

Experiential Learning: Dialogue of Civilization Fluid Mechanics in Vietnam

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Abstract

A faculty-led mechanical engineering undergraduate student group spent 7 weeks in Vietnam for a “dialogue of civilization” (DOC) program at Northeastern University to promote *experiential learning* [1,2]. Participants took two courses for credit: (i) Fluid mechanics which is a 4- credit hour core course in mechanical engineering and (ii) Exploring Engineering, History and Culture in Vietnam which is a technical elective. Visits were arranged to hydropower stations, local traditional industries such as wooden boat manufacturing, basket weaving, lantern making and honey bee farms, world heritage national parks, and numerous local points of interest which were an integral part of this DOC program. Homework, projects, book reports, presentations, two tests and a final exam were based on the standard syllabi and site visits. Learning environment was conducive to promote interdisciplinary academic pursuits, experiential learning, and practical applications in fluid mechanics, mechanical design, hydropower, geology, socio-economics etc., as well as independent study, teamwork, and communication skills.

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Fig. 1. Dialogue team visits the Hanoi University of Science and Technology.

Introduction

Northeastern University (NU) Global Experience Office (GEO) sets up a number of special programs available to all students to provide intellectually challenging and culturally enriching opportunities outside the US and to promote experiential learning. Such experiences enhance students' on-campus studies and prepare them to become effective leaders in an increasingly global community. In "study abroad", participants spend one summer / semester at a foreign institute to take classes for credits and to interact with local students and academic communities. In "global co-op", the many US and international companies and organizations working with NU offer 6-month co-op programs where students are exposed to diverse cultures and have the opportunities to address today's global challenges. In "dialogue of civilization" (DOC), students are offered opportunities to take their NU courses led by NU-faculty at an overseas locations to promote experiential learning. This paper focuses on a "dialogue of civilization" held in July-August 2018 in Vietnam.

The program is coined "Hydropower in Vietnam". Vietnam is chosen because of the many unique manmade and natural features. The country is famous for having 306 hydroelectric stations that produce 15.5 GW electric power. There are several UNESCO world heritage sites including the Ha Long Bay, the historic city of Hoi An, Phong Nha-Kẻ Bàng National Park, Huế, Tràng An and Space of Gong culture. The country also borders Laos, and Cambodia, part of the historic South East Asia region that has been influenced by China in the ancient past. Students spending 6-7 weeks in Vietnam learn the history, culture, language, lifestyle, food, transportation, agriculture, industry, arts, natural beauties, and many other distinct features different from the rest of the world. In the meantime, they will develop teamwork spirit, communication skills and a better understanding of the world outside the US.

Program

A group of 17 undergraduate sophomore and junior students led by one faculty and one undergraduate teaching assistant (TA) spent 7 weeks in Vietnam (Fig. 1). All participants took two courses for credits: (i) ME 3480 International

Applications of Fluid Mechanics, which is a core course mandatory to all mechanical engineering students, (ii) ME 4699 Exploring Engineering, History and Culture in Vietnam, which is a culturally related course counted as a technical elective. Participating students paid \$2500 on top of their normal tuition for 2 courses which covered the round-trip airfare, room and board, ground transportation, and admission to points of interests.



Fig. 2. Map of Vietnam indicating the three main cities that the group visited. Hanoi, the capital, in the north, Da Nang in the middle, close to the old North and South Vietnams and Ho Chi Minh City in the south.

ME 3480 International Applications of Fluid Mechanics

ME 3475 is standard introductory fluid mechanics course offered in 7-week summer sessions at the Boston campus and serves as the introduction to fluid mechanics. ME 3480 is an equivalent but modified course essentially covering the same syllabus and requirements for passing, but includes

