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INITIAL BENEFITS AND OUTCOMES OF EXPERIENTIAL LEARNING PROGRAM IN COMPLEX FIELD SCIENCES

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Initial Benefits and Outcomes of Experiential Learning Program in Complex Field Sciences

Synopsis:

The Northern Gulf Institute and its partners developed the Mississippi State University – Science Education at Sea (MSU-SEAS) program with the intention to provide an engaging, experiential learning opportunity to those students who attend historically underfunded districts, regions of exceptionally high poverty (Title I Schools), and those districts with high percentages of underrepresented populations, as well as home-school students, who may otherwise not have the opportunity to undertake these often expensive, and sometimes "exclusive" educational experiences.

The following paper and associated presentation are a blueprint for the program and its initial outcomes.

Initial Benefits and Outcomes of Experiential Learning Program in Complex Field Sciences.

Author Note

The program was sponsored by the Northern Gulf Institute at Mississippi State University and undertaken with the support of the Mississippi State University Department of Geosciences, Mississippi Aquarium, the Maritime and Seafood Industry Museum, and the Gulf Islands National Seashore office of the United States National Park Service.

Press Coverage Concerning the MSU – Science Education at Sea program can be found here:

https://www.msstate.edu/newsroom/article/2021/09/msu-seas-program-launched-partnership-mississippi-aquarium

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Abstract

Originally intended to occur in the Summer of 2019, The Northern Gulf Institute and its partners developed the Mississippi State University – Science Education at Sea (MSU-SEAS) program. This program set forth to implement an experiential learning opportunity for participants, and to successfully demonstrate the efficacy for experiential learning through hands-on activities, and fully interactive experiences, for the participants in an outdoor and "complex" field environment.

After postponing the program until the Summer of 2021, following the CoVid-19 Outbreak and subsequent initial round of vaccinations, the program took 30 participants offshore on an historic Biloxi Fishing Schooner to experience an engaging hands-on educational opportunity in marine science, sampling, and research, with the intention to both help give direction to the students and participants for the future sciences workforce development needs, and to provide an engaging, experiential learning opportunity to those students who attend historically underfunded districts, regions of exceptionally high poverty (Title I Schools), and those districts with high percentages of underrepresented populations, as well as home-school students, who may otherwise not have the opportunity to undertake these often expensive, and sometimes "exclusive" educational experiences.

Initial benefits and outcomes of experiential learning program in complex field sciences.

Experiential Learning Theory, also known as learning by doing, implies that students learn and retain material more effectively when immersed and materially involved in the learning process as an educational experience. In this manner, knowledge is discovered by the student and therefore gains more cognitive meaning for the student. John Dewey (1897) stated: “Experiential learning takes place when a person is involved in an activity, looks back and evaluates it, determines what was useful or important to remember, and uses this information to perform another activity.”

This concept can be better visualized using the graphic produced by David Kolb (1984; Figure 1). He reiterated and enforced Dewey's theory by stating that "learning is the process whereby knowledge is created through the transformation of experience."

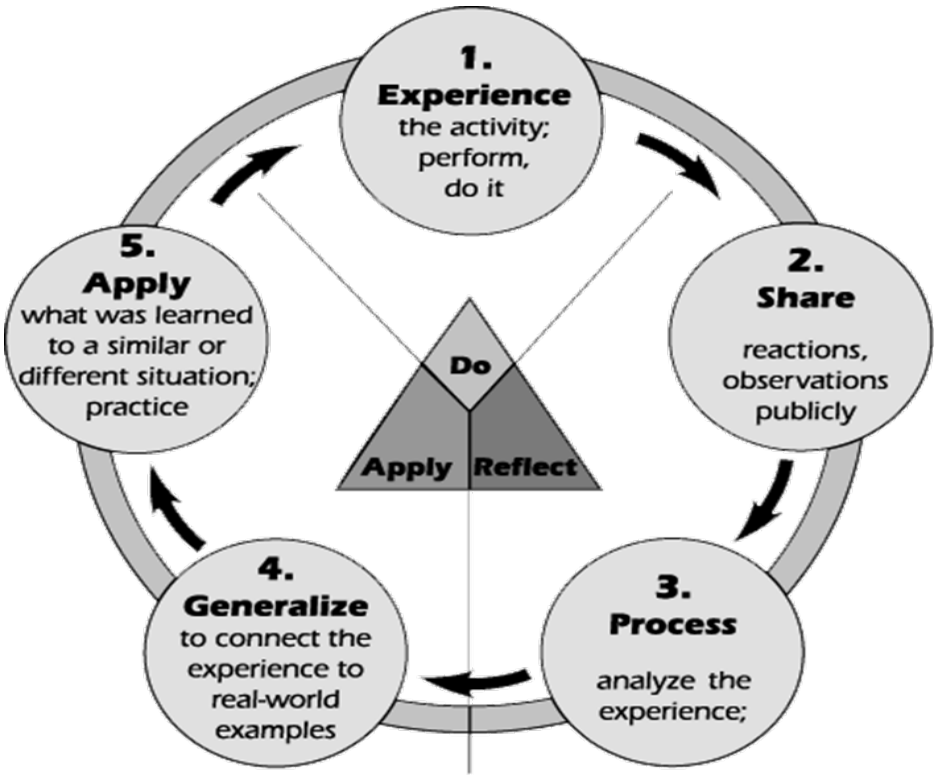

Figure 1. David Kolb (1984) Experiential Learning: Experience As The Source Of Learning And Development

Project Concept

This project was meant to provide an engaging, experiential learning opportunity to those students who attend historically underfunded districts, regions of exceptionally high poverty (Title I Schools), and those districts with high percentages of underrepresented populations, as well as home-school students, who may otherwise not have the opportunity to undertake these often expensive, and sometimes “exclusive” educational experiences.

This program set forth to implement an experiential learning opportunity for a class of up to 30 participants, and to successfully demonstrate the efficacy for experiential learning through hands-on activities and fully interactive experiences for the participants in an outdoor "field" environment (Figure 2).

Figure 2. Faculty member lecturing participants on invasive aquatic plant species.

Educational teams from the Northern Gulf Institute, the Mississippi Aquarium, Mississippi State University (MSU) Department of Geosciences, the Maritime and Seafood Industry Museum, and the

National Park Service's Gulf Islands National Seashore partnered to develop an informative, hybrid offshore-onshore Experiential Learning program for Middle and High school students on the MS Gulf Coast. This program exposed students to sampling and data collection experiences that included Gulf Coast history, geography, geology, biology, and ecology concepts, as well as environmental and climate factors. The program was conducted offshore onboard one of the historic Biloxi Schooners operated by the Maritime and Seafood Industry Museum located in Biloxi, Mississippi, and onshore at Horn Island, part of the Gulf Islands National Seashore (Figure 3).

Figure 3. Maritime & Seafood Industry Museum's Biloxi Schooners: S/V Glen Swetman and S/V Mike Sekul

Risks and Liability

Fieldwork of this magnitude involves some level of risk to the participants or liability to the operators. In this instance, the risk factors include wildlife and aquatic hazard as well as common slip/trip/fall injuries associated with maritime operations. These were mitigated through an intensive pre-trip safety briefing, and emergency medical training provided by vessel operators and its U.S. Coast

Guard inspected and licensed crew, and an MSU and Aquarium Staff including (WEA-COE, 2022) outdoor educators and a team EMT/First Responder on the vessel and the island during the program excursions. Inherent risks were further mitigated by State, Aquarium, and University insurance coverage and liability waivers for each participant. Participants were also restricted to Middle and High School students only.

Methodology, Activities, and Learning Opportunities Offered

Beginning with an intensive safety orientation with ship emergency procedures and equipment, the course includes lectures and activities concerning Gulf Coastal history, geography, geology, biology, and ecology concepts, as well as environmental and climate factors that influence and impact the region. Offerings include a walk around the historic Biloxi Lighthouse constructed in 1848; the Biloxi Lighthouse was one of the first cast-iron aid-to-navigation structures erected in the Southern United States. While sailing the waters of the Mississippi Sound, we discuss the actions of the Pirate Jean Lafitte and the actions leading up to the War of 1812, and the battles of Bay St. Louis and Lake Borgne as they led up to the Battle for Chalmette and New Orleans and the last ingress of foreign military power in the last naval conflict in U.S. Waters, from the point of view of the crews of the USS Seahorse and USS Alligator Lost in that battle (Figure 4).

We then continue to discuss the geographic importance of the Gulf Coast to the Nation's Blue Economy and its sensitivity to natural and human disasters and changes in economic conditions. Some of the main topics include the coastal communities' economies which are historically "tied to the lives of resident fisheries, fishers, boatbuilders, and factory workers, as well as all of the other industries, and peoples whose lives and livelihoods are tied to the sea, ranging all along the Gulf Coast. Coastal industry, shipping, fishing, and development, alongside many different sectors, have long been important to life all along America's waterways" (Harris, 2019).

Figure 4. Painting depicting the Naval Battle of Lake Borgne, Louisiana, between the U.K. and U.S.forces in the War of 1812. The original painting is in the U.S. Naval Academy Museum, Annapolis, Maryland. It was donated to the Museum in 1945 by Commander Walter Karig, USNR, Lieutenant Welbourn Kelley, USNR, and Commander E. John Long, USNR.

The abundance of seafood and other valuable natural resources, including Oil & Gas, has helped strengthen the region and the entire nation's economy. Shipbuilders and boatmen have long been an integral and necessary component of these communities. Hundreds of small craft and ships have been built and used to ply these waters in trade.

The boat-building traditions and maritime trade in the Gulf Coast region date as far back as the French settlements stretching along the Mississippi gulf coast beginning around 1699 (Galloway, 1982). Shipping in this region has been a critical component to the economy and national defense, including the construction of all manner of vessels, from the smallest fishing vessels to the largest and most formidable American warships. This includes many petroleum drilling and production platforms that typically dot the horizon offshore in the region.

The natural resources of the coast rely on its safekeeping and effective management, which further influence the future of not just the economic livelihoods of coastal residents but the students' lives themselves. These are a crucial series of points the project uses as a guiding point throughout the program, all while being involved with an active working historic fishing vessel (Figure 5).

Figure 5. Student participant hoists a sail on the Biloxi Schooner Glenn Swetman

Geography leads nicely into the geological history of the Gulf region and ties directly back to natural resources and the energy industry, and the benefits and threats they pose on the area. The influence of major rivers and depositional environments, including Barrier Islands and the Gulf Islands National Seashore in the Northern Gulf of Mexico Basin, provides ample material for participants to be hands-on with modern marine sampling technology, including Sub-Bottom Profilers, Side Scan Sonar, and Sediment Sampling Devices as well as some introductory water chemistry (CTD) systems to both experience what collecting data is like, and allow for a basic understanding of how to interpret that data and how it all ties back to Earth history and the environment around them. In this component, we

discuss existing fisheries and oyster reef systems and impacts of onshore flooding, pollutant transport, and the opening of the Mississippi River's Bonnet Carre Spillway in 2017-2019 (Posada et al. 2017) that allowed freshwater influx that caused the devastation of the Mississippi oyster population, and which significantly, and negatively, impacted the fisheries to the East of the Mississippi River. We also discuss the impacts of the British Petroleum (BP)-Deepwater Horizon Oil Spill in 2010 (Posadas, 2010) and the science behind the Oil and Gas and other Natural Resources in the Gulf. At this point in the excursion, we reach Horn Island, part of the Gulf Islands National Seashore, where we begin to discuss coastal processes and the geology and formation of the barrier islands by landing the participants on the island and allowing participants to take part in measurements and sampling, and transects of the dunes and to observe coastal currents and sediment transport (Figure 6.).

Figure 6. Participants witness active aeolian dune sediment transport and coastal sediment transport on Horn Island.

This component allows for a segway into discussions and observations of meteorology, tides, and currents, all of which play a significant role in developing the natural landscape.

Leading from geology and coastal processes into meteorology at this point is an easy step. With the barrier islands as our living laboratory, participants can witness firsthand not only wind-driven sedimentation and erosion but local cloud formation patterns and processes, as well as impacts of tidal processes, currents, and wave-driven forces to the coastal environment.

Leading on from meteorology, we transition to ecology and the environment when we walk the participants through a coastal marsh environment allowing them to observe existing and invasive species and the interaction between them. Invasive species such as Cogongrass, Chinese Tallow, Japanese Climbing Fern, Torpedograss, Laurel Wilt, Giant Salvinia, Nile Tilapia, Lionfish, Nutria, and Wild Hogs are a few of the dozens of non-native, invasive species found in coastal Mississippi (Weeks, 2011; Smith, 2014).

Many of these species do considerable ecological and economic damage to the area that have cascading effects through ecosystem processes and economic opportunities. Participants are queried on how this might be mitigated, and options are explained with demonstrations on some of the ways to identify and remove these species as a threat from the Gulf Coast ecosystem (Figure 7). We transition from ecology to coastal marine life by first encouraging participants to use typical sampling methods such as cast, or seine, nets to sample near-shore environments and observe the avian and terrestrial species living in the dunes of the barrier islands (Figure 8). We continue observations of marine life as we return to the Port of Biloxi, with hands-on examples of aquatic life, including observations and a lecture on species that call the Gulf of Mexico home (Figure 9).

Figure 7. Participants observe invasive species in a coastal marsh environment.

Figure 8. Participants sample and observe near-coastal marine life.

Figure 9. Participants are taught to identify local marine mammals and turtles through hands-on and interactive lectures on skeletal morphology.

Results

Post program surveys and discussions with parents and students indicated a stronger than previous interest in marine sciences and potentially an impact on career path choices with the student participants. 2 of the attendees have specifically expressed interest in attending geosciences or marine sciences programs as they enter the university level in the coming years. At least one of the participants has taken part in several subsequent marine science-based programs offered by the MS Aquarium and the Northern Gulf Institute. Only time will tell on the true impact, however as this program continues as a biannual event, and the students reach the university level we shall begin to see the outcomes.

Conclusions

The Earth's surface is approximately 71% water. It is no giant leap to believe that much of the future of life, agriculture, and aquaculture, as well as technology and natural resources, will be directly

linked to the Earth's oceans. At the Northern Gulf Institute (NGI), we stand ready to provide educational opportunities tied to this vital resource.

The experiential and hands-on nature of this program allowed for far more student interaction with their environment than could be found in a traditional learning setting. Impacts of this program have been felt in the regional school districts through hundreds of requests by parent and student groups and regional educators expressing interest in taking part in similar programs. NGI outreach teams and partner institutions have responded by increasing interactive, outdoor learning opportunities to allow more students, the public, and regional stakeholders to participate in more hands-on learning opportunities. Interest in this program and those like it has also fueled increased interest in a marine science career and education queries to partner institutions and local industry, as well as increased attendance at other coastal and marine education centers along the Gulf Coast following the press coverage and advertising concerning this learning opportunity.

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