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## **The PetroChallenge – An Innovative E&P Learning Experience Using an Interactive Learning Simulation**

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### **Abstract**

For decades, the university education has provided a base foundation and prepared students to join the workforce. Despite the technical foundation, students lack practical exposure. To bridge the practical knowledge gap, the industry has launched various short duration interns/externs programs. Even then these programs are not broad enough to provide a holistic understanding of the Oil and Gas Industry. Therefore, in 2015 to address this practical application NExT, a Schlumberger company, launched an interactive simulation based learning competition called PetroChallenge sponsored by Oil and Gas companies. The students are grouped into integrated teams of 3 or 4 participants; for example, an engineer, geoscientist and a business major student forms a team. Each team then acts as an operating company being fully exposed to the complete upstream cycle of the oil and gas industry using a web-based simulator called OilSim. Throughout the event, these teams make Exploration and Production (E&P) decisions and their actions and choices are then judged through the Net Present Value (NPV) of their company. The winning teams are declared based on the combined highest NPV and credibility points, earned by each team based on their challenge decisions and corporate social activities and engagements.

As E&P companies are making a stride to reduce the "Time to Autonomy" for new recruits, an event like the PetroChallenge can be a good enabler for students to be better prepared when joining the workforce. In these unique events, the sponsoring companies have an opportunity to evaluate potential recruits in action, not only from a technical perspective, but also, their business acumen including negotiation, risk taking and decision making skills. In the same token, students get an opportunity to network with their potential employers.

In 2015, three Universities (Rice, Penn State and University of Toronto) and ShawCor partnered with NExT and launched the inaugural PetroChallenge. These three events marked a phenomenal impact in students' learning and understanding of the oil and gas decision making process. Two winning teams from each of these events met at the North America finals, with Penn State becoming the first North American PetroChallenge university champions.

This presentation is prepared to share the key learnings and benefits of this type of student engagement prior to them moving into the real world.

## Introduction

Even though market conditions of 2015-2016 have led to a drastic reduction of staff numbers, the effects of the Great Crew Change (Coton 2011) are still relevant. Employers will be required to consider revised recruitment strategies in the future given the reduction of the experienced and knowledgeable employee workforce.

The forecasted 2020 mobility of new employees in Multi-National Companies and National Oil Companies (PWC 2012), requires not only higher education course equivalency for graduates but also the need for integrated teams with cross cultural understanding. Also, a step change in assignments to project based ones (PWC 2012), will require Tuckman's (1965) "Performing" to be achieved more swiftly since the team development and integration times will be greatly reduced in the new 'project based' working environment. Therefore, the need is to create leaders of the future who can cope with our high-velocity industry (Eisenhardt and Brown 1998), possess quality soft skills and be prepared to work in an integrated team environment from day one.

To address such recruitment dilemmas it has been common practice for large oil and gas players, along with other leading service companies to become engaged in university activities thereby creating relationships that support the university's career offerings whilst addressing the companies' recruitment needs. This can be seen through Industry/University ambassador programs, visits to campuses for career and recruitment fairs, and sponsorship of fun activities, such as Shell's Helix Formula 1 campus visits (Shell Helix n.d.). However, whilst these programs raise general company awareness and highlight motivated or theoretically knowledgeable students, they do not always provide enough early insights into the traits of the students for the companies to deem them as a 'good company fit'. Alternative means of engagement that not only provides short term promotional benefits but also long term stakeholder value should be considered. Also, whilst intern or externships can provide intrinsic benefits and company insights, these are often from a specific domain perspective and seldom provide the students an overall experience of the oil and gas business industry.

In our review of the vision, values, and strategic goals of a few oil and gas companies (Table 1) in 2016, some common themes emerged:

- Invest and develop talent
- Adding value and excellence
- Grow profitability
- Value integrity, innovation, and partnerships

For oil and gas companies to achieve these goals it would be beneficial for these values to be reflected in their potential recruits. Therefore, it really is a good idea to establish whether a person has the right set of values and 'shapeability' to become a valuable company asset.

Also, the time to autonomy for new graduate recruits is believed to take 4-5 years, and targeted integrated approaches, such as Shell's Graduate Programme reduces this to 2-3 years. Such in-house programmes concentrate on both technical knowledge, broad business understanding and integration abilities (Schaaf and Garg-Buck 2013). However, less time is spent on understanding the holistic industry business concept versus the individual corporate cultural approach, and additional time can be saved or better utilized in these programs from earlier exposure of the students to the upstream industry in a practical and engaging manner.