additional materials related to the DOC program at a foreign location outside US. Participants were pre-studied fundamentals of hydrostatics from Chapters 1-2 in prescribed textbook prior to departure for Vietnam. Specialized classes were designed with a focus on hydropower generation and hydro-machinery. Arrangements were made with the Vietnam stated owned hydropower authorities to visit two hydro-stations and our visits were guided by on-site engineers. A team of four students was also charged to gather information on hydropower and present their work in a PowerPoint presentation to the entire class. Assessment of ME 3480 is based on homework, two tests, and the final exam similar to ME 3475 at Boston campus, in accordance to the department policy that all sections of the same course should have the same grading criteria. Ten homework sets were assigned to the students over the period of 7 weeks, to be graded by the TA in a timely manner and were returned to the students with the solutions. Regular on-site office hours were held by the faculty instructor after every class and by the TA every mid-afternoon. Low student to instructor ratio facilitated the assessment as the students were regularly asked questions about the covered topics when in-class examples were solved. In a few occasions that the instructor felt a student did not grasp a concept thoroughly, indicator questions (IQ's) covering that same topic were given outside the class time and saw to it that the IQ was done properly even if multiple attempts were allowed. This is a common practice at the Boston campus as well to satisfy the ABET requirements. Some homework problems were specifically designed to reflect their understanding of Vietnamese hydropower and other materials related to the trip. Such challenging problems turn out to be more appealing to the students as they are able to apply their newly learned and unique knowledge and experience acquired during the trips.

ME 4699, Exploring Engineering, History and Culture in Vietnam

Prior to the trip, participants were asked to read about natural environments, local industries, science and technology (hydropower, traditional industries such as wooden boat making, basket weaving, lantern making, leather and textiles) in Vietnam. A plan was drawn in advance to delve into

the history, culture and arts as well as science and technology by seeing Vietnam from north to south. Leaving Boston, our team landed first in the capitol city of Hanoi (circled in Fig. 2), where we stayed for six days. A train ride was made to our headquarter city of Da Nang (circled) in the heart of Vietnam where we stayed for 33 days, before a flight to Ho Chi Minh City. Course assessment included two book reports from a list of 10 books about Vietnam, a daily journal compilation by each student, active participation in site visits, and a group presentation. The four teams conducted a thorough search on one of the following topics: (i) history and culture, (ii) natural beauties, (iii) arts and museums, and (iv) hydropower, and presented their work to the entire class. With the rich Vietnamese history and culture, abundant historical and cultural sites as well as natural beauties, the groups can only present a small sample of what they learned, saw and experienced in a short paper like this with limited space. A curious mind could spend months in Vietnam and not run out of fascinating spots to visit.

Site visits

Our 6-day stay in Hanoi included visits to the Ho Chi Minh Mausoleum (Fig. 3), Temple of Literature built as a homage to the Chinese scholar Confucius (Fig. 4), the iconic Long Bien Bridge constructed across the Red River between 1899 and 1902 during the French colonial period, Hoa Lo Prison Memorial (Fig. 5), Thang Long Citadel, St Joseph's Cathedral, Hanoi University of Science and Technology, Vietnam Museum of Ethnology, and the Hòa Bình hydropower. All students born post-Vietnam War had only heard, read or watched documentaries about the military history. This trip gave them an opportunity to see the devastating effects of senseless wars on a small nation. The reading assignments and book reports shed lights on several key aspects of the war and further discussion is beyond the scope of this paper.

The next amazing visit was the coastal port of Halong Bay (Fig. 6). Upon arrival, in groups of two, we boarded traditional wooden "junk" boats for a cruise through the "Bay of Descending Dragons". The archipelago of Halong Bay is a UNESCO World Heritage Site comprising almost 2,000 islands and jungle-clad limestone pillars. We spent a couple of hours exploring an ancient lime-



Fig. 3. Ho Chi Minh Mausoleum.



Fig. 6. Halong Bay.



Fig. 4. Temple of Literature.



Fig. 7. Limestone Cave.
stone cave (Fig. 7) and a floating bamboo village.

Hòa Bình hydropower

A 2-hour bus ride west of Hanoi brought us to the mountains on the Black River. The massive dam and the hydropower plant were constructed during the Vietnam War. The main facility was underground to be shielded from bombing (Figs. 8-12). The dam was built with the help of the Soviets, and was decorated by murals and artwork depicting the Vietnam-Soviet collaboration. The hydropower engineers took us into the hydraulic turbines and generators via the underground tunnels. Hòa Bình is the largest hydroelectric plant in Vietnam, and 2nd largest in SE Asia. Power is generated by 8 turbines with a capacity of 240 MW each, totaling the installed capacity to 1,920 MW.



Fig. 5. The Hoa Lo Prison.



Fig. 8. Water discharge back to the Black River from the Hòa Bình hydropower plant.

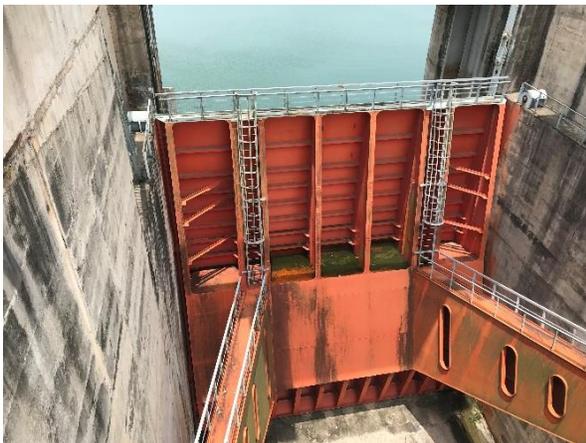


Fig. 9. The overflow gate of the Hòa Bình hydropower plant.

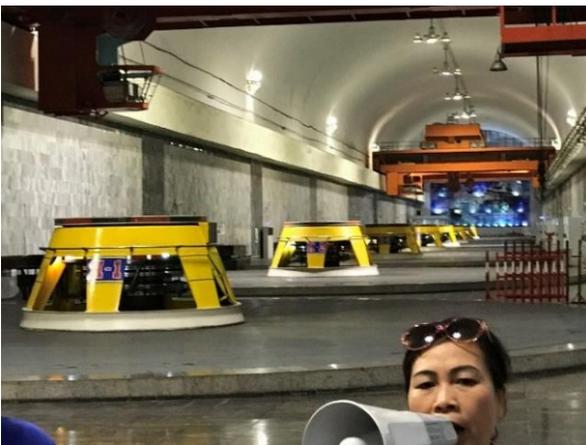


Fig. 10. The electric power generators in the Hòa Bình hydropower plant.

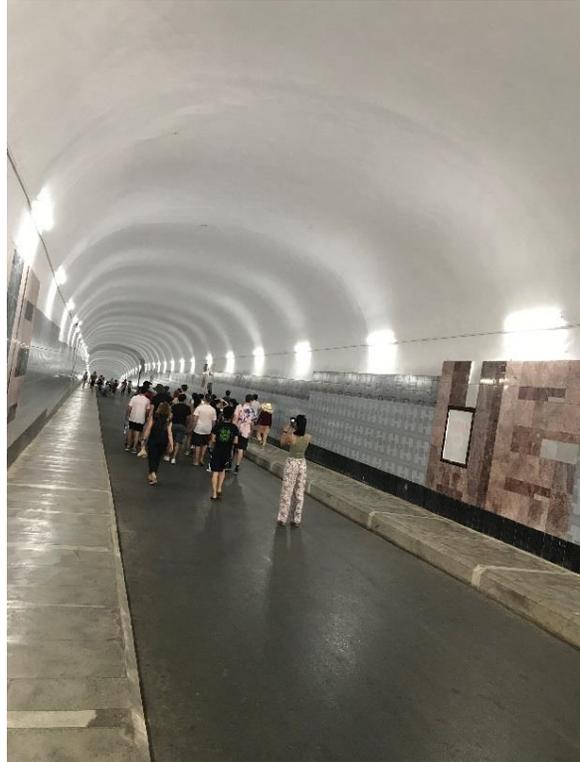


Fig. 11. The impressive underground tunnel leading to the hydraulic turbines and electric generators in the Hòa Bình hydropower plant.



Fig. 12. Students looking at the mockup hydraulic turbine on display.

Homestay

The next destination was the scenic town of Mai Chau, about a 6-hour drive from Hanoi. The route took us through some of northern Vietnam's most picturesque scenery, with mountain roads carving through lush foliage and overlooking stunning panoramas. We then drove to Pung Village where we were greeted by our homestay host to a home-made lunch. A tour of the village led by our guide gave us the opportunity to meet the villagers and learn about the rice fields and their operation from seed planting to harvest (Fig. 13). The tour was followed by a cooking class to prepare our dinner. Our accommodations were on the second floor of a stilt house with the host family living on the first floor. Two big room were provided, one for the males and one for the females. We slept on mattresses laid on the floor next to each other, separated by sheer curtains.

We had a basket weaving class the next day followed by a tour of Dan Tien, Phay and Bao villages (Fig. 15). In particular, the Friday morning market in Bao gave us an up-close and personal look at local lifestyles in the region (Fig.16). A fascinating experience indeed! From the homestay village we drove to Hanoi to take a night train to Huế.



Fig. 13. Rice fields on our way to Mai Chau.

On our way to Da Nang

An overnight train from Hanoi led to Huế in central Vietnam, which was the seat of Nguyen dynasty emperors and the national capital from 1802 to 1945. Ruins of the city's regal past can still



Fig. 14. Cooking in Pung Village.



Fig. 15. Basket weaving during homestay.



Fig. 16. Friday morning market in Bao Village.

be seen inside the Citadel and the Imperial City. Created in the 19th century, the Imperial City was modeled on the Forbidden City in Beijing, China,

holding many palaces and temples within its giant walls. Many buildings were war torn over the years and are now being restored to their former glory. We visited the Imperial City before taking a short journey to the surrounding countryside to visit the Tombs of Khai Dinh King and Tự Đức, a Nguyễn emperor (Fig. 17). We then took a boat trip along the Perfume River and visited the Thien Mu Pagoda (Fig. 18).

Our journey continued along one of Vietnam's most beautiful stretches of road, the Hai Van Pass and onto the former imperial capital of Hue. On our way, we visited the Cham Museum, home to the largest collection of Cham sculptures and artwork in the world, illuminating the lives, culture and history of Vietnam's ancient Kingdom of Champa through their artwork and treasured relics (Figs. 19-22). We have more about that later when we visit Mỹ Sơn.

Our bus ride ended in Da Nang, a coastal city in central Vietnam which served as our head-



Fig. 17. Tombs of Khai Dinh and Tự Đức.



Fig. 18. Thien Mu Pagoda.



Fig. 19. Cham sculptures, display 4.



Fig. 20. Cham sculptures, display 1.



Fig. 21 Cham sculptures, display 2.



Fig. 22 Cham sculptures, display 3.

quarters and most of the classes were held there. Among the highlights of the site visits in Da Nang were the Marble Mountains, a cluster of five marble and limestone hills located in Ngũ Hành Sơn District, south of Da Nang. The five mountains were named after the five elements: water, earth, wood, fire and metal. The Marble Mountains are home to several Buddhist and Hindu grottoes. A stairway of 156 steps leads to the summit of Thuy Son, the only Marble Mountain accessible to visitors. It allows a wide panoramic view of the surrounding area and the other marble mountains. There are a number of grottoes, including Huyen Khong and Tang Chon, and many Hindu and Buddhist sanctuaries, the temples of Tam Thai, Tu Tam and Linh Ung, and the pagoda of Pho Dong. The sanctuaries feature statues and relief depictions of religious scenes carved out of the marble.

While in Da Nang, we made a half-day trip to Mỹ Sơn, a UNESCO World Heritage Site and the former capital of the ancient Cham civilization. Between the 2nd and 13th centuries, a unique culture which owed its spiritual origins to Indian Hinduism developed on the coast of contemporary Vietnam. The Cham people ruled central Vietnam during this period, and their kingdom once stretched into what are now Laos and parts of Cambodia. What is left of Mỹ Sơn is a cluster of abandoned and partially ruined Hindu temples, constructed by the kings of Champa (Figs. 23-25). The temples are dedicated to the worship of the god Shiva, known under various local names, the most important of which is Bhadresvara. There are a few headless statues in place and one of the temples has some decorative stonework.



Fig. 23 Mỹ Sơn temples, first view.



Fig. 24 Mỹ Sơn temples, second view.



Fig. 25 Displayed artwork in Mỹ Sơn temples.

About 30 kilometers south of Da Nang is the UNESCO World Heritage ancient city of Hội An. Cut through with canals, Hội An's melting-pot history is reflected in its classic architecture, a mix of eras and styles from wooden Chinese shop houses and temples to colorful French colonial buildings, ornate Vietnamese tube houses and the iconic Japanese Covered Bridge with its pagoda (Figs. 26 and 27). Of particular interest is the festival of lanterns that is held every month on the full moon night. Thousands of people gather around the water canals after dark and set their locally-made lit paper-lanterns on the water for good luck. The scene is magnificent (Fig. 28). The group also visited two traditional small industries in Hội An – a wooden boat manufacturer (Fig. 29) and a lantern making factory. Students were offered a training class in the latter and made their own lanterns.

A 90-minute flight from Da Nang brought us to the Ho Chi Minh city followed by a tour of the



Fig. 26 Hội An historical district.



Fig. 27 Old town of Hội An.



Fig. 28 Hội An lantern festival.

city that included the Central Post Office designed by the renowned French architect Gustav Eiffel (Fig. 30), the Saigon River, Dong Khoi Street - a prominent spot in Graham Greene's famous Vietnam novel, *The Quiet American*, the Saigon, Opera House - a commanding building completed in 1901, shelled during World War II and served as a shelter to French citizens fleeing North Vietnam in 1954 when Vietnam earned its independence from France, Reunification Palace where a North Vietnamese tank crashed through the gates in 1975 to end a war that killed an estimated 58,000



Fig. 29. Wooden boat factory visit in Hội An.



Fig. 30. Central Post Office in Ho Chi Minh city.

Americans and 3 million Vietnamese, the War Remnants Museum, where the Vietnamese government has assembled presentations - some of them graphic - of wartime hardships and atrocities, Tan Dinh church which was closed to visitors for renovation, the Tan Dinh market. Tan Dinh church is a stark contrast to traditional Notre Dame Cathedral, but equally impressive with its high steeple and distinctive pink design. It is one of the most beautiful and unique churches in Ho Chi Minh

city with its dazzling architecture and sculpture patterns and inside is just as dramatic, Le Thi Rieng Culture Park, and People's Committee Building.

Our next stop was the intriguing Cu Chi Tunnel system which was once a stronghold of the Viet Cong. The cramped tunnels were central to a few of the war's strategic operations, including the famous 1968 Tet Offensive. The tunnels did not escape damage. American B52 bombers dropped hundreds of missiles, leaving behind huge tell-tale craters. The tunnels served not only as living quarters, but supply routes and hospitals for thousands of guerilla fighters. Many died there from malaria and other diseases, and a few were also born or married. Today they are viewed by the tourists as a testimony to the Vietnamese people's resiliency.

Can Gio Biosphere Reserve, a UNESCO-listed wetland on the outskirts of urban Ho Chi Minh City was our following stop. Car ferries on the Saigon River took us to the Rung Sac Museum, site of a military base that was an important revolutionary locale during the Vietnam War. We then boarded small boats for a leisurely glide through the dense mangrove forests, where Viet Cong soldiers hid a guerilla camp during wartime where their headquarters, barracks and munitions workshop were hidden deep within the foliage. Along that path we saw some of the area's most famous wildlife - crocodiles, pythons and playful primates.

Tri An Hydropower

Our second hydropower plant visit was to Trị An whose dam and lake are on the Đồng Nai River in Vĩnh Cửu, Đồng Nai. The power plant has an installed electric capacity of 400 MW producing around 1.76 TWh of electricity per annum. The plant is operated by Trị An Hydropower Company, a subsidiary of Vietnam Electricity.

The enormous reservoir with the main dam and the relief dam supply water to the hydraulic turbines. Bounded by much stricter rules at this powerplant, tourists were not allowed to take photos or movies. Our group, however, was given a meticulous tour of the facilities including the dam, the overflow gate, the turbines, the generators, and the control room. Having gone through some of the

fundamental concepts in the fluids class, they could easily relate the classroom and on-site concepts.

Discussion and Conclusion

Experiential learning is necessary to train students in all engineering disciplines, as conventional lectures and lab-scale experimentation and measurements are limited in many ways. Exposure to real life applications will expand the students' horizons, trigger and inspire their interests in engineering, raise their competency and awareness as an engineer, leave unforgettable memories, and give opportunities to think outside the box or the confinement of conventional engineering education. Most students might initially take the *dialogue of civilization* program as an entertainment tour, but their personal and direct participation changes their attitude and gives grounds and flexibility to apply their academic knowledge to practical situations.

The trip also provides an excellent training for the teaching assistant who travels with the group. Like all other participants, it is the first time the TA traveled to Vietnam and visited the various sites of interests such as the hydroelectric power stations. The challenge to master and apply his knowledge to the real world is quite overwhelming, let alone helping the students to tackle their homework and projects related to the sites. The culture related course poses major difficulties for the engineering graduate who is not trained in such disciplines. The TA lived with the group in the same accommodations and helped to ensure the team spirit, safety, and cooperation with individuals. The instructor had also good lessons to learn. For instance, the course materials and assessment scheme should be progressively modified to fit the goal of the two courses, the students will satisfy the course requirements like their peers in parallel classes held at the Boston campus, the two courses will be better integrated such that they will complement each other, group dynamics in the student group will be improved over times with better strategy and planning etc.

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