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### Designing a datawarehousing and business analytics course using experiential learning pedagogy

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## DESIGNING A DATAWAREHOUSING AND BUSINESS ANALYTICS COURSE USING EXPERIENTIAL LEARNING PEDAGOGY

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### Abstract:

Experiential learning refers to learning from experience or learning by doing. Universities have explored various forms for implementing experiential learning such as apprenticeships, internships, cooperative education, practicums, service learning, job shadowing, fellowships and community activities. However, very little has been done in systematically trying to integrate experiential learning to the main stream academic curriculum. Over the last two years, at the authors' university, a new program titled UNI-X was launched to achieve this. Combining academic curriculum with experiential learning pedagogy, provides a challenging environment for students to use their disciplinary knowledge and skills to tackle real world problems and issues through inter-disciplinary approaches and activities. A course designated as UNI-X involves external partners from corporate, non-profit or government-sector organisations. The course requires the student to learn knowledge and skills during the classroom sessions and then to apply them in solving a real-world project proposed by the partners. The instructor along with the industry partner plays an active role in the project design, mentoring and assessment. In this paper contribution, the authors share their experience in designing a Data Warehousing and Business Analytics (DWBA) course to include experiential learning activities. The paper describes in detail the content, pedagogy, in-course project, challenges and lessons learned when introducing experiential learning into an existing course. Thus providing one pathway for Information Systems (IS) professors to adapt their analytics course to include experiential learning activities.

**Keywords:** Experiential Learning, Course Design, Pedagogy, Data Warehousing, Business Analytics

### I. INTRODUCTION

The pedagogy of "learning by doing" emphasizes the acquisition of knowledge and skills through subjective experiences such as work, real-world project, play, and other life experiences, rather than purely from text books and lectures. Learning theories which focus on "learning by doing" and "learning through experience" are building blocks of experiential learning frameworks. Early work in experiential learning focused on promoting problem solving and critical thinking rather than memorization and rote learning [Dewey, 1938]. Subsequently, Kolb's proposed the Experiential Learning Theory (ELT) which is widely recognized and accepted as an important framework for learning-focused curriculum development and instructional design [Kolb, 1984]. The ELT comprises of two levels: a four stage cycle of learning and four separate learning styles. According to Kolb's theory, the impetus for the development of new concepts is provided by new experiences gained by the student that can be applied in a range of situations. Thus a key element of experiential learning, is the student, and learning takes place as a result of the student being personally involved in an experiential learning cycle. The role of the educator is to design the "experiences" and the assessments. Experiential learning can take many forms such as apprenticeships, internships, cooperative education, practicums, service learning, job shadowing, fellowships and community activities [Moore, 2010].

Experiential learning provides a number of practical benefits to the student, namely providing opportunities for applying knowledge and skills in real-life situations, improving problem-solving and communication skills, building competence and confidence, and providing opportunities for professional networking. More specifically, for an IS program, Ramos-Torres argues that the

experiential learning pedagogy can make the program more responsive to both student and industry needs, and also improve stakeholders' perception about the program [Ramos-Torres, 2014]. Considering these benefits of experiential learning, Singapore Management University (SMU) launched a new initiative, UNI-X pedagogy, in 2015 following three-and-a-half years of study and conceptualisation. A UNI-X course integrates theory that is learnt in the classroom with experiential learning through heavy use of real world projects. In order to support the experiential learning pedagogy [Pan et al., 2016], SMU also created unconventional, flexible spaces, which are accessible 24 hours, for student teams to work on projects.

A UNI-X course combines academic rigour with experiential learning through the heavy use of projects to challenge and inspire the students to apply their disciplinary knowledge and skills in tackling actual multi-disciplinary problems faced by partner companies. UNI-X courses therefore, not only accelerate students' learning beyond hypothetical classroom exercises, but also give them the opportunity to bring value to businesses. In the process, the University's ties with the business community are also strengthened [Ho & Ko, 2013]. Essentially, a UNI-X course establishes a learning loop for the tripartite: students obtain a deeper understanding of what it means to apply theory learnt outside the classroom, faculty learn how real world adapts theory and external partners solve their business problems and also deepen their own learning on emerging topics.

In this paper we share our experience in the design and delivery of a UNI-X course, Data Warehousing and Business Analytics, at the School of Information Systems. This course is offered to IS year 3 and year 4 undergraduates. We describe our recent efforts in converting an existing data warehousing course into a UNI-X course by integrating experiential learning pedagogy into the existing course. We present the re-designed course, challenges and share the lessons learnt. Thus providing one pathway for Information Systems professors to, adapt their current courses to incorporate experiential learning activities. The remainder of this paper is organized as follows. Section II presents a literature review of related work. In Section III, the data warehousing course background and its structure is described in detail. Section IV describes the pre-course preparations for experiential learning and the design changes that were implemented to tackle the project related challenges. Section V describes the details of experiential learning project, the learning outcomes of the project and project results. Section VI provides our observations, industry feedback, student feedback, lessons learnt and recommendations. The final section presents conclusions that can be drawn from our work.

## **II. RELATED WORK**

### **Types of Experiential Learning**

Experiential learning can be classified into two categories, namely classroom-based learning and field-based learning. A classroom provides setting for experiential learning through embedded activities such as labs, case studies, guided inquiry, simulations, experiments, or projects [Wurdinger & Carlson, 2010]. Although we can simulate experiential learning in classroom through projects and labs, authentic experiential learning creates an invaluable opportunity to prepare students for a profession or career [Moore 2010]. Field-based learning provides a more authentic form of experiential learning where students are given opportunities to learn in real situations in university or in the industry such as internships, community service, field work, clinical experiences, research and service-learning projects [Van Over & Dangerfield, 1993], [Tan & Phillips, 2005], [Ambrose et al., 2010]. Heim et al., discuss the use of experiential learning in a MIS course by simulating IT consulting and report that students gained valuable learning through the challenges posed by the complex and relevant business issues [Heim et al., 2005]. Hoxmeier put forward the importance of service learning as a means of implementing experiential learning within a computer information systems program [Hoxmeier, 2002].

Through these different forms, the learning becomes significantly more powerful and the close interaction with the external world ensures a smoother transition into the workforce. Inspired by the advantages of authentic experiential learning, through UNI-X pedagogy initiative, we took an

approach of incorporating experiential learning through the industry sponsored projects in information systems undergraduate curriculum. In particular, we transformed data warehousing and business analytics course into an experiential learning course.

### **Best practices in experiential learning**

One of the key outcomes of experiential learning is that throughout the experiential learning process, the learner is actively engaged in posing questions, investigating, experimenting, being curious, solving problems, assuming responsibility, being creative, and constructing meaning, and is challenged to take initiative, make decisions and be accountable for results [Kolb, 1984]. To achieve this, Bass suggested that the educational environment needs to intentionally create rich connections between the formal and experiential curriculums [Bass, 2012]. The UNI-X program achieves this by getting students to work on projects for real clients. Cantor sees experiential learning as helping the university fulfil the need for “higher education to more closely interface with business to promote community economic development” [Cantor, 1995, p. 79]. Unlike a capstone course, where the students work on a project the entire course, a UNI-X course is structured as a regular course, where the students learn the theory, concepts, principles and tools, and then simultaneously apply these to solve problems posed by real clients. In the information systems domain, this typically translates into designing and building proof of concept (POC) solutions for business problems proposed by industry sponsors. These POC solutions are then assessed for further development and deployment by the sponsor.

### **Role of instructors (as facilitators)**

In experiential learning the instructor takes on the role of a facilitator, a cheerleader, a resource, and a support [Warren, 1995]. Warren emphasises that instructors must relinquish their authoritarian influence and become, instead, “an integral member of the evolving student group”. As a facilitator, the role of an instructor comprises the following (adapted from [Warren, 1995]):

- Explain the potential and challenges of undertaking an experiential course
- Discuss the learning outcomes, and what the students might expect from the experiential learning course
- Facilitate the interaction between the student groups and the external partners by setting the basic operating procedures and the ground rules, and intervene when issues arise
- Provide the necessary skills and knowledge required for undertaking the project, this can include supporting the students in their journey of “learning to learn”
- Assess the student learning outcomes

To incorporate experiential activities, the instructor along with the course designer plays major roles by considering several aspects of learning in experiential learning setup [Cantor, 1995, p. 84]. Firstly, the course designers should recognize and encourage spontaneous opportunities for learning, engagement with challenging situations, experimentation and discovery of solutions. Secondly, the instructor should help the learner notice the connections between one context and another, between theory and the experience and encourage this examination repeatedly. Wurdinger suggested the use of a major project or field experience to guide learning over the entire course [Wurdinger & Carlson, 2010]. Having one major task to work on through the entire semester motivates students to keep moving forward, gives them a clear goal to focus on, and becomes the driving force behind everything the student does in the class [Wurdinger & Carlson, 2010]. In the Data Warehousing and Business Analytics (DWBA) course, we implemented a single project approach. The theory and the hands-on lab work conducted during the classroom sessions are aligned with the needs of the project. As a result the students are equipped with the necessary skills and knowledge that can be immediately applied in the project.

Moon discussed the challenges of implementing successful external activities, such as external projects, within an experiential learning course [Moon, 2004]. She highlights the need for carefully crafted learning outcomes, well planned briefing sessions, opportunities for reflections and well-

designed assessment criteria. When deciding on projects, it is essential that the scope is defined to make it attractive to the partners and at the same time fit within the duration of the course, this ensures that the partners are motivated to invest in the project and the students can deliver the project on time [Cantor, 1995]. Accordingly, the DWBA course project scope is designed for fifteen weeks of duration where the employers can benefit from short term collaborations and in particular proof of concepts developed by the Information Systems students. Owing to the current demand of analytics projects in the industry and being an advanced course, DWBA course perfectly falls into the bucket of UNI-X courses. In subsequent sections we share our experience on how an experiential learning framework is incorporated into DWBA course.

### III. APPLYING EXPERIENTIAL LEARNING TO DWBA COURSE

#### Course Background

Analytics has emerged as a powerful tool to track, analyse, report, and predict business data. The backbone of any analytics application is data. Before one can analyse the data, a number of tasks such as data acquisition, cleaning, loading, formatting have to be performed. A data warehouse enables to achieve these goals through various techniques and tools. Data Warehousing and Business Analytics (DWBA) course focusses on two major concepts; data warehousing and data analytics. Figure 1 shows the structure of DWBA course. The fifteen week course provides an introduction to fundamental techniques and novel applications of data warehouse. Topics covered in this course include, but are not limited to, data warehouse planning, business analytics modelling, design, and implementation, data mining, and reporting.