**Table 1—Representative oil and gas company visions, values, and strategies.**

Company	Chevron <sup>a</sup>	ADNOC <sup>b</sup>	ENI <sup>c</sup>	PETRONAS <sup>d</sup>	BP <sup>e</sup>
Vision	To be the global energy company most admired for its people, partnership and performance.	Energy that powers the nation and drives its engines of prospectivity by unlocking the full potential of our natural and human resources	Committed to growth in the activities of finding, producing, transporting, transforming and marketing oil and gas.	A Leading Oil and Gas Multinational of Choice	BP provides customers with fuel for transportation, energy for heat and light, lubricants to keep engines moving, and the petrochemicals products used to make everyday items.
Values	Integrity, Trust, Diversity, Ingenuity, Partnership, Protecting people and the environment, High Performance	Agile, Innovative, Efficient, Collaborative, Value-driven, Reliable	Sustainability, Culture, Partnership, Innovation, Efficiency	Loyalty, Integrity, Professionalism, Cohesiveness	Safety, Respect, Excellence; Courage; One Team
Corporate Strategy	Invest in people; Execute with Excellence; Grow profitably	More profitable upstream; More valuable downstream; More gas supply; Developing world class talent	Profitable growth; Restructuring; Transformation; Financials	strategy of integration, adding value and globalization	Setting clear priorities, actively managing a quality portfolio and employing our distinctive capabilities.

<sup>a</sup> <https://www.chevron.com/-/media/chevron/shared/documents/The-Chevron-Way.pdf> (accessed 20 June 2016)

<sup>b</sup> <https://www.adnoc.ae/en/home/index.aspx>, About, Vision & Mission (accessed 20 June 2016).

<sup>c</sup> [https://www.eni.com/en\\_IT/home.page](https://www.eni.com/en_IT/home.page) (accessed 20 June 2016).

<sup>d</sup> <http://www.petronas.com.my/Pages/default.aspx> (accessed 20 June 2016).

<sup>e</sup> <http://www.bp.com/en/global/corporate/about-bp/bp-at-a-glance.html> (accessed 20 June 2016.).

## An Innovative Learning Approach

PetroChallenge had previously been running in schools since 2002 as a way to showcase prospective careers in the industry and highlight useful academic subjects, including STEM, for study in higher education. The occasional university event had also taken place under many guises using OilSim but in 2015, under the new ownership of NExT, PetroChallenge was relaunched with a specific focus on universities and bridging the gap between the oil and gas industry and academia who are preparing the next generation of potential recruits.

### What is PetroChallenge?

PetroChallenge is a series of hands-on educational events held at participating universities over two days with the purpose of developing the participating students' knowledge of the upstream oil and gas industry using an online business simulation, OilSim; and to enable participants to actively experience the exploration, field development and production stage gates. It is the combination of the simulation's core features and facilitator led learning approaches that create the event's uniqueness and improves knowledge retention and skill transfer.

### Event Structure

The structure of a typical PetroChallenge event is shown in Fig. 1. The University events are designed to be run with up to 33 teams per event, each team with 3-4 members. The winning team from each event is invited to participate in the Regional Final event and a Regional winner is announced.

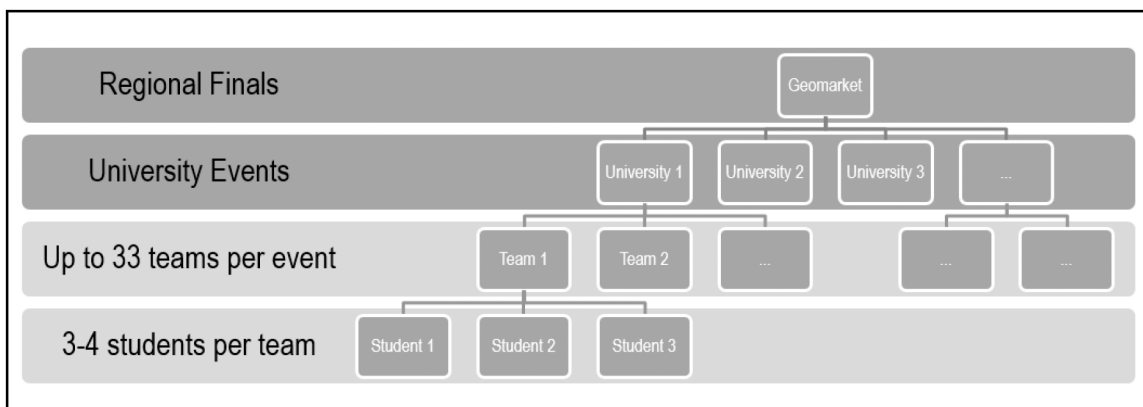


Figure 1—PetroChallenge Event Structure.

### Team based event

Team participation is key in this learning approach. The team selection process is specific to each university but designed to promote a diversity of gender, nationality and age, whilst bringing together students of cross-curricular or multi-discipline backgrounds. The makeup of the teams considers each team member's education background, year of study, gender and country of origin to create integrated multi-disciplinary teams, so that each team is exposed to a variety of knowledge and cultural perspectives, which impact their communication styles, team behaviors and strategy viewpoints.

The optimal team size was determined as three to four participants. This was observed to promote the necessary levels of interaction amongst the team participants. In addition, limiting the allowed number of computers per team to two forces the team members to take on specific tasks or roles and find their own level of contribution and effectiveness within the team. Team size of only two participants did not promote sufficient discussions and hence was not found to be optimal for effective participation and learning. On the other hand, prior team sizes of five or more participants has been observed to lead to disengagement if participants are not able to see the OilSim screen sufficiently or purposefully contribute and find their own team member position.

The event facilitator and guests from the sponsoring organizations including recruiters are presented multiple opportunities throughout the event to observe and understand the traits of participating students and their capabilities. Some examples are:

- The ‘storytelling’ that takes place in team discussions to make sense of new ideas or concepts.
- The narrative that teams create through their choice of team name or logo and their communication style and methods used during partnership negotiations with other companies.
- Each team's approach to their overall strategic aim of profitability.
- How teams share information, discuss their findings or interpret data.
- How teams approach risk managing, capital spending and borrowing, and ethical behaviors.

### Pedagogy

A great number of teaching approaches are available to educators and trainers. The MERLOT resource (MERLOT 2016) which provides programs for university students, based in California, indicates that in their educational programs they make use of 23 separate teaching strategies. In a PetroChallenge instructors and students make use of 18 of these (see Appendix 1) which helps highlight why this learning platform is so effective.

The concept of ‘Learning-by-doing’ (Al-Abdulbaqi et al 2013) incorporated in the PetroChallenge events emphasizes analytical thinking and experience gained through a mixture of traditional teaching and hands-

on training complemented by technology and data exposure. In fact, higher education is expected to provide experiential learning as part of any quality program (Clark 2010) and incorporating an oil and gas business simulation in the preparation of students' professional development fits well with this recommendation.

Learning is a natural process, however there are different ways for people to learn that need to be taken into consideration for instructional sessions. Each individual has a "learning style" or preferred way of learning. The most commonly considered learning styles are visual, aural, kinesthetic and tactile (or sight, sound, movement and touch) (Fleming 1995). Effective instructional design should include a combination of learning styles to facilitate the cognitive process for all participants. The nature of team based PetroChallenge events and the use of the OilSim simulator makes it an effective instructional delivery method, using all four major styles. Also, the iterative nature of some of the simulation's challenges gives the teams the opportunity to learn from their own mistakes and improve on their actions and decisions.

It is important to assist students with the development of their soft skills which will enable them to adapt quickly into a particular oil and gas company culture, especially in today's dynamic, globalized and integrated working environment. PetroChallenge aids in the development of the following soft skills in addition to providing the participating students a holistic understanding of the Oil and Gas industry:

- Leadership
- Negotiation
- Teamwork
- Communications
- Analysis
- Decision Making
- Strategy
- Time management
- Multi-tasking

### **The business simulation**

Simulation is a technique for practice and learning that can be applied to many different disciplines and trainees. It replaces and amplifies real experiences with guided ones, often "immersive" in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion. Simulation-based training techniques, tools and strategies can be applied in designing structured learning experiences, as well as be used as a measurement tool linked to targeted teamwork competencies and learning objectives (Lateef 2010).

The OilSim upstream learning simulator facilitates interactive training and was designed as a web-based platform to make it highly portable. It can be accessed through special event usernames and passwords without any need for software downloads. Whilst stable internet is required, it is possible to use the simulation in areas with minimum technological capabilities by bringing an actual server to a site and creating a local network for the event. The use of the simulator does not have any specific pre-requisites for knowledge which makes PetroChallenge events an inclusive learning experience and where the team selection process aims to balance the differences in discipline knowledge.

OilSim takes users through the entire oil and gas exploration and production business process, from acquiring a block to its development and production. Each team acts as an oil and gas company and is challenged to explore, develop and produce oil and gas in a fictitious petroleum province either offshore or onshore.

OilSim modules address six business and technical challenges as shown in Fig. 2. A brief description of the six challenges is included in Table 2.



**Figure 2—OilSim Challenges.**

**Table 2—Description of OilSim Challenges.**

Challenge	Description
<b>Challenge 1</b>	Teams (Companies) act as advisers to the government by researching data and deciding which licensing blocks the team thinks should be included in the upcoming licensing round.
<b>Challenge 2</b>	The government has opened up a licensing round (either Bonus Bidding or Well Commitment). Each company is to identify the three most promising blocks and submit a bid to the Government for these licenses.
<b>Challenge 3</b>	Each company has a license. They are able to drill exploration and appraisal wells to find and increase the proven reserves of reservoirs they find. Before drilling can commence, all teams have to farm-out a minimum of 20% of their license.
<b>Challenge 4</b>	Well plans are created for each reservoir the companies wish to develop, optimizing tubing sizes and the number of production wells required. Creating optimal well plans for depleting the hydrocarbons improves the overall net present value of the license.
<b>Challenge 5</b>	A facilities plan is created to enable the oil and gas to be produced, separated and transported to onshore facilities. Choosing a facility type and specific capacities and parameters based on the individual asset and its environmental setting can lead to maximizing the value of the license block and reducing risks that will occur during the production life of the asset.
<b>Challenge 6</b>	Plan and execute the construction of a production facility, considering costs, local content and risk. The aim is to reach the first oil and gas on time and within budget, optimizing resources whilst reacting and amending plans during construction if issues occur.

Teams start with an allocated funding amount (e.g. USD500 million for an Offshore scenario) and their objective is to maximize the company's NPV. Teams are also awarded with Credibility Points (CP) for effective decision making, Corporate Social Responsibility (CSR) activities and making responsible decisions concerning protection of the environment.

As well as sustaining the environment and CSR projects, another E&P social value that the students are exposed to is to manage stakeholder relations in E&P operations, including that of that government, investors, local communities and joint venture partners.

The winning teams in PetroChallenge events are selected based on:



- Weighted ranking of the companies NPV and CP. [Table 3](#) below shows an example of determining the final position of 4 teams in an event using the weighted ranking method.
- Observation of teams' progress and understanding – metrics, visual cues and decisions taken.

**Table 3—Team Ranking Determination Example.**

Team Name	Final NPV (\$)	NPV based Rank	Final Credibility Points (CP)	CP based Rank	Weighted Score	Final Position
Team5-Ocean O&G	\$ 21,897,476,377.00	1	2194	1	1	1
Team7-Rock Oil	\$ 20,501,098,207.00	2	2114	3	2.5	2
Team6- M Oil	\$ 15,079,074,874.00	4	2135	2	3	3
Team8- ABC O&G	\$ 17,060,307,880.00	3	2037	4	3.5	4

Each time an OilSim session is created, an offshore or onshore scenario is chosen. However, the variables within the software enable a completely random and unique session to be created, so that no two events or classes contain the same data.

## Corporate Social Responsibility

One key learning outcome of PetroChallenge for students as well as for sponsors is the real value created by corporate social responsibility ([Freeman 2009](#)). The teams themselves carry out corporate social responsibility projects as part of their licensing bid process, and choose from a number of different types of projects involving education, health and safety, environment, Civic and community, and arts and culture. These projects provide them with a number of different credibility points, have various success probabilities and implementation costs.

Whilst the decision making process is simplified it does reflect the rational of conscious capitalism and the benefits of Corporate Social Responsibility. Rather than just providing for a short term boost in the company's reputation at licensing time or in the local press, the teams are able to activate long term projects that can add a stakeholder value to their companies, such as setting up a new Geoscience Institute, which could enhance the local higher education availability, but also benefit the company itself through access to specifically educated students for future recruitment.

