

# Application of Computer Aided Education in Well Logging for Foreign Student Majoring in Petroleum Engineering

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**Abstract.** The application of computer aided education (CAE) in Well Logging was presented in the paper. Well Logging is an important professional basic course for student who majors in the petroleum engineering specialty. The course covers the abundant contents, including the conventional logging, imaging logging, producing logging, logging while drilling (LWD) and measurement while drilling (MWD), and it is difficult in classroom teaching and learning, especially for foreign student who comes from the main oil producing country along the Belt and Road. Combination CAE with Internet and artificial intelligence (AI) would provide more choices for classroom teaching and learning, such as simplifying the complex concept and principle. The course content and the learning status of foreign student were all analyzed. Two case histories on CAE application in Well Logging were introduced. The object of the study is to set up the perfect knowledge system for foreign student to completely and quickly master Well Logging in classroom teaching.

## 1. Introduction

Well logging is an essential technology in petroleum industry, especially has very important role in petroleum engineering. In petroleum exploration stage, well logging is often used to correct stratigraphic, identify oil, gas and water, estimate porosity, permeability, water saturation, and evaluate the potential capacity of the reservoir; in petroleum development stage, well logging also could be used to monitor dynamic condition of oil, gas and water and the status of the well, which could offer the real-time downhole information for oil reservoir management optimization [1, 2]. Therefore, Well Logging is an important professional basic course for the student who majors in the petroleum engineering specialty.

Well Logging is a professional course based on the wide field application. The theoretical bases of Well Logging are the physical field theory and the advanced mathematics, moreover it is also an interdisciplinary course based on geology, drilling, petrophysics, computer science, information science and so on [3]. Well Logging includes a wide range of contents: the conventional logging, the production logging, the imaging logging, logging while drilling (LWD) and measurement while drilling (MWD), logging interpretation; and each part has the relatively independent knowledge system, and furthermore it is complicated in principle and application [3, 4]. The wide knowledge coverage of concept, principle, strong practicality and application would increase difficulty in classroom teaching and learning, especially for foreign student.

With promotion of “the Belt and Road”, a number of foreign student increases rapidly in China. Most of the foreign student from the main oil producing country along the Belt and the Road majors in petroleum engineering specialty. The foreign student from the different country has the difference of culture, language and custom [5]. The present main problems of classroom teaching and learning for the foreign student are the complex student structure, poor quality of students, obvious cross-cultural barriers, imperfect foreign student management system and so on [6]. The foreign student generally has large difficulty in studying the professional course, such as Well Logging.

The petroleum engineering specialty is a strong applied discipline, and most of courses are closely connected with the field application. The professional course learning needs more mathematics and physics basements, which gives high requests for student learning. Most of foreign students in China are from Central Asia, Middle East and Africa, and English level is poor as their native language is not English, such as Russian. Otherwise the level of basic education is much lower than that of China, and the foreign student has weak science foundation. In order to help the foreign student to quickly and completely master Well Logging in classroom teaching to solve the complicated engineering problem in the future, the course reform is necessary, and various teaching methods should be used in classroom teaching. Computer aided education (CAE) application with Internet by means of the student-centered learning (SCL) was introduced in the paper.

## 2. CAE and SCL

### 2.1 SCL

SCL is popular in the university's engineering course classroom teaching in the recent years [4]. SCL was firstly proposed in USA to adapt to the undergraduate education in the middle of the twentieth century, which gives rise to the widespread impacts on the teaching method and teaching management in the world [8, 9]. Generally teacher is the center in the classroom teaching, and student should passively follows the teacher's guide. To develop student's ability is the basic aim in the classroom teaching, and it is also the main idea of SCL. The course reform of Well Logging for the foreign student is also based on SCL.

### 2.2 CAE

CAE has been widely used in classroom teaching as a new-style teaching tool. The combination of CAE with Internet and artificial intelligence (AI) would offer more choices for teacher in classroom teaching. Teaching content and teaching style with CAE has the characteristics of diversity, wide applicability and strong immediacy information [10]. Based on the difference and trait of the student in the whole teaching process with CAE, teacher could obtain the branching type teaching degree which further promote teacher to provide the teaching material and teaching method to be suitable for student's learning characteristics. The multimedia technology with integration of graph, text and voice is mainly applied in CAE, which would present various forms of the same teaching content and timely judge and analyze the learning outcome for student.

### 2.3 Case history

CAE has various application in Well Logging classroom teaching for foreign student to master concept and principle. Two case histories were presented.

#### 2.3.1 Describing the basic concept

The professional course is based on the concepts and principles, and concept is the basic knowledge point in classroom teaching. Foreign students are often difficult to clearly understand some concepts. For example, how to understand "Logging"?

Logging is a basic concept in Well Logging teaching. It is easily expressed and clearly understand in Chinese, but most of the foreign students are hard to grasp because of poor language ability. In English expression, Logging, Well Logging, or Log, means that "a record containing one or more curves related to properties in the well bore or some property in the formations surrounding the well bore" [11].