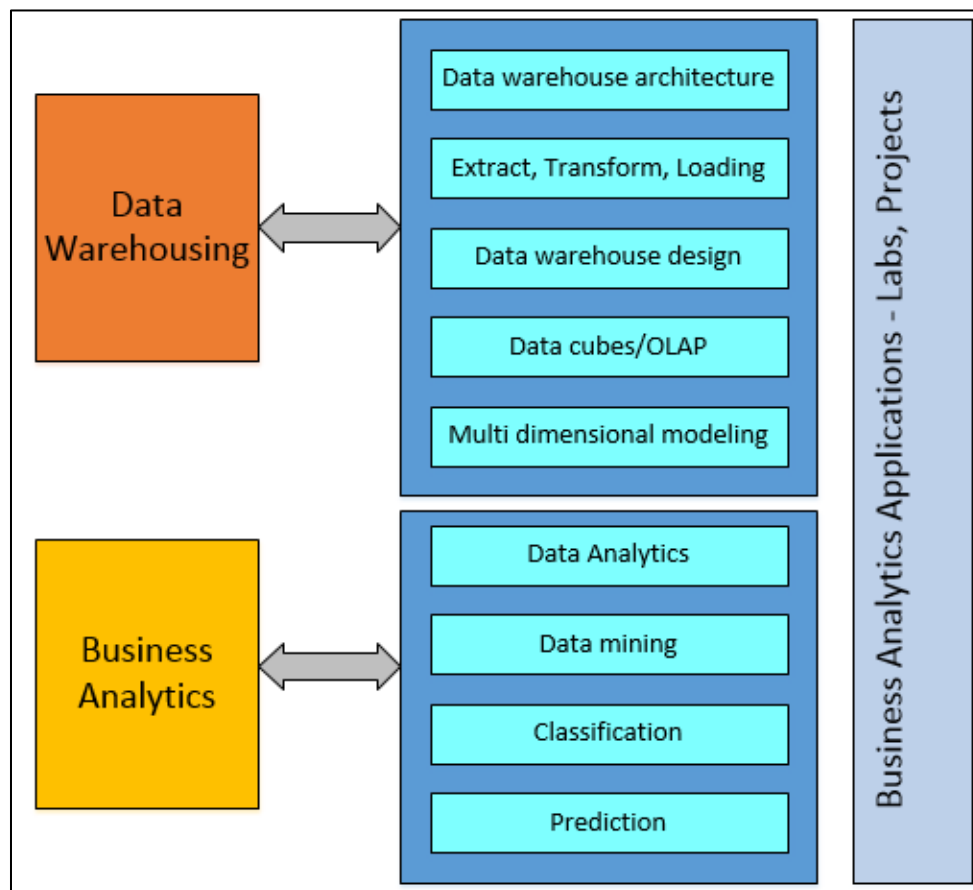


Figure 1: Overall course structure for DWBA

In particular, the role of data warehouse in supporting business intelligence and effective decision making is emphasized through labs, projects and case studies. The course is designed to expose students to concepts, enabling methods and hands-on usage and problem solving in an integrated way. As one of the IS depth electives, this course provides a good balance between theory and practice. The students explore applications and have great opportunity for hands-on experimentation with data warehousing using advanced software packages from leading industrial vendors. Industry tools such as Microsoft SQLSever and Tableau are the tools used by the students in this course. From the above description of the course, it is evident that DWBA is a technical course where the real applications are driven by problem solving and critical thinking skills. Theoretical knowledge with some lab exercises is insufficient to achieve the learning outcomes in an effective manner. Therefore effective learning is possible with more hands on and challenging content of the course and it is designed as UNI-X course to enable the experiential learning through real world examples.

Table 1 shows the course structure along with the experiential learning activities. We provided weekly plan, the topics and the activities such as exercises, discussions and labs related to the topics.

Table 1: DWBA course weekly planning.

Week	Topic	Activities
1	DW and BA introduction. DW basics	Class exercises. Software set up
2	DW systems, Dimensional Modeling – Basic	In-class exercises
3	Dimensional Modeling – Advanced	In-class exercises, Lab 0 - DW basics
4	Extract, Transform, Load (ETL) Part 1	In-class exercises, Lab 1 (Dimensions model, ETL)
5	Extract, Transform, Load (ETL) Part 2	In-class exercises
6	OLAP and Data Cube	In-class exercises, Lab 2 (OLAP), Submit Project Proposal
7	Midterm Group Presentation	Midterm project presentations
8	Recess Week	
9	Business Intelligence concepts, Data Analytics basics	In-class exercises, Lab 3 (Reporting using SQL Server and Tableau)
10	Data Mining concepts - part 1	In-class exercises
11	Data Mining concepts - part 2	In-class exercises, Lab 4 (Data Mining)
12	DW Architecture	In-class exercises
13	Final Group Presentations	Final presentations and report
14	Break	Break
15	Final workspace and poster	Project posters

Table 2 shows the assessment components designed for this course. Project takes the major portion of overall assessment.

Table 2: Assessment criteria for DWBA course.

Assessment	Tasks	Scoring
Class Participation (Individual)	In class activities, discussions	10%
Quiz (Individual)	3 quizzes for 45 minutes each	35%
Lab assessments (Individual)	5 lab assessments	10%
Project (Team)	1. Project Proposal	45%

	2. Midterm Presentations 3. Final report and presentations 4. Poster	
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**Experiential Learning Setup**

In this sub-section, we describe the activities involved in setting up experiential learning activities within Data Warehousing and Business Analytics (DWBA) course.

Learning Outcomes

To convert DWBA course into an experiential learning course, we revisited the learning outcomes of DWBA course and added two additional learning outcomes to be achieved by all the students in the course:

1. Gain hands-on experience by applying key components of an integrated data warehousing and business analytics system, using a leading industry commercial application package.
2. Design, develop and demonstrate an enterprise business intelligence and analytics applications for solving a real world problem.

Setup details

The following describe the two main steps along with the challenges that were involved in the process of embedding experiential learning activities into the DWBA course:

**1. Identifying suitable project and defining scope**

To achieve this, the UNI-X steering committee provided the necessary support to establish close relationships with number of industry partners in Singapore and draft high level project ideas. The instructors of DWBA course then examined the proposed list of project ideas and choose a project relevant to the learning outcomes of the course. Once the appropriate project was identified, the instructor worked with the chosen partner to further refine the project scope, study the data for preliminary analysis and suitability for the project, and came up with the project specifications, which were then approved by the industry partner.

**Challenges faced and solution approach:** The first challenge faced by the faculty was in finalising a suitable project for the course. Out of the many projects proposed by different companies, Singapore Media Company (SMC) was chosen as the partner (we changed the name for confidential purposes). SMC suggested three different projects related to analytics. To finalise the project, the instructor had to spend a lot of effort to study the sample data, project needs and then engage in discussions with the partner sponsor. Out for the three projects proposed, the first two projects were more suitable for text analysis, they did not have much of “data warehousing” component. The third project, titled “Online ads and clicks” was deemed suitable for the course.

The second challenge faced by the faculty was in managing the volumes of the data given by the partner. The data generated by the transactional database for every hour was close to 1 million records with approximately 50 attributes. Initial suggestion was to use this hourly data for 2 months, which totalled to approximately 800GB. However, it was evident that such a high volume of data preparation and analysis will be practically impossible to execute on students’ machines. The instructor then proposed that it may be appropriate to study one week, seven days, of data since the online behaviour of a customer is dependent on days of the week. The database was reduced to around 600 files for one week. Each file consisted of around 3 million records. This resulted in a total of approximately 100GB over one week. Students’ experiences on data challenges are described in Section VI.



The third challenge faced by the faculty was the data aggregation task. Since, SMC had no provision for data aggregation; this meant that data loading and analysis on students' machines would result in very tedious process. Therefore, the suggestion was to categorise the data and dimensions, and assign different goals to each team in the class. In other words, the project was sub-tasked and nine teams worked on various goals based on categories and dimensions. This not only helped the students to have better control on the data, but also ensured that the partner can complete a large scale project in a short period by leveraging on nine teams. Finally, all the parties signed up Non-Disclosure Agreement (NDA) forms to ensure the confidentiality of data.

## 2. Active student-mentoring by instructor and industry

The industry partner allocated a team of mentors who interacted with the student teams both offline and online, for the entire fifteen weeks of the course. To maximise the effectiveness of these consultation sessions, the instructor consolidated the queries from all project teams and facilitated the discussions. The main goal of the partner mentorship was to provide domain knowledge and fine-tune the project requirements for each team. The partner mentors also guided the students on getting a better understanding of the relationship between the different data elements and their alignment with project goals. The instructor played a major role in providing technical guidance to the student teams. It involved working with the teams and solving the data challenges, evaluating design options, supporting tool related queries and driving the teams towards the project goals.

**Challenges faced and solution approach:** The first challenge faced was the lack of domain knowledge for both instructor and students. The approach we took to tackle this problem is that the industry mentors documented the details of the data elements and purpose in the context of the business process. At the same time, as and when required the industry mentors participated in discussion sessions to transfer domain knowledge to the instructor and students. The second challenge faced were the data related problems such as missing data and redundant data in data files. To solve these problems, the industry mentors worked with the instructor to provide the missing data and provided alternatives to handle missing data. The third challenge was a lack of student exposure to such hand-on real world analytics projects, though they had learnt the design and development of web applications in the software project management course. The analytics projects required different design and development approaches and one such approach is shown in Figure 2.

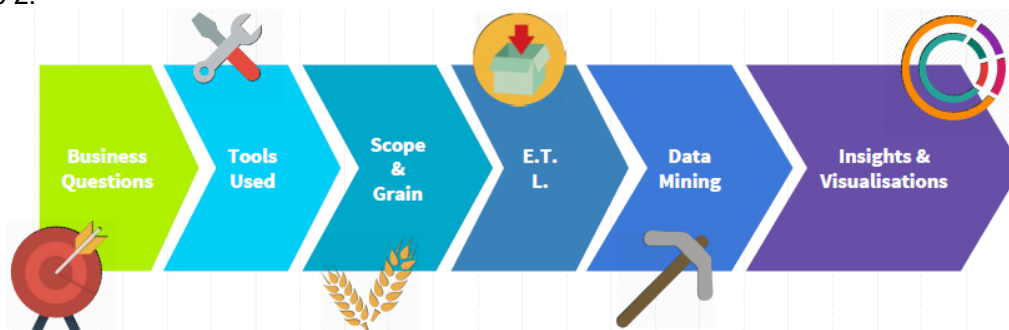


Figure 2: Design and development approach for analytics project

Data plays a major role in analytics projects and the data drives the data warehouse design and development. In the first stage, the task is to draft the analytics business questions from the business goals. In the second stage the team will install the tools, and study the data for refining the business questions. In the third stage, the task is to define the scope of the project and define one or more grains (a business definition of the data warehouse design). In fourth stage, the data will be extracted from the files, transformed and loaded into the data warehouse. After the dashboard design and report generation, the next stage is data mining applications such as prediction and clustering. Finally, the visualizations, insights and analysis is presented. The students have limited time to learn the tool independently. To tackle this problem, the instructor designed labs using Microsoft SQL Server that guide the students on an analytics project.

Furthermore, the instructor developed a small scale project on the same dataset by selecting one file and specifying a business goal and single grain.

## **V. EXPERIENTIAL LEARNING PROJECT**

The business users involved were the management of SMC who were interested in the reporting and visualization of advertisement data across all countries, industries, and timeline.

### **Business Sponsor**

Singapore Media Company (SMC) is a media organisation in Singapore with businesses in print, Internet and new media, television and radio, outdoor media, and property. Its key target market is Singapore and widely popular in Asian countries. SMC's advertising sales process include the managing of clients' advertising campaign(s).

### **Business Problem**

In online advertisement and marketing, impression refers to an advertisement or campaign which is displayed on the web page to a potential customer. The ad impressions (adunits) include properties such as sizes, versions, targets, and are embedded in various parts of the webpage. However, more important property of adunits is that the potential customer clicks on the advertisement or campaign link. The impression clicks are stored in another table/file. The higher the click-through rate the more effective the marketing campaign has been at bringing people to a website. Hence the project sponsors were keen to have a better understanding of the factors driving an advertisement's click-through rate to improve the quality of their campaigns, and provide better recommendations for their clients.

### **Course Project Objectives**

The main objective of the DWBA course project was to create a platform that supports decision making by enabling the SMC management team to view relevant data and their relationships using data visualization. The project involved four key tasks. First task was to pre-process the data and then create a data warehouse task flows from the given data sets. The second task was to allocate appropriate dimensions and fact table to support the decision needs. The third task was to develop appropriate data visualisations to aid decision making and present analysis and insights on the data. The final task was to develop predictive models to predict if an advertisement is likely to result in a click.

### **Project Facilitation**

As part of the classroom sessions, the teams were introduced to the various stages of an analytics project through concepts, class activities and labs. Additionally, each team was also given additional guidance during the different project stages.

### **Dataset**

The network advertisement impressions (adUnits) and clicks dataset contained information on the data collected about online advertisements for a particular date and time range. Information collected included date and time, user information, advertisement information, network domain, geographical locations, browser and device information. There were over 600 files with around three million records for each file which was generated every hour. The total data set was around 100GB in the end.

### **Project Tools**

The teams were encouraged to use the below tools in the course and any other tools that they find useful:

1. Microsoft SQL Server 2012 Enterprise Edition or 2014

2. Visual Studio 2010 Professional or 2013/2012/2010
3. Integration Services
4. Analysis Services
5. Reporting Services
6. Tableau (optional)

A few teams used SAS Enterprise miner for data analysis and prediction tasks.

### **Project Team Setup**

Firstly, the class of 45 students was divided into 9 teams. Since the project was broken down into multiple sub-projects based on the data and business needs, the teams were assigned to different sub-projects. Some examples of the sub-project were:

1. Business analytics on English websites for various countries, advertisers, adUnits, impressions, click-rates, time, etc.
2. Business analytics on Singapore transactions for all websites, advertisers, adUnits, impressions, click-rate time, etc.
3. Business analytics on non-Singapore transactions for all websites, advertisers, adUnits, impressions, click-rate time, etc.
4. Business analytics on the technical aspects of transactions such as browsers, devices, language, impressions, click-rates, time, etc.

### **Project Outcomes**

At the end of the project, each team provided a list of business questions, data preparation process, data schema, exploratory data analysis, insights on data using various dimensions, prediction models on the advertisements and recommendations to the business questions. Due to data confidentiality, we will provide only high level project outcomes and some examples to appreciate the results of the project. Some key outcomes of the project include:

1. Study the performance of specific client's advertisements by tracking impressions and click conversion rates.
2. Study consumers' behaviors on different markets such as Singapore and other countries to provide useful business insights and recommendations.
1. Understand the factors and parameters driving an advertisement's click-through rate to improve the quality of the campaign
2. Develop a dashboard with interactive visuals to answer various business questions

Figure 4 shows the dashboard developed by a team whose goal was to answer three main business decision making questions: identify industries for sales and marketing, identify advertisement units for sales team, and identify periods for price discrimination.

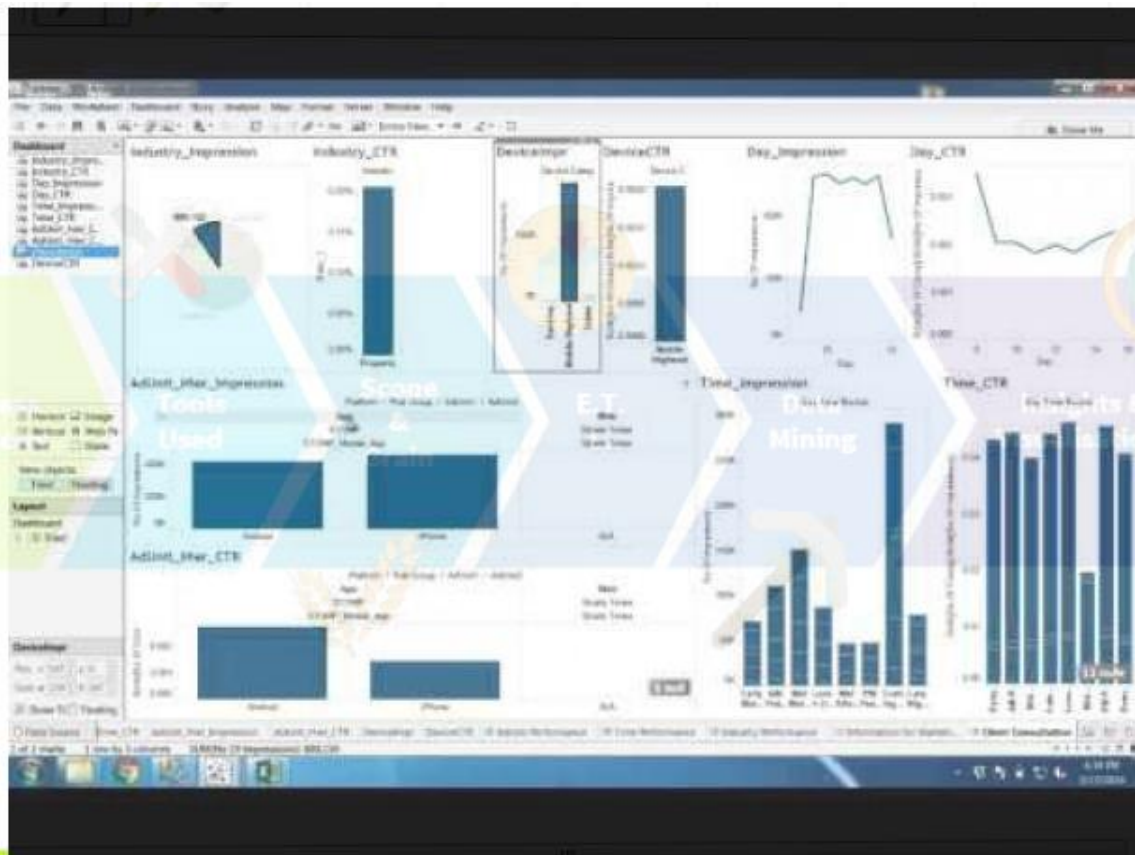


Figure 4: A sample dashboard developed by a student team

Each team presented the insights and analysis on their findings to the SMC sponsors. Further, all teams studied the gap analysis on the data and suggested strategies such as what other data is required to bridge the gaps. Some teams developed predictive models and presented predictions and recommendations based on data mining and analysis. For example, market basket analysis is used to predict the click through rates and recommend the advertisements, timings and clients to the SMC team.

## VI. EXPERIENCES AND DISCUSSIONS

In this section, we will share the experiential learning experiences from the three stakeholder; industry sponsor, students and instructor.

### Industry Sponsor Feedback

The industry sponsor provided encouraging feedback on the professional conduct of the student teams and the outcomes of the project. One of the goals of the UNI-X experiential learning pedagogy was to provide channels for enhancing the employment opportunity for students. This goal was realized through the DWBA experiential learning project, where the sponsor was keen to offer employment for the students from the DWBA course. Additionally, the sponsor invited a select set of 3 teams to present the project outcomes to the senior management. With the success of the first project, the sponsor was keen to continue the project collaboration for the next run of the course.

### Student Feedback

In order to gather student feedback, an online survey was conducted and 44 students (out of the total of 45) participated in the survey. Table 2 shows the survey results covering the various areas. Questions 1 and 2 relate to experiential learning; Questions 3 and 4 to the project; Questions 5 and 6 to instructor facilitation; Questions 7 and 8 relate to industry sponsor mentorship.

Table 2: Student survey results

Survey Questions	% of Students selecting “agree” and “strongly agree”
Q1: Has the course met your expectations in providing a practical and hands-on experience in applying concepts to solve real-world business problems?	86.36%
Q2: After going through the course, you prefer a experiential-based module, rather than theory-based module	68.18%
Q3: The project workload was manageable	81.81%
Q4: The scope of the project requested by the industry sponsor was appropriate to your group’s knowledge and skills	65.12%
Q5: There was sufficient expertise and facilitation from the instructor to drive the team towards meeting the project requirements	90.70%
Q6: The class materials taught by the instructor, provided the necessary knowledge and skills for the group to handle the project requirements	77.27%
Q7: The feedback from industry sponsor was sufficient for the group to gain a deeper understanding of the business problem and to work towards a solution	61.37%
Q8: The sponsor was sufficiently clear in setting the project objectives and expectations for the group	56.82%

