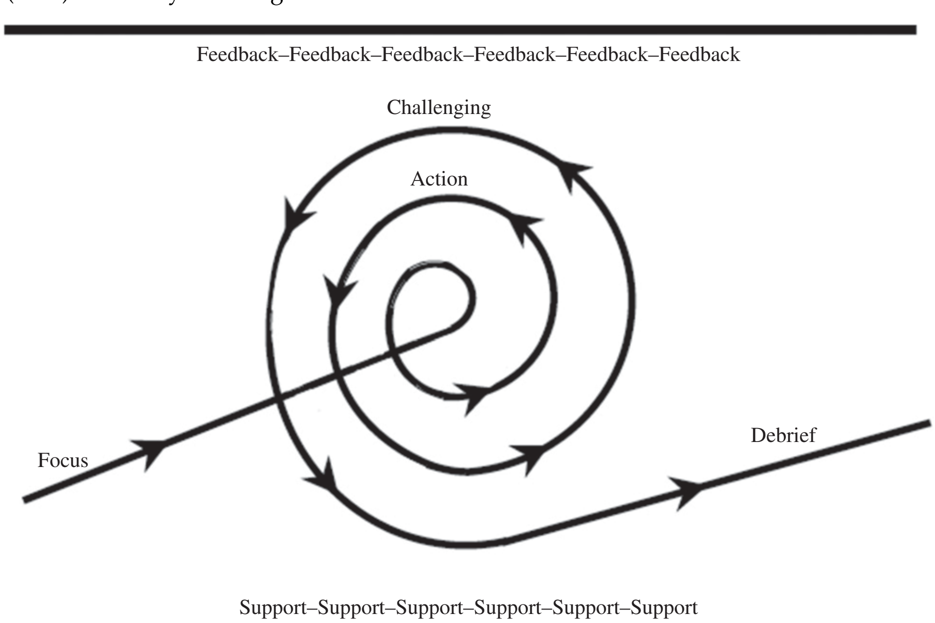
Adult learning theory often focuses on the importance of discovery or transformative instructional models to engage students in the learning process (Bruner 1996). Discovery learning incorporates a field setting wherein students identify and address a problem, struggle with solving the problem using iterative feedback/processes, resulting in the creation and presentation of a solution (Borthick and Jones 2000, Bruner 1967, van Joolingen 1999). Discovery learning is often connected to constructivist processes, i.e., the student decides what information to react to and which techniques to apply, as well as what information and techniques not to apply, to develop a deep understanding of how to solve similar types of problems in the future (Doolittle and Camp 1999). The learning process moves from inductive to deductive reasoning (Dewey 1938) as students are placed into a difficult, uncomfortable situation and seek solutions. Finally, experiential learning is a critical aspect of discovery learning; the literature on experiential learning is extensive, including seminal work by Dewey (1938), Kolb (1984), Lewin (1951) and Piaget (1971).

In the process of designing and implementing a relatively new master's program, discovery learning was implemented as a guiding framework that shaped the architecture of the overall program and provided the impetus for a co-curricular field learning project to initiate students to the profession. There are a variety of discovery/experiential learning process models (Lewin 1951, Dewey 1938, Kolb and Kolb 2013). We found Joplin's (1981) five-stage discovery learning process (focus, action, support, feedback, debrief) compelling as the hurricane-shaped model emphasizes "challenging action" by focusing on a specific experience; the resulting student application of skill (action) and emotional responses requires faculty support and feedback (see Exhibit 1). A more detailed presentation of Joplin's process and the integration of discovery learning with this process are presented in a subsequent section.

Discovery learning sounds compelling, yet it is a difficult approach to successfully implement (van Joolingen 1999). If there is significant complexity in the problem domain, students run the risk of suffering from cognitive overload, reducing overall learning and creating negative emotion (Kirschner et al. 2006). At the same time, the problem environment must induce student uncertainty about how to solve the problem (Hyde 2007). This negative emotion can be demotivating for a student, making future learning interventions more challenging and difficult to overcome (Ford 1992). In addition, research has highlighted the need for guidance, i.e., guided discovery, where a faculty member provides a meaningful framework or defines a process such that students create the desired learning outcome (Mayer 2004, Shulman and Keisler 1966).

Therefore, discovery learning can only be effective when a field project is thoughtfully designed and structured. As the experiential field project has evolved through multiple iterations, we recognize and thus strive to create scaffolding to connect the field project to classroom and non-classroom learning experiences. Scaffolding provides structure and support such that

Exhibit 1. Joplin's (1981) Discovery Learning Model



knowledge can be progressively built (Chandler and Teckchandani 2015, Marquardt and Waddill 2004). In addition, scaffolding creates hooks such that students can meaningfully link project and other personal experiences to course content and other concepts (Chandler and Teckchandani 2015).

