Integrated Teaching Approach for Senior Geophysics Project

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Abstract: - Contemporary theory of learning requires a cooperation between University and Industry to enhance the quality of research so that it meets the needs of qualified people in industry. Such cooperation has begun between the Earth Sciences Department of KFUPM and the Schlumberger Dhahran Carbonate Research Center. Based on this first initiative, the Earth Sciences students at KFUPM are encouraged to learn the industrial approach and standards in the acquisition of field data.

Key-Words: Cooperation, Senior Project, Comprehensive Theory of Learning

1 Introduction

A faculty member and students from the Earth Sciences Department of KFUPM visited the SDCR (Schlumberger Dhahran Carbonate Research Center) and gave a presentation on the objective of Senior Projects based on previous experience [1]. We informed the industrial colleagues about the facilities of Software and Instruments at the Earth Sciences Department (ESD). The presentation by Dr. Oncel as a Course Instructor included a summary of previous Senior Projects done by undergraduates. Schlumberger's presentation, given by one staff, underlined their interest in possible bilateral cooperation to help meet the industrial needs for manpower. A research topic was negotiated, based on the mutual interests of university and industry. The chosen title for the bilateral research is "***The integration of surface seismic data with geo-electric data".***

The present work aims to provide tomograms for the subsurface geology, based on seismic and electric data. Those geophysically derived tomograms will be compared so as to explain the underlying geology. Thus the seismic and electric data will serve to integrate the velocity and electric response due to unknown subsurface geology. This method is comparable to a hospital where various types of evidence are integrated so as to minimize diagnostic errors. For similar reasons, we applied well-known geophysical methods with advanced geophysical instruments to obtain subsurface geological tomograms.

2 Data Acquisition: Student's learning

Previously undergraduates had gained only limited field skills on data acquisition through their geophysical program, but this new project gave them an opportunity to deal with field data acquisition in the light of Schlumberger's long-term experience. The field work took three days: (a) two days on Seismic Refraction, and (b) one day on Electrical Methods.

2.1. Field Data Acquisition from Seismic Survey

The Field Schedule for the seismic refraction survey was decided by the team as 6am -5pm. A deploying model for 32 geophones was conducted through the profile (see Figure 3). The first day involved the students in the hard part of geophysical surveys, namely digging holes to deploy the "Geophone" sensor (see Figure 4). Five students took one day to dig 32 holes. Although the upper level was a trench full of loose sand, the lower level was very hard. The students realistic experience by digging through soft to hard ground, but they could have been given an advanced instrument for digging faster, rather than simply using hammers.

Finally, the components of the geophysical survey were checked (see Figure 6) to assess the quality of data. Noise (interference) was detected by the seismic system, and the students sought its source. When they found that it came from man-made movements such as traffic, they asked for these to be stopped. (see Figure 8).

2.2. Field Data Acquisition from Electric Survey

The Earth Sciences Department had purchased an instrument (IRIS, Syscal R1 Plus) for acquiring data on resistivity. Thus the students in this senior project had the opportunity to conduct the Department's very first work on resistivity tomography (see Figure 7).

The IRIS instrument has great flexibility to apply different types of electrical arrays for ground surveys. Thus, two types of array methods were applied and each student had a chance to create his model individually.

The electrical survey took less time than the seismic survey, since electrical currents as a source are applied directly to the ground.

3. Report and Presentation

As a part of course policy, students have responsibility for submitting their reports regarding their analysis of field data and possible calculated models for interpreting subsurface layers of geology through survey profiling. The students on this project used an inversion program to convert the seismic and electric data to characterize changes in 2D seismic velocity and resistivity for a certain depth of geology. The influence of geological depth is directly related to the total length of the survey profile. In this project, the depth for studying the geology was about 35 meters since the survey line's total length was limited to 160 m (see Figure 3).

The students had a good opportunity to gain experience in using professional programs such as SeisOPT 2D and Res2Dinv. Such programs have been tested frequently and accepted routinely for data analysis of geophysical methods. They thus provide a good worldwide standard for the credibility of geophysical studies involving data analysis and geophysical tomography. The manuals and sample data, together with software, are given to the students [2]. Tutorials on applied methods for their project were presented in class and provided through the class web-page [3].

Following their report, the students had a further duty (due to course policy) to present their work to all faculty, staff and students. For each of their presentations (see Figure 9) the Earth Sciences faculty and Schlumberger staff provided suggestions and comments [4].

4. Integrated Teaching Approach

The Earth Sciences Department of KFUPM firstly conducted a new model for cooperation between the Department and the outside industry (Schlumberger), which is an case work for contemporary and comprehensive theory of learning [5]. The students benefited very much from conducting this new senior project model by undertaking an advanced field experiment with industrial realism. This integrative approach for interaction with industry provided a very good opportunity not only for the students but also for the faculty.

We believe that our experience as the Earth Sciences Department may strengthen relations between KFUPM and industry. Thanks to the integrated approach, the improved teaching will enable graduates of KFUPM to gain priority for better jobs and careers in Earth Sector employment, not only in Saudi Arabia but throughout the world.

Acknowledgements: *I thank Dr.Shaibani, Chair of ESD, for supporting my interaction with industry and the other faculty's involvement in their fields of expertise. My appreciation is extended also to Dr. Qahwash, who supervised the students in the electrical field survey, and to Dr. Cesar Barajas-Olalde and his colleagues from Schlumberger due to their great contribution in the Field Data Acquisition. My appreciation is Extended to Mr.Birkett from DAD for his review of present paper*

References:

[1] Oncel, 2007. Effective and Creative Senior Project for Geophysics, presented in Schlumberger-Dhahran. http://faculty.kfupm.edu.sa/ES/oncel/schlumberger-2007.pdf

[2] Software, manuals and sample data as used for the present project. http://faculty.kfupm.edu.sa/ES/oncel/geop402software.html

[3] Tutorials on the use of professional software for enhancing the students' interactions. http://faculty.kfupm.edu.sa/ES/oncel/geop402tutorials.html

[4] Students' presentations on their fieldwork. http://faculty.kfupm.edu.sa/ES/oncel/geop402SenProPres_2007.pdf

[5] Illeris, K., Towards a contemporary and comprehensive theory of learning, *International Journal of Lifelong Education*, vol 22, 4, 396-406.

FIGURE CAPTIONS

Figure 1: A) Dammam dome in the eastern region of Saudi Arabia B) Survey profile (*Courtesy of Abdurrahman Al-Shuhail).*

Figure 2. Diagram showing the steps in cooperation between KFUPM and Schlumberger.

Figure 3. A) The survey model for deploying geophones (blue geophones) and sources (red stars). B)Profile line in the field area.

Figure 4. Upper figures showing a student digging and another student moving with geophones. Lower picture showing geophones.

Figure 5. A) Interaction between Student and Industry Staff for connecting cables. B) Geodes and Battery. C) Cables for connecting geophone to recorder.

Figure 6. A) Seismic Recorder B) Test data is checked for entire deployed geophones C) Test data D) First interpretation regarding recorded data.

Figure 7. A) Students deploying electrodes for the same position as geophones deployed. B) Students started to take data readings.

Figure 8. Student tried to convince worker to stop noise.

Figure 9. A) Students waiting for questions regarding their project after presentation. B) Students concerned about something before presentation. C) Faculty's valuable comments to help progress of students' work. D) Faculty added comments and suggestions as time permitted.

Figure 1

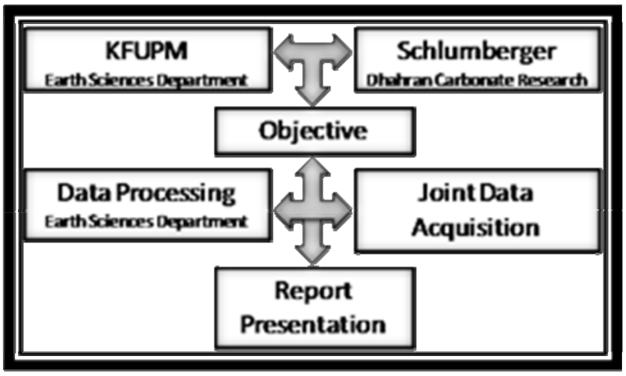

Figure 2

Figure 3

Figure 4

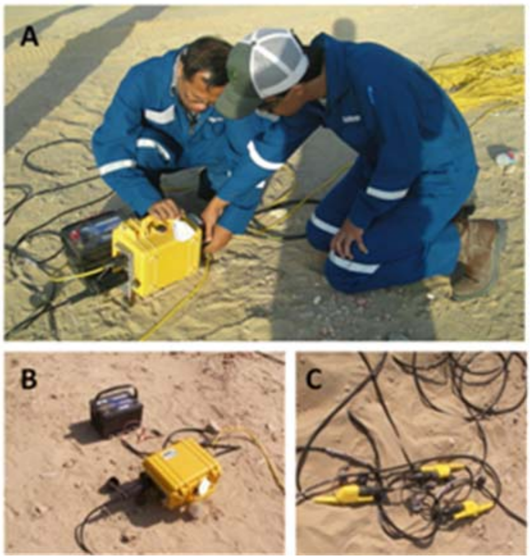

Figure 5

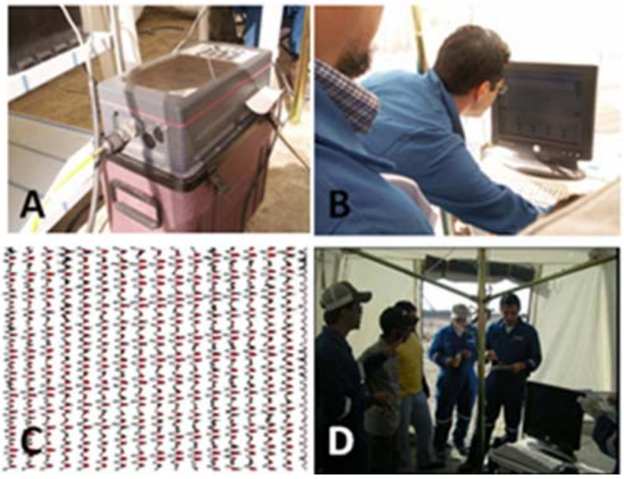

Figure 6

Figure 8

Figure 7

Figure 9