With respects to experiential learning component more than 85% of students were satisfied with experience of applying the concepts in a real-world project. Nearly 70% of students preferred application based course rather than theory based learning. More than 80% of students agreed that the project workload was manageable and 90% of the students were satisfied with the faculty guidance. The areas of improvement lie mainly on the ability of the sponsor to clearly specify the requirements and their ability to give feedback to the student. We attribute this to the nature of a real project, were the business sponsors themselves rarely have a clear picture of what they are looking for. A good IS consultant’s role is to literately work with the sponsor and elucidate the requirements. Moreover, unlike a regular software development project such as web application or a HR system, we noticed that for data analytics projects, it is very hard to clearly define the project requirements and scope it appropriately at the early stages of the project lifecycle. Additionally, the sponsors were also unsure of what types of insights the data can provide them to aid them in better business decisions. This resulted in some dissatisfaction for a group of students who expected a timely feedback from the sponsor. Table 3 and Table 4 show some sample qualitative feedback and suggestions for improvement respectively.

Table 3: Qualitative feedback from students

<p>“It’s good to have a hands on real world course where we can use real world data. I think that it’s also good that this courses focuses on showing what you have learnt through hands on”</p> <p>“Real client (SMC) was engaged, giving their insights and problems in the real industry. This helped us understand and see how our learnt concepts can be applied to industries.”</p> <p>“Application-based allows me to have a better hands-on experience which will be more helpful in the future. However the theories gave me a better knowledge of how industry experts do DW in the market. So I think theory is important too”</p>
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I don't think i'm the kind of person who can understand concepts by pure memorization.  
Application based modules will allow us to think deeper about the concepts

The project is manageable with the given timeframe that simulates real world situation and the scope is manageable for the duration of the course.

The feedback from client is good and it helps us to move forward with the project

Table 4: Suggestions for improvements

It will be better to have a more clearly defined client requirements before we embark on the project.

The course could have an additional instructor for help

More engagement from the client.

Bulk of "difficulty" is purely due to large amount of data, not so much with the ETL process.  
Should reduce the amount of data to reduce the amount of time required for processing.

More labs, especially labs on data cleaning.

### Instructor Feedback

The main challenges from the faculty perspective were discussed in Section III under the sub-section "Experiential Learning Setup". The instructor reported that she gained valuable real-world project experience from this course. According to the instructor, managing the sponsor expectations, the large volume of data and attributes were the key hurdles in facilitating the project. Besides the 10 week internship, most of the students had never worked on a real project, especially in the area of data analytics. This posed some challenges during the early phases of the project, when trying to scope the project and clearly define the deliverables. Similar to projects in many other courses, the students expected to be given a clearly worded set of requirements. The instructor had to spend a lot time with the teams to coach them on how to translate the sponsor "wishes" into clearly documented requirements that the project could deliver within the time and resource constraints. Additionally, as the course progressed, the instructor had to align the content and lab work covered in the class with the knowledge and skills required for handling the project. At times, this led to redefining the original competencies that were defined in the course design document. Even though nine teams work on different sub-tasks, there were many overlapping queries. To maximize the benefits of the industry involvement, the instructor consolidated the queries from the students' teams, worked with business users for the answers, consolidated the answers and dissipated the information to all the teams. By including experiential learning activities, the instructor had to put in additional effort amounting 1.5 times the effort needed for the regular DWBA course. One of the suggestions for tackling time challenge is to have an additional project mentor for the course. The feedback was given to the school management and the response was positive.

## VII. CONCLUSIONS

Experiential learning pedagogy equips students with future work skills so as to tackle increasingly complex problems. However, not that many IS programs apply experiential learning beyond the capstone project. In this paper we shared our experience in designing a Data Warehousing and Business Analytics (DWBA) course to include experiential learning activities. Overall in the context of the DWBA course, the inclusion of experiential learning activities has been a win-win situation for industry sponsor, students, and the instructor of the course. The students' feedback indicated that the UNI-X experiential learning approach is beneficial for their overall learning

outcomes such as enhancing their problem-solving in real world context, synergizing theory and practice, providing insights into working on real projects. The DWBA course demonstrates a curriculum design that integrates industry experience with learning in classroom. External partners were also supportive of the experiential learning approach. We believe that our experience in modifying an existing IS course will provides one pathway for IS professors to adapt their current analytics courses to suit the experiential learning pedagogy.

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