3. Experiential Field Project: Discovery Learning as Pedagogy

We believe that incorporating a field learning experience in the first semester of our MSBA program is perhaps its most unique attribute and that this "run before you walk" experience has tremendous ramifications for student learning and development. We describe the nature of the project and then focus on the learning outcomes and how this field learning experience has changed over time. First, however, we provide a brief description of our curriculum and our students as they directly influence our experiential field project discovery learning outcomes.

As noted earlier, there is a great deal of consistency in perspective on the broad-based skills a data scientist should have; however, the depth of any one of these skills (e.g., data management or machine learning) will vary widely across a sample of such professionals (Wilder and Ozgur 2015). In part, this reflects the breadth of backgrounds (computer science, engineering, statistics, math, business, healthcare, humanities, etc.) that data scientists might have. Similarly, organizations hiring data scientists have an equally broad definition of the sophistication of skills needed (e.g., heavy on the machine learning technique versus someone with solid machine learning skills who can be a persuasive communicator of outcomes). Given the tremendous variety in incoming experiences and the necessary outbound skills, it should not be surprising that there is significant variation in curriculum offerings across universities (Schoenherr and Speier-Pero 2015).

Our MSBA program was developed as a multi-college offering and as such, we anticipated and have seen qualified applicants from a breath of backgrounds. We established minimal statistical and programming expectations as necessary prerequisites for acceptance into the program (in addition to GMAT, GPA, etc.). More specifically, we seek prior coursework in statistics (3 credit applied statistics) and programming (any language but preferably Python). Prior demonstrated course completion can be waived in some situations where students have work experience and can demonstrate the necessary skill. In addition, all students are required to successfully complete graded statistics and programming (Python) modules before matriculating in the program. Each course (whether a highly quantitative advanced statistics course or a soft-skill communications course) has significant student skill heterogeneity, creating a challenge for faculty teaching the course. The vast differences amongst student skills within a cohort is acknowledged before admission and directly at orientation. Students are told that a baseline skill is needed in each of the key skill areas. Some students will need to work hard to develop that baseline;others may already have the minimal skill level as they enter the program (students with significant prior experience are pushed to develop greater sophistication). We highlight the value of a collaborative learning environment across the cohort and create an expectation and build structures (technology to facilitate information sharing, etc.) to support such an environment.

Incorporating a field project at the outset of the program formed the initial scaffolding structure, i.e., a series of hooks on which the content learned in the first semester's four courses could be "hung" when moving through the project's discovery process. This scaffolding structure creates value in a variety of ways, perhaps none more critical than providing each student a self-assessment process for understanding his/her strengths and skill gaps. Awareness of such gaps creates significant personal motivation to fill these gaps throughout the program and thus creates highly motivated learners. Just as important, this scaffolding creates an environment where students take control and responsibility for their own learning (King 2003, Kolb and Kolb 2005) so as to achieve their career and life goals (Boyatzis 1994).

Additional motivation for an initial field project stemmed from conversations with technology and corporate partners. Corporate partners, those organizations that had an interest in potentially hiring graduates, described immediate needs, i.e., skilled human capital to address a backlog of analytics activity. Technology partners, firms offering to provide analytics tools and training, described existing software and pedagogical approaches that could be used to support university programs and students. As faculty and partners had "blue sky" conversations about the nature of applying analytics, a consistent theme was the difficulty in developing and shaping the data scientist mindset, i.e., curiosity, iterative nature of problem solving, immersion into the domain of the problem, ability to communicate (orally and visually), etc. Thus, the technical skills, i.e., statistics, data management, machine learning, must be sufficiently learned so that a student knows which tool to apply and how to apply it (Sigman et al. 2014). However, the shaping of the problem-solving mindset required more iterative approaches to know when one has followed a rich data mining expedition, when a vein has been tapped out without sufficient value, and when even the best application of tools and insights cannot generate value-added results.

To highlight the importance of developing a data scientist mindset, we believed that inductive learning, i.e., a field-based learning experience to provide a safe arena for teams of students to test their thinking and draw conclusions, would establish a salient understanding of the data scientist career. At the same time, while we recognized that on the first day of a new program any one student might have prior experience in one of the three areas of expertise, no one would have depth of experience in all three. Thus, team-based structures were essential to ensure that sufficient prior experiences were reflected on a team such that the team could begin to move the project forward.

If appropriately scoped and managed, such a project could instill tremendous personal learning motivation for students. Alternatively, if the project were poorly scoped/managed and not well supported, it could result in students feeling demoralized (e.g., this career perceived as too difficult and the student lacked the capabilities to be successful). Therefore, we needed to leverage our technology partners to provide hands-on skill development and similarly, to provide transparency to potential project sponsors to find the "right" type of project as well as an organization with mentoring/student development goals as part of its motivation to participate in such a project. Characteristics of appropriate projects include those where clean and meaningful data is available (a more difficult challenge than one might think) and where the analysis of the specific data can lead to actionable information for the sponsor. Project sponsors have been particularly excited to participate in this initial project, in part to create corporate visibility with and a means to assess every student in one cohort. Initially, prospective project sponsors were identified from amongst existing corporate partners given the long-term relationship between the organizations.

Finally, in the initial curriculum design (and still true today), this formative project was designed as a required co-curricular learning opportunity. Although no grades were given, every student was required to participate and the project involved significant time (comparable to a course) throughout the semester. This co-curricular structure necessitated careful framing at the beginning of the program (e.g., throughout the admissions process and orientation) as well as strong faculty mentoring throughout the initial semester.

The co-curricular nature of the project has evolved into much tighter linkages with the courses taught during the same period. Three of the four courses have explicit assignment and grading hooks (scaffolding) related to the project deliverables. For example, the statistics class asks each student to perform descriptive and basic statistics using the project data to simultaneously give students feedback on their statistical knowledge/skills as well as level-set the group on their understanding of the project data.

4. Implementing the Field Project Using Discovery Learning Processes

The field project experience was implemented consistent with Joplin's (1981) five- stage discovery learning approach. The activities and processes incorporated into each stage are described here. These activities are explicitly in place to facilitate the delivery of this initial discovery learning field project; some are leveraged to support other aspects of the program (e.g., subsequent projects, student career development, etc.).

4.1. Focus

In the first stage, *focus*, students are exposed to the phenomenon, and learning goals and outcomes expectations are articulated. Subsequent research has noted the importance of focus to the success of the learning experience (Leonard and Marquardt 2010). For many students, the field project provides their first exposure to analytics. Consistent with Joplin's model, the initial exposure needs to have structure, yet at the same time, offer sufficient challenges and perhaps even be provocative.

In the year before the field project launch, the faculty and program directors identify prospective project partners with the goal of finalizing project partner selection and project definition approximately 3–4 weeks before the launch of a new cohort. In the early stages, candidate project partners are characterized based on:

- the types of business problems/analytics projects;
- the strength/availability of the firm's analytics human capital (i.e., availability of a business person and, separately, a data point person to support the project);
- the value of the project to the partner;
- the likelihood that the partner point person can serve as a mentor;
- the ability of the partner point person to engage top leadership to attend the final presentation;
- the appeal of the industry for the incoming cohort of students; and
- the potential that the partner organization may hire students as interns or for full time positions.

This process is informal and each year a small number of strong potential field projects are identified for the cohort's first project. The MSBA program has two director roles: (1) a faculty director focused on learning and curricular issues; (2) a program director focused on program administration . Both are in frequent conversations with corporate partners (in general) and specifically on projects since there are project offerings each semester. Potential project partners develop a 1–2 page project description that includes key contacts, project focus and overview, specific research questions, and project deliverables.

The faculty and program directors have multiple conversations with the partner organization to define the overall project. The initial conversation involves educating the partner on the overall goals of the project, i.e., creating a student learning experience that exposes and challenges teams of students to apply analytics techniques to a problem of relevance to the organization. This conversation provides examples of prior projects and sample project descriptions so that the partner firm understands what information needs to be documented. As the potential project partner field is winnowed, the faculty director evaluates the learning experience to determine the degree to which it meets the overall discovery learning goals required of the experience and the ease of linking the specific needs of the project to the first semester coursework.

Before project launch with the students, a faculty project support mentor is identified and all faculty teaching in the program are informed about the nature of the project. Prospective faculty mentors are identified based on their familiarity with the industry/partner firm or area of business process expertise. More technical data mining skills are not as critical, as these technical skills are the focus of multiple concurrent courses and are provided by technology partners. The faculty director works with the faculty mentor and the faculty teaching courses to identify specific class sessions where the faculty mentor will be responsible for content (e.g., more detailed introduction to the project and problem if needed, student deliverable practice presentation days as appropriate, and team collaboration/sharing data on preliminary findings).

The faculty director also communicates with all faculty teaching courses concurrently with the project to confirm the manner in which the project will be integrated or touched on in each course. In the current program iteration, the connection between the project and any one course may be deeply embedded where content (e.g., project management), class sessions (e.g., preliminary results sharing), and grading (approximately twenty percent of the final grade) are linked to the field project. Faculty are aware of the project deliverable deadlines and create assignment deadlines such that students have a chance to learn, practice, and receive feedback on necessary skills before the project deadline.

Finally, the faculty director creates homogeneous (as feasible) teams made up of four (or five) students. Given the diversity of student backgrounds, teams typically consist of one or two students with prior applied analytics experience, at least one student with related business domain knowledge, and at least one student with strong data management skills. All attempts are made to balance the critical data scientist skills across teams and then demographic factors (age, gender, international/domestic) are considered to achieve diversity across teams. Prior research has highlighted the importance of establishing diverse teams when implementing field learning projects (Dilworth and Willis 2003) and the teams are encouraged to leverage the diverse skillsets within and across teams.

Matriculating students know they are required to participate in this co-curricular experience. The motivation behind the timing of the field project and the specific project are introduced at orientation. In addition, students are provided with key training and presentation dates (see an example in Exhibit 2) so that they can plan for the semester and begin to engage

Exhibit 2. Example Field Project Meetings and Deliverables

Date	Topic	Location	Description
Before or shortly after classes begin, couple of hours	Project Kickoff Meeting	University	Students meet project and technology partners. Executives represented by all parties. Project partner will provide overview of industry, firm, detailed problem introduction, and detailed discussion of the data. Technology partner will provide description of statistical tools, training, and the manner in which the technology partner can provide direct team support.
First week of semester, all day	IBM SPSS Training:	University	Technology partner training
Two weeks post kickoff, 2 hours	Initial Presentation—Methodology	University	Student teams present understanding of business problem • Ask significant business questions that need to be clarified to achieve their objectives • Additional clarification on data interpretation and possibility to include (modify) additional data
4–6 weeks post kickoff, 2 hours	Analysis Plan Presentation	University	Teams present a detailed plan for the type of analysis they will perform to answer the questions and achieve business objectives
10 weeks post kickoff, 2 hours	Preliminary Results Presentation	University	Teams present preliminary results and insights from their analysis based on their analysis plan. Balance between technical and strategic presentation given the audience of project and data owner.
14–15 weeks post kick-off, 2 + hours	Final Presentation	Project Partner Corporate HQ	Teams present their analysis and insights to project and technology partner executives. Nature of presentation changes given top management team audience.

in the project management process. The students are introduced to the cross industry standard process for data mining (CRISP-DM) project management model for data mining in one of their initial courses; the key project deliverables are linked to this model to acclimate the students to best-practice project management (Shearer 2000).

4.2. Action

The second stage, challenging action, or as Kolb (1984) describes it, concrete experience, involves students participating directly in the field project. The action stage places the student into a stressful and often unfamiliar environment where new skills and knowledge are applied to solve a problem (Joplin 1981). The action phase often occurs over a longer timeframe. In addition to the "on task" work effort, it often involves emotional and psychological outcomes, e.g., struggling, frustration, embracing of one's success. Given the breadth of emotions such action might promote, it is important that students perceive the experience as meaningful and relevant and that the experience foster interest by being sufficiently connected to prior knowledge/skills and yet requiring experimentation above and beyond their current comfort level (Revans 1980, Marquardt and Waddill 2004). For the action stage to have the greatest impact, it is critical that students be given responsibility for much of this portion of the learning process (Joplin 1981).

Project deliverable due dates provide marked inflection activity points, i.e., the general content and skills students need to develop before the due date. Prior research demonstrates that learning occurs most robustly when there are synergistic interactions between the recall of prior knowledge (content learned in courses) and the experiential environment (Kolb 1984, Piaget 1971). This integrative learning has been described as "awakening," where student self-awareness of how his/her knowledge/skills can be used in much more sophisticated and impactful ways (Kolb 1984). Student teams work on project deliverables outside of class responsibilities (as described earlier, there are times where the project deliverable and course deliverable are the same) and are encouraged to bring questions to faculty during class meeting times. By discussing the project within the classroom environment, the statistics faculty member can address appropriate statistical techniques, the database professor can provide commentary on data cleansing, and the communications professor can highlight important talking points given the nature of the project. All faculty teaching in the program have deep project knowledge and thus can customize facets of lectures and assignments to integrate learning hooks into their class sessions.

One of the recent changes to team field project responsibility has also enhanced the field project learning experience. In the first two iterations, all teams focused on solving the same problem. As such, there was a certain level of collaboration, but also competition (e.g., some teams were focused on having the model with the greatest explanatory power). In the third iteration, teams addressed different facets of the primary project goal and thus each team developed a unique analysis to the project partner. The partner was thrilled with the diversity; they learned something from each analysis/presentation and had a number of possible projects to launch based on these different findings. We found these unique project components, housed under a broader project umbrella, generated much greater collaboration and leveraging of findings than we had seen in prior project experiences, we built this requirement into subsequent projects. In identifying possible project partners, we re-framed the priority to be a situation where the company had an overall goal and then unique insights that required greater drill down (e.g., examining specific and meaningful customer segments, quality and delivery issues across plants and distribution centers, regional/global location differences, etc.). Using such a process, each team strives to address a unique question, yet shares information with all other teams on data cleansing, effective techniques, etc. At the same time, every team learns about the issues unique to each team through shared discussion amongst the teams and with the project partner. Exhibit 3 provides a brief description of the action phase of learning and how it has evolved across program iterations as the number of matriculating students has grown over time.

4.3. Support

Support, the third stage of discovery learning, ensures that the student is provided a safe environment in which to take risks and obtain assistance throughout the duration of the learning experience (Joplin 1981). Support enables the student to continue working on the experience (e.g., encouraging the student to try a new and different approach) or providing moral support (e.g., reminding the student that he/she is not alone in solving the problem, identifying resources that might help the student, and providing an outlet for the student to share frustration).

The most direct support comes from the faculty mentor and, separately, the program and faculty directors. The faculty mentor facilitates guided discovery by providing structured information to the entire cohort while also mentoring each team. Mentoring may involve helping the team solve a specific challenge, determining what can be done if the team has exhausted its efforts, facilitating resolution of team issues, etc. Similarly, the program and faculty directors are part of the connective tissue between teams, courses, and the project partner, and often receive "early warning" about a team/

Exhibit 3. Evolution of Experiential Field Project Over Time

	Year 1	Year 2	Year 3	Year 4
Number of students	9	22	23	29
Number of teams	1	6	7	7
Team size	9	3–4	3–4	4–5
Partner	General motor	Steelcase	Diageo	Carhartt
Corporate Partner Project Goal	We think there is something here in the data, but not sure what. Our corporate leads will be an extension of your team to provide guidance and direction	We are looking at the same data internally, but are interested in how the teams think. Therefore, we care about the outcomes and recommendations, but we really care about what processes you use, what data you create/append, and what techniques you apply.	We have multiple firms in our portfolio who all have the same business goals and are in the industry. Project outcome: provide strategically corporate and operational firms direction. Specifically, want to understand customer lifetime value and how to increase this value.	This is our online business which relatively small but growing rapidly. We need to better understand how to manage this business as the "customer" is very different from our typical customer.
Data	Same data	Every team given same data but each team created new data either by manipulating existing data and/or appending customer/distributor/competitor data	Every team given same data but each team created new data either by manipulating existing data and/or appending data from external sources (scraping Facebook or other social media sites, appending Google Analytics data, etc.)	All teams given same "core" data and then each team given its own focus when examining the data (e.g., specific customer segment to examine, impact of specific events on all customers, etc.)
Student/Team approach	Students divided themselves into activities where the student felt he/she had greatest comfort level and then shared thinking/skills with others			
Learning observations	Some students willing to go beyond comfort level.	Teams challenged by using technique required by data and supported by technology provider. Students on 4 of 6 teams pushed themselves to become adept and applying technique and tweaked model to develop greatest explanatory power.	Significant difference in analytical approaches to data based on team comfort level with an approach. Teams felt that the didn't have enough time to learn about (and how to do) other team's approaches.	To address team –to-team sharing gap from prior year, built in team sharing sessions and a project lab to facilitate co-location.

student who is struggling, a disconnect between coursework and the project, project partner perceptions, etc. In addition, the program administrators provide logistics support (teleconferencing meetings, transportation, food, project kick-off gifts with the company logo, etc.) to create excitement about the project and the learning experience.

An important component of support during the field project is formal training beyond what is taught in class and where the training incorporates specific knowledge of the project. Our technology partners teach general platform skills and customize this training based on their knowledge about the company and data. This training is conducted early in the field project timeline;

then the technology partner provides additional "consulting" sessions to each team if such assistance is needed in developing their analytical models.

4.4. Feedback

The fourth stage, feedback, ensures that students are provided progress assessments so that they can continue to move the experience forward (Joplin 1981). Joplin (1981) describes feedback as critiques of existing student work outputs, the nature of student interactions with others, etc. In the MSBA context, students are provided feedback on project-related assignments through grades and class discussion. In addition, the project partner provides feedback to each team after each presentation. This feedback often guides the team in how to best move the specific analysis they have undertaken forward to more fully develop insights. In addition, the project partner helps the team to shape the key insights and recommendations that the company executives would be interested in understanding. More critically, the faculty mentor and involved project faculty also provide feedback to each team. Some of the presentations are a graded assignment in the Business Communications course and this faculty member establishes the due date before the project partner presentation to evaluate, grade, and provide constructive feedback to the team. In addition, the faculty mentor provides a critique specific to the project before the presentation. The faculty mentor also provides post-presentation feedback based on the questions/issues that arose during the presentation to provide additional feedback to the team as they prepare for the subsequent deliverable. Finally, one or more top level executives attend the final presentation (the most recent presentation included the CEO). The executives provide feedback directly to the students as well as privately to the faculty/project director. Such feedback is critical in providing developmental guidance to students.

4.5. Debrief

In the final stage, *debrief*, students recognize, articulate, and/or evaluate their learning. It is important that a debriefing involve public dissemination or sharing of information (e.g., final presentations, group discussions, summary papers, etc.) so that students can make sense of the learning experience (Joplin 1981). The debriefing stage is structured to occur immediately after the project and again at the culmination of the program. In the most recent project experience, the program provided a bus to transport the students from campus to the project partner's corporate headquarters. On the return trip, students articulated how they personally and their team both struggled and learned throughout the project. The trip culminated with a celebration (food and drink) where all students were given an opportunity to decompress and enjoy their project achievement. At the end of the semester and program, students were asked to assess the learning process and outcome including how the field project shaped their learning and career goals, etc. These assessments were designed to provide program feedback on the field project experience and how it could be improved, as well as to be introspective for the student.

5. Discovery Learning Field Project Administrative Issues

As noted earlier, the MSBA program relies on significant human capital for learning and administrative support for the field project. In addition, there are other administrative/support structures that are critical in creating impactful learning outcomes. First, the project partner provides significant resources including human capital, data, and mentoring support for an entire cohort of students. As such, we do not ask for any direct financial support related to the initial discovery project. As also noted earlier, field learning projects occur throughout the duration of the program and many project partners provide financial support in subsequent semesters. In the summer and spring semesters, project partners are informed that partners often provide $10 K at the completion of the project where all funds generated are given to students in the form of scholarships. Firms are not required to provide any financial support, but most do.

Three of the four spring semester projects have been proximate to the university location, allowing students to visit the company, observe workflow, meet top leadership, etc. This has deepened the learning experience as students receive a more holistic view of the organization. We did participate in one remote field project experience and would do so again. Geographically distant projects are inevitable for analytics professionals; receiving guided support structures for such an experience created a different and distinct type of learning experience. Similarly, developing presentations for remote audiences, incorporating cues or checkpoints during the presentation, and implementing processes to gather feedback (in lieu of facial expressions, etc.) is also a meaningful skill for students to develop. While the faculty director and mentor guided many of these remote processes, the students created the analytical models and remote presentation interactions, which resulted in a more complex project deliverable. Although student feedback indicated that the additional complexity contributed to learning, such complexity could also reduce the overall value of the learning experience if not carefully managed.

6. Field Project Challenges

The experiential learning project places significant pressure on student readiness, perhaps more so than readiness poses for a program without such an experience. When beginning a new program, students often experience significant excitement and stress, for example, how will this program change their career trajectory and are they ready and able to succeed? The field project can provide students with early insights into such questions. A negative answer to the latter question could induce more self-doubt, frustration, and greater stress that the student can handle. Thus, student readiness is defined across multiple dimensions and handled aggressively, from initial interactions with prospective students and more aggressive actions once the prospective student has matriculated.

All communication methods (website, brochures, etc.) highlight the initial field project and its importance in student development and thus there are no surprises. The admissions process is rigorous in evaluating student skills and requires students to complete an online statistics and Python programming course to level-set skills before beginning the program. These requirements help shape student expectations about requisite skills and the extracurricular effort that will be expected throughout the program. The previously described orientation provides an opportunity for the program faculty director to share the philosophy behind the experiential project with the students. More specifically, we explain why we put students in such a high stress/expectation position, what students get out of such an experience, how and why we create collaborative team expectations within and across teams, the stress and insecurity that might occur during the project, and finally, how we hold each student accountable (through grades in multiple classes) for the effort they put forth on the project. Our goal is to create student buy-in about the experience, describe the lines of communication and support that are available (whether for technical analysis help or stress), and outline the project process (e.g., deadlines, course touchpoints, etc.) to provide concrete connections for students.

Another challenge that programs must address is faculty engagement. For analytics projects, the faculty mentor and the collaborating faculty who are teaching concurrently during the project semester must be engaged. To be effective, the faculty mentor must play the role of collaborator or facilitator instead of the central authoritative figure (Welsh et al. 2007). Typically, the facilitator establishes the experience and boundaries, supports students' physical and emotional well being, guides reflective activities, and provides process support and information as needed (Roberts 2012, Steinaker and Bell 1979, Fink 2003). To make the faculty mentor role more manageable, some of these responsibilities (e.g., establish experience, provide infrastructure support, create course linkages, etc.) are split between the faculty director and the faculty mentor. Faculty mentors are incentivized through compensation or by incorporating the mentoring into one's teaching load. In addition, analytics is a strategic lever of the college; many faculty members have been interested in engaging as a mentor to develop a more strategic and sophisticated understanding of the area.

Access to collaborative spaces also poses a challenge, at least in our environment. As with any program, student teams find spaces to conduct their work in a variety of campus and off-campus locations. In addition, there is significant team-to-team learning that can and should occur, implicit learning about the data, the problem, techniques attempted, etc., as well as explicit learning ensuring that the implications for what one team has discovered are shared with other teams as appropriate. Given the present size of the cohort (over 30 students), a classroom is needed and such spaces are difficult to access. Going forward, we have commandeered space to create a field project team lab where teams can gather to work on and share pertinent information. In addition, this lab space can support "pop up" lectures/tutorials (e.g., applying R, programming Python, measuring customer lifetime value, etc.).

A final challenge is establishing appropriate expectations with the project partner. The most significant concern relates to maintaining security over the project partner's data/findings and project partner value creation. To address security, all teams and faculty mentors sign a non-disclosure agreement covering the data and findings. Projects can be discussed in a general manner (e.g., Company X is interested in looking at customer lifetime value, etc.) but not in detail (e.g., customer demographics were examined and customers who purchase x have a high likelihood of purchasing y) without explicit permission from the company. In addition, all data must be securely stored and we ask that the data be de-identified (e.g., customer identifying data removed) to further protect the data security and confidentiality. As to value, most partners are excited about participating in a project that will produce new information from which to make better decisions. These organizations also expect to learn more about human capital, specifically, the types of skill sets that bring greater value to the organization, how such personnel might fit with the organization, etc. At the same time, the organization commits time and its own human resources to ensure project success. Although discussed earlier, it is important to reinforce the primary goal of student and partner learning: This is not a consulting project (Hyde 2007). In establishing partner expectations, the goal was to focus on projects as a win first for the student through an active learning experience. Project partner value creation is a secondary goal. We discovered that project partners are highly motivated by being part of the learning process for the students.

7. Discovery (Field Project) Learning Outcomes

We believe that the experiential learning project established at the outset of the program provides substantial benefits related to student learning and beyond. As the field project has evolved over time, we have increased integration of the project into the courses simultaneously offered to create more impactful learning experiences (and feedback) for all students (see Exhibit 4). In addition, Exhibit 4 describes the formal assessment of the experience from the perspective of all stakeholders (partners, students, and faculty). Relatedly, students were asked about their perceived abilities (ability to address overall analytics problem, ability to manipulate data, ability to develop analytical models, and ability to present and persuade others as to their findings) before and at the end of the project. On average, student perceptions of their abilities increased (higher confidence)

Exhibit 4. Field Project Facilitation and Assessment

	Year 1	Year 2	Year 3	Year 4
Co-curricular Project relationship to courses	Removed time from each course (e.g., days at the end of the semester) to "give students time to work on project"	Incorporated some components of the project (strategic evaluation of industry and business process) into course	In addition to Year 2, had practice presentations embedded in Business Communications course and focused discussion of industry, process, data in the Intro to Analytics course	In addition to Year 3, all 4 courses directly incorporated graded deliverables into their overall grade assessment. For example, the intro stats course included an assignment whereby each team provided a specific statistical analysis of the overall data as well as the data the team would focus on to deliver its findings. Similarly, the large data class included an exercise involving scraping of social media sites whereby the data could be incorporated into the overall analysis. The Business Communications and Intro to Analytics courses increased time and explicit guidance (e.g., developing student skill and providing feedback re visual communication of results, etc.)
Faculty Mentor	All formal support occurred outside of class	Some formal support occurred during some class time and non-classroom sessions were scheduled to support the project	Same	Faculty mentor was allocated time during scheduled class sessions to present information about the project or have students share information. No formal faculty mentor sessions were scheduled beyond the class time that was allocated.
Assessment Process (students)	Informal	Informal	Formal—Used survey to obtain student feedback about project experience	Formal—implemented a more comprehensive survey to obtain feedback on learning, etc.
Assessment process (partner)	Informal	Formal-post-mortem meeting held to hear assessment of project value, process, etc.	Formal—received post mortem feedback (in person, via email, etc.) from all organizational stakeholders involved in project as well as technology partner stakeholders. Provided feedback on value, how results/process being used within organization, what they sponsoring organization learned and would do differently do make the experience better, etc.	Formal—solicited formal feedback via survey as well as through face-to-face conversations

1 point on a 1–5 scale. Some of the responses to the open-ended questions about students' self-assessments of their abilities are included in Exhibit 5; there is a great deal of consistency in comments about "integration of skills," developing a data scientist's mindset, etc.

To more fully understand the broader impact of success, we examine the ramifications of the project beyond student learning and on students (specifically and broadly), the partner company, and faculty. First, the experiential project creates reverberations throughout the program that affect students directly and more generally. Eighty percent of our spring project partners have hired students as interns and full time employees. This deep connection to the students is one of the "selling points" we make with potential project partners. Project partners have in-depth exposure to all of our students, allowing partners to identify those that fit its organization. In addition, the early exposure to the project partner's business issues, industry, data, etc., gives students who are hired as interns or full-time employees a significant jumpstart and reduces the overall orientation time needed.

The project partner firms have been highly satisfied with their project experience. Eighty percent of those that have served as project partners for the students' initiation into the program look for subsequent student project opportunities. Such projects occur during the summer or fall semesters where the students have had additional coursework and can bring more learning to bear on a problem. These subsequent projects provide a continued relationship with the university and specifically the business analytics program. Finally, we receive partnering requests from other units in the university and have developed three such partnerships to date. The university receives explicit value from the work output of the project team. In addition, we selected these units because they offered student experiences that were in demand and yet more difficult to provide with a corporate partner (e.g., sports analytics). This targeted type of partnership has resulted in tremendous success for a subset of students so that they could interview for and obtain offers from organizations in these boutique industries. Thus, the specific nature of the project experience opened doors to career opportunities to which students would otherwise not have had access.

Finally, project experiences have created a number of significant opportunities for our faculty mentors in the form of research and consulting opportunities. Multiple company projects have resulted in outcomes wherein a faculty member perceived value in documenting the manner in which analytic techniques were used by submitting a paper to a journal to enhance the academic community's understanding of a phenomenon. In such situations, it was critical to obtain project partner support on the sharing of information

Exhibit 5. Student Feedback On Field Project

In what ways did the Carhartt project prepare you or hinder your development in becoming an analytics professional?

The Carhartt Project guided my development in becoming an analytics professional by presenting the real world challenges often associated with corporate projects. Furthermore, in the professional world, problems do not always have one "right answer," but rather processes and methods of knowledge discovery that are better or worse. The Carhartt project afforded us the opportunity to explore various means of discovering new and meaningful knowledge.

Carhartt project prepared me in two main areas, first being technical skills. Learning SPSS, and involving tableau was extremely beneficial. We also made it a point to do some of the same work in R and SAS to get more experience. Second, just as important, I learned the business mechanics behind an analytics project. Because this was foreign to me at the beginning, I didn't know how much of a process it was/what steps are taken when consulting for a firm. I learned the process of negotiating expectations, interpreting data, aligning analysis goals, and addressing data quality issues. Very beneficial for any future data analytics project!

I really liked the project. It really helped all the random stuff in class make more sense.

It was great to start working on real world data, gain insights, and come up suggestions to better their business. And getting to work on the entire thing right in the first semester was very positive.

It helped me: /—Work within a team /—Understand the analytical issues facing companies /—The issues that arise from data analysis (recoding data, missing data, etc.) /—Learn to communicate insights to a C-level audience /—Be concise with recommendations

What surprised you most about the Carhartt project experience?

The degree of freedom we were given to explore a noteworthy story to share with Carhartt was the most surprising to me. We were not told what to think or how a problem should be solved. We were given general pointers on what was expected and we delivered solutions based on our own skillsets.

What were the positive and negative feelings/experiences you had in engaging in a live project in your first semester?

It was exciting and really helpful to have it before the coursework.

It allowed me to develop analytical skills quicker than just learning via classroom lecture. I don't think this project correlated with the MGT 888 class very well. And once again, I was surprised at how short the final presentation was, given how long we worked on the project.

Initially, I was a little taken aback that we would be working on live data for a company without any prior coursework. But as time progressed, I thought it was a great idea. We immediately applied our knowledge in statistics to develop insights. The project as a whole was a great idea. I particularly did not have any negative experiences with this project. Working together as a team to understand the data and perform statistical analysis to understand what is happening. It was a perfect vehicle to the world of analytics.

(e.g., the data can be used for such a purpose, the corporate partner would like its identity masked, etc.). Some corporate partners want to extend the relationship by having the faculty mentor serve in a paid consulting role. Although such faculty extensions of projects are by no means the norm, they provide significant value. Such relationships offer faculty depth of data and knowledge to enhance their research and teaching as well as potential financial gain. Awareness of such faculty involvement has facilitated interest in serving in project mentor roles and has resulted in greater faculty subject matter diversity than can then be leveraged to support specific projects, thus creating a symbiotic situation.

8. Conclusion

We are excited about our MSBA program and the contribution it makes to the lives of our students and stakeholders. The immersion field project experience provides scaffolding to more firmly ingrain fundamental concepts and skills as well as the difficult to develop data scientist mindset in our students. We continue to find ways to improve on this experience for the students and project partners and believe it is a field project approach that can be replicated by others. The detailed description of the field project discovery learning process as well as the noted challenges provides a high-level roadmap for those institutions that are interested in pursuing such an endeavor.

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