

**AC 2010-559: CONSTRUCTING THE NORM OF THE PROBLEM SOLVING
ABILITIES OF SENIOR STUDENTS OF MING-CHI UNIVERSITY OF
TECHNOLOGY**

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Constructing the Norm of the Problem Solving Abilities of Senior Students of Ming-Chi University of Technology

Abstract

Lots of research regarding the Science-Technology-Society issues reveal that the problem solving ability should be more important for students. The high level cognitive skill may help the students to face the future complicate development of the society. The ability of the problem solving is thus the front one of the education goals. Especially in this decade most of the senior high school students easily take the permissions to the University in Taiwan. The curriculum of each department in the University may formulate and hence help those students to get their career once they graduated. Assisting the practical training in the factory of an actual position with the University may enhance the professional experiences and abilities of those students. However, the actual enhancements of the abilities of the students during the practical training of the sandwich program are still unknown. By the education study approach, the problem solving inventory for the sandwich program students is constructed to assess the ability variation before/during/after the practical training. The circle of the pre-testing, statistical analysis, expert consulting and assessing would feed back the ability variation to the fundamental science courses to construct the proper teaching modules of this special sandwich program in University. The inventory of the ability is constructed for the portfolio assessment of each student on the problem solving ability. And therefore the database of this assessment can be derived to indicate the performance of the practical training of the sandwich program. This project provides the enhancing model of the problem solving ability and the relationship between fundamental science course and the training. Furthermore, the feedbacks of the ability assessments of each student to the related teachers to improve the teaching modules are worthful for the higher technical and vocational education.

Introduction

Kolb's (1985) experiential learning model (ELM) has been one of the most influential models of learning. The ELM has been widely used by educators for a variety of different purposes of the using with higher education students (Armstrong, 2000) and in professional education (Rakoczy & Money, 1995). The students of studying in technological universities of Taiwan derive the vocational training which differs from the general university. For constructing of the learning environment for practical training by the Kolb's ELM is therefore very important. Many schools have been adopting sandwich programs containing of the practical training to help their students to learn the professional know-how. Obviously, sandwich programs are profitable for designing the practical learning environment and minimizing the gap between theories and practices (Patterson, 1981, Lindsey et al., 1999). The implementation of sandwich programs of university may be diverse of a half year or a full year in the private incorporation during the tertiary education. Basically, learning alternates between school and factory. No matter how the diverse of sandwich programs, seeking an instructive company for students is the most important.

Not all sandwich programs can be naturally successful. Intrinsically, factory practice is a process of "learning by doing". If cooperative companies cannot provide instructive learning environments, the practiced students maybe become low-cost labors. Therefore, "how to grade the student's achievements and discriminate the qualification of factories" is the principal concern of the faculty administering the sandwich program. Ming Chi University of

Technology, funded by the Formosa Plastic Group, has been demonstrating her sandwich program more than forty years in Taiwan. The students graduated from the school must complete a one-year factory practical training. During the year, the faculty guide and grade the students by students' reports. However, it is not easy to assess the students' achievements only by the seasonal reports because the students' learning is a process based on the Constructivism (Krol, 2004, Fosnot, 1996). Furthermore, due to the changing of industrial structure, the sandwich program of the university thus needs to revise for adapting the change of society. Moreover, as a part of engineering education accreditation, the faculty also needs a standardized procedure to supervise the implementation of sandwich program and assess the learning achievement of students. Assessment for learning should be used to enhance all learners' opportunities to learn in all areas of educational activity, especially of the practical training of sandwich program. And the one can ensure all learners to achieve their best and to have their efforts recognized.

Learning assessment for students raises the achievement of each course. By the assessment the students will know and then improve most once they understand the aim of their learning. This understanding is where they are in relation to this aim and how they can achieve the aim. Bransford, Brown and Cocking (2000) reveal that an effective teaching environment is by way of the assessment-centered scheme for pupils. Besides, Bransford et al. (2000) further indicate that within the effective teaching environment of the assessment-centered scheme, the feedbacks from the students are responded to the teacher by the formative assessment during the teaching process. The ongoing feedbacks by monitoring of the learning status of students would reflect the linkage between the course and the general information of students'. Brown and Knight (1994), and William and Black (1996) also stated that the purpose of the formative assessment is the learning feedback for student which would be closing the gap between actual and desired levels of performance (William & Black, 1996). Brown and Knight (1994) further indicated the timely feedback of the formative assessment is much more important to increase the learners' knowledge and skill thanks to the clear information let the learners understand what must be done.