Logging is an obscure concept, and foreign students are hard to master the concept which would induce the new obstacle for the further study. With the help of CAE, a PPT (Power Point) with animation and graph could clearly express concept of Logging, shown as Figure 1, which could help foreign student to study.

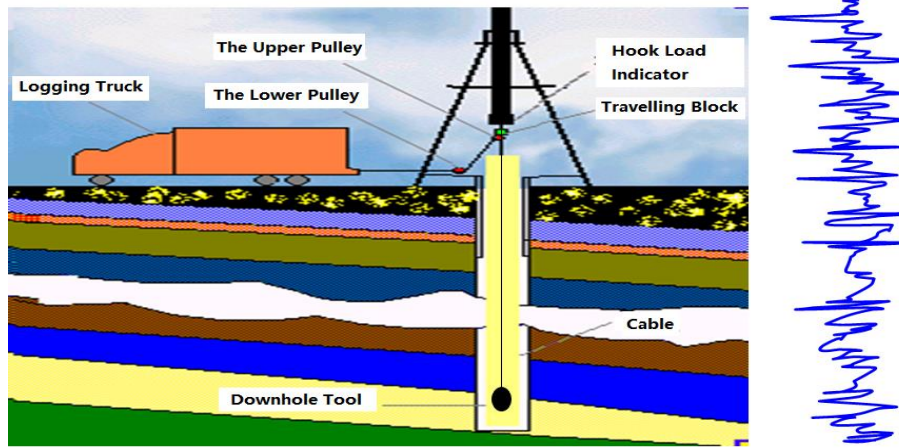


Figure 1 the concept of Logging with animation and graph

In Figure 1, animation describes the logging run. A logging tool is placed into downhole, then logging tool is brought up with cable car in the truck. At the same time transducer system within the tool transmits signal into formation and receives the returned signal related to properties around the borehole. It is called Logging, and foreign student easily accepts.

### 2.3.2 Understanding the logging principle

Most of logging principles are complicated, and it is difficult to understand for foreign student. For example, acoustic (AC) velocity logging is based on elastic wave field theory to detect the mechanics properties of the formation. Figure 2 is AC logging principle, the acoustic sonde including a transmitter (T) and two receivers (R1 and R2) detects the velocity of the formation. In the normal borehole, the velocity difference between R1 and R2 reflects the formation property. But in the abnormal borehole, such as caliper expansion, the abnormal value would be recorded. Borehole compensate acoustic logging (BHC) has been developed to correct the caliper change. The principle of BHC is difficult to understand for foreign student.

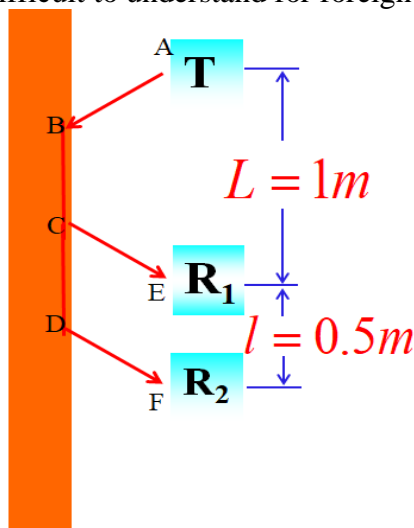


Figure 2 AC logging principle

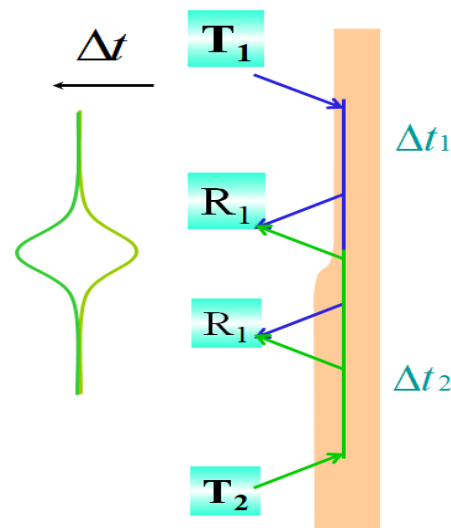


Figure 3 BHC logging principle

Animation of CAE is also used to help foreign student to understand BHC logging principle, shown as Figure 3. In order to correct the abnormal value induced by caliper change, the acoustic sonade including two transmitters (T1 and T2) and two receivers detects the velocity change. T1 and T2 alternatively transmits acoustic signal into the formation, two velocities difference between R1 and R2 would be recorded, and the average exactly correct the influence of caliper change. The animation on BHC logging principle is visualized and easily accepted by the foreign student.

### 3. Summary

Well Logging is an important basic professional course for the undergraduate student majoring in the petroleum engineering. The foreign student has more difficulties in learning Well Logging because of poor language ability and weak science foundation. The various teaching methods based on SCL should be used in classroom teaching to help foreign student to master the knowledge. CAE with Internet and AI would provide more choices for teaching and learning. Two case histories about CAE application in Well Logging classroom teaching were introduced, which indicates that CAE could help foreign student easily understand the complex concept and principle.

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