The teams, just like the sponsors of such events can choose to be different in how they engage in corporate social responsibility, because PetroChallenge aims to achieve corporate behaviors that do what is best for the shareholders – maximizing profit; and what will support the companies' long term strategic goals too and also best for the stakeholders – providing corporate Stakeholder responsibility ([Freeman 2009](#)). Sponsoring a PetroChallenge, not only supports local educational institutes but bridges the gap between industry and academia, and gives sponsors access to and influence over potential future recruits.

Michael Porter's Diamond Model of National Competitiveness is used as a model to assess the sources of competitive advantages of a company within a particular country and can help realize its competitive status globally ([Ismail Bakan and Inci Fatma Dogan 2012](#)). This model ([Fig. 3](#)) consists of four determining factors for competitive advantage: Factor conditions, Demand conditions, Related and supporting industries, Firm's strategy, structure and rivalry.

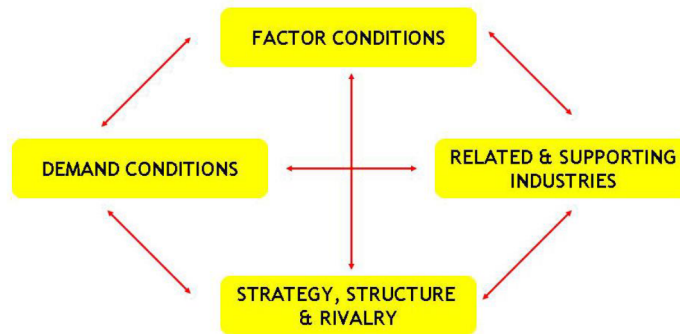


Figure 3—Porter's Diamond Model (Porter 1990).

PetroChallenge enables sponsors to aid their own company's or country of operations' competitive advantage through the determining factors in Porter's diamond model in the following manner:

- Factor conditions: PetroChallenge can support local businesses by improving prospects of local talent through innovative education methods.
- Demand conditions: PetroChallenge events help in educating future consumers about the change of mindset within oil and gas companies, how they work respecting the operating environment and their local content commitments.
- Related and Supporting Industries: In the business challenges used in OilSim as part of the PetroChallenge events, teams have to utilize the services of a variety of external providers to achieve the company's goals. Sponsors of the events can be either Oil and Gas companies or Service companies which demonstrates the relationship between supporting industries and the E&P companies in a particular country, whether they are National Oil Companies or International Oil Companies.
- Firm's Strategy, Structure and Rivalry: Team interactions during the PetroChallenge events enables participants to appreciate the benefits of and balance needed in collaboration and healthy competition. The simulator actively discourages corruption to gain competitive advantage.

## North America PetroChallenge 2015

PetroChallenge for universities was launched initially in North America in 2015 and has acted as a proof of concept. Several universities in the USA and Canada were invited to participate in the event. Despite the state of the oil and gas industry in 2015 due to low oil price, three key universities, namely Rice University, Penn State University and University of Toronto realized the potential benefits and participated in the inaugural events held in Fall 2015 at the respective university campuses.

The Rice University PetroChallenge was sponsored by the Rice University Energy and Environment Initiative (EEi). The concept and benefits of PetroChallenge aligned well with EEi's objective of educating the next generation of energy leaders to ensure they have a holistic understanding of the technological, economics, policy and human dimensions of energy.

The Penn State PetroChallenge was sponsored by the Institute of Natural Gas Research (INGaR) and Center for Collaborative Research on Intelligent Natural Gas Supply Systems (CCRINGSS) at Penn State (financially supported by GE). INGaR's mission is to conduct independent and impartial scientific research in the broad area of natural gas, ranging from exploration to production to utilization, working closely with industry and government partners to support the ongoing development of a natural gas-based economy. Again PetroChallenge fitted well with their mission, since the event is driven by individual team research and decisions based upon their own findings and strategies.



The PetroChallenge event at University of Toronto was sponsored by ShawCor Limited who actively collaborates with the university in various research projects and wanted to deepen this relationship in a hands on manner where they would have the opportunity to observe chosen students in action.

Representatives from NExT worked closely with the sponsoring organizations to determine the objectives for them in hosting the events and considered this in deciding the target undergraduate or graduate programs for students' selection and the final team composition. Each event was different, for instance at Penn State, the event was sponsored by INGaR and CCRINGSS with the vast majority of students being Petroleum and Natural Gas Engineering undergraduates, with a few chemical or mechanical engineers. Whereas at Rice University, Houston, the sponsoring entity EEI promoted an open participation, allowing registrations across a variety of faculties and of both under and post graduate students. The makeup of the teams then took into account each team's education background, year of study, gender, country of origin – all with the aim of creating diverse and multi-disciplinary teams.

Dates for the events were carefully selected to minimize disruption to students' regular class activities. Sixteen teams competed at Penn State and ten teams in Toronto, with both the events using an onshore OilSim scenario. At the Rice event, another ten teams participated but they experienced an offshore OilSim scenario, in light of their interests in the Gulf of Mexico.

Also, the events were attended by several staff from the sponsoring organizations and also various university faculty to support and encourage the teams.

The top two winning teams at each university event were recognized and given an opportunity to participate at the North America Regional Final event held at the Schlumberger training center in Houston, Texas in January 2016. Penn State and Toronto students were given advanced training in the differences between the offshore and onshore simulator scenarios, since the Regional Final made use of another offshore scenario, as this offers more dynamism and complexity to the decision making process. As usual, the ranking of the teams overall changed during and after each challenge, and it was not until the final team achieved 'First Oil' were we able to combine the company NPV and CP ranks to give an overall weighted position and the Penn State teams emerged as winners. The regional final event provided the winning teams from the respective university events with an opportunity to experience the corporate environment and to interact and network with the winning teams, faculty and sponsors from the other universities.

The feedback from the participating students, visitors from sponsoring organizations and university staff confirmed the success of the PetroChallenge 2015 inaugural event. Key results from the feedback surveys are included in [Appendix 2](#).

## Key Learnings and benefits

Students who participated in these events were able to achieve hands on cross-curriculum in practice, putting their education to the test, and also practising and building their soft skills that are vital for successful careers in any industry. The event promoted peer to peer learning, exposed the multitude of both technical and non-technical career opportunities with sponsoring organizations and an exclusive opportunity to interact with industry experts, all whilst increasing each participant's overall understanding of the E&P value chain and how their particular disciplines contribute to the big picture of maximizing profit whilst maintaining corporate stakeholder responsibilities.

Participating universities had an opportunity to provide a unique experiential learning experience to their students through the use of the OilSim simulator and its individual challenges.

The sponsoring organizations gained from a unique opportunity to invest in the future workforce of the oil and gas industry and consolidate their relationships with key universities. PetroChallenge can be a CSR project for the sponsoring company or institution and provides long term value in increasing the practical knowledge and skill set of the students, which would benefit any company that employed them. The event also provided them an unprecedented opportunity to see possible recruits in action with the added advantage

of the participants not being influenced by the Hawthorne effect (the alteration of behavior by the subjects of a study due to their awareness of being observed). The PetroChallenge environment - encompassing the highly engaging simulator; team-based decision making activities; tight deadlines for each challenge; competitive but collaborative inter-team communications and overall short duration of the event - means that individuals cannot help but display their natural traits in any given situation, and the observers definitely go unobserved themselves.

## Conclusion

PetroChallenge events using the OilSim learning simulator have proven to provide effective learning experiences based on the feedback from the student participants and the sponsors from the inaugural events in North America in 2015.

PetroChallenge taps into our industry's real-world business situations, a variety of teaching methods and multiple skill practices, all contained within a familiar gaming environment that excites students of the current generation. Partnerships between industry and academia enhance not only students' studies, but prepare the talent pipeline, adding strategic value for both with the added ability to reduce the 'Time to Autonomy' of future recruits in a particular corporate environment.

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## Appendix 1

### PetroChallenge Teaching Strategy comparison with MERLOT teaching strategies

Teaching Strategy	Included	When and how
Active Learning	Yes	Each challenge, in analysis and decision implementation
Clicker Use in Class	No	*Considering introduction of instant surveys on smart phones in the Fall of 2016
Collaborative/Cooperative Learning	Yes	Intra team collaboration required in all challenges, interteam collaboration is required for partnering during exploration. Once partnerships established, teams continue to collaborate across teams that they have invested in.
Critical Thinking	Yes	Each challenge, in determining what data should be purchased, how best to approach analysis, who should take on particular tasks, discussion of necessary final decisions for each challenge; simple scenario planning for possible outcomes of their decisions
Discussion Strategies	Yes	In each challenge within the teams to discuss analysis and decision making; within the event group as part of the review process for each challenge
Experiential Learning		Throughout all challenges, but particularly in the exploration and depletion challenges where iterations of tasks are required and improvements of method or approach can be made.
Games/Experiments/Simulations	Yes	OilSim is a simulation that is used throughout the PetroChallenge
Humor in the Classroom	Yes	In facilitator led presentations, questions and answers and team discussions
Inquiry-Guided Learning	Yes	Data is made available, but students determine what data they need to purchase and research.
Interdisciplinary Teaching	Yes	Teams specially selected to include interdisciplines to enable peer-to-peer learning; the concepts introduced throughout the simulation take into account several cross-curricular or multi-disciplinary aspects
Learner-Centered Teaching	Yes	The instructors are trained to use facilitative methods and encourage individual accountability for their understanding and learning for the different concepts that arise.
Learning Communities	Yes	Each team is its own community with responsibility for understanding and learning for each task and the numerous steps involved, within their own community.
Lecture Strategies	Yes	Each challenge has an introductory lecture and Q&A
Mobile Learning	No	
Online/Hybrid Courses	Yes	Simulation is web-based
Problem-Based Learning	Yes	Every challenge has a number of problems to be solved from either economic, time, social, scientific or environmental perspectives.
Service Learning	No	*However civic responsibilities are discussed as part of CSR program and local content strategies and students participate in CSR tasks in the simulation.
Social Networking Tools	No	*However, networking opportunities during team introductions, problem-solving, breaks and presentation preparations.
Teaching Diverse Students	Yes	Interdisciplines: gender and cultural diversity, bringing different social norms and perspectives to the forefront of communications and decision making.
Teaching with Cases	Yes	Students review their own cases with one another
Team-Based Learning	Yes	Team discipline regarding attendance and participation of challenges; students participate in the same team throughout the 2 day experience; the experiences and shared learning from one challenge are spread throughout the team and improved upon as the simulation progresses.
Team Teaching	Yes	Exchange of ideas within individual team setting or cross group facilitated exchange of ideas and approaches.
Writing Assignments	No	*However, team presentations are used to practice public speaking and large group communications.

## Appendix 2

### PetroChallenge 2015 feedback survey results and comments from participating students

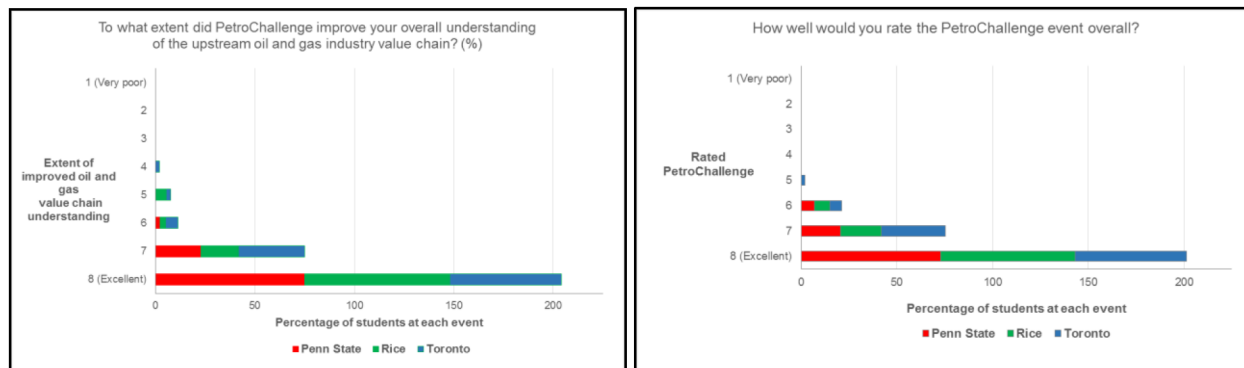


Figure 4—Participants survey results from the PetroChallenge 2015.



Figure 5—Pictures from PetroChallenge 2015 event and comments from participants.