Over the past three decades,

It is a belief that one constructs knowledge from one's experiences, mental structures, and beliefs that are used to interpret objects and events. Jonassen (1991) stated that the mind is instrumental and essential in interpreting events, objects, and perspectives on the base that is personal and individualistic. Hence each learner has the ability to seek out and gain new knowledge, new skills. They can engage in self-reflection and to identify the next steps in their learning. Teachers and/or the teaching institute should design the learning environment to help the learners to construct their skill, knowledge and the ability of solving problem. Besides, the learning environment should be authentic and interactive (Jonasson & Land, 2000).

The problem solving ability should be more important for students to face the future complicate society. The higher cognitive ability of the problem solving is thus the front one of the education goals. The assessment of the trained ability of the student is therefore vital thanks to the actual enhancements of the ability of the student during college that should pay more attention on. By the education study approach, the problem solving inventory for the senior student of the higher technological education is constructed to assess the ability. Accordingly, the university conducts a study to build a standard procedure for portfolio assessing the students' performance and evaluating the cooperative companies. Based on the Constructivism, the construction process of intellectual skills is the main concern. Therefore, the student's growth in problem solving and cognitive strategy, before and after the sandwich program, is observed and analyzed. This article summarized the test results of the students in mechanical engineering. The circle of the pre-testing, statistical analysis, expert consulting

and assessing would derive the norm of the problem solving abilities of the students which may feed back the ability trained to the fundamental science and technology courses to construct the proper teaching modules for the sandwich program performed in the Ming-Chi University of Technology. The purpose of this study was to develop a suitable inventory of problem solving abilities of the technological University students and then to test the students for constructing the norm of the previous abilities. By the assessment results of the every student, one evaluates that the training position provided by the cooperated incorporation is suitable for increasing the problem solving abilities of students by the sandwich program.

Methods and implementation

By the sandwich program, all junior students practiced in companies, factories and academic institutions in this problem-oriented investigation, a class of thirty-eight students of the department of mechanical engineering, Ming Chi University of Technology, are assessed before proceeding of the practical training of sandwich program for constructing the problem solving ability norm of this technological University's students. The focal point of the assessment tool is developed to measure the problem solving used by students in the completion of technology education learning activities. The tasks include (1) developing a procedure for identifying the mental processes as they were used by students, (2) creating an inventory to analyze the mental processes used by students, and (3) proofing the inventory for consistency and reliability.

It is relevant to note that while the term assessment often is used within a context where a value judgment is made and one thing is determined to be better than another, the process described in this study uses the term operationally to describe procedures for identifying particular activities, determining how long these activities last, and how frequently activities are repeated in practice. The procedure would enable an observer to determine whether a learning activity accomplished objectives related to use of mental processes in problem solving. It was not, however, designed to directly measure the products or outcomes of the activities involved. Preliminary testing of the observation procedure was done using a timer to record the duration and frequency of each mental process observed. The phase of field-testing demonstrated that agreement could be achieved between observers independently viewing videotaped technology education activities.

The data for the research have been collected through several stages. First, sample descriptive statistics such as arithmetic means and standard deviations on the study scales have been computed and reported in tables. Subsequently, the relational solutions determined in alignment with the objectives of the research have been computed. The statistical solutions of the data have been tested by the SPSS package program. If the distributions showed normal distribution characteristics, parametric analysis techniques such as independent group t-test have been used. In order to determine whether there is a significant relationship between the students' problem solving skills and self confidence points, Pearson product-moment coefficient has been calculated. In addition, for finding relationships between problem-solving skills and self-confidence scores, simple coefficient analysis was used.

The initial questionnaire has 90 items for assessing of the problem solving abilities of the students for pilot testing on the population of 36 students. The analysis by SPSS shows that the reliability of the inventory by Cronbach's Alpha of 0.696 while the normalized one is 0.773. Removing the items of the initial questionnaire based on the conditions of the item dependence lower than 0.3 and the Cronbach's Alpha lower than 0.696 without the evaluated item, the final items of the questionnaire are of 76 in amount by the previous pilot testing and analysis.

Results and Discussions

A total of 456 questionnaires are returned while the initial ones are 534. Respondents included 154 (34.3%) females and 295 (65.7%) males. A total of 137 (30.4%) of the respondents had not any service learning experience, and total of 141 (31.5%) of the respondents had no part time works during tertiary education and senior high school. As the result of the analyses, the students' problem-solving skills show an insignificant variability across gender and department variables. It is concluded that no significant difference was present in terms of classroom variables. As a result of the t- test conducted, it is concluded that problem solving ability scores of students from the groups showed significant differences in the part-time working experience, learning achievement ranking in the class and the service experience during the tertiary education and the senior high school.

According to the results obtained at the end of research, the prospecting the tertiary students have different varying in terms of problem-solving skills according to various variables which differ statistically. Besides, it has been observed that education received have made differences in sub-dimensional levels of problem-solving. It has been concluded that the students' levels of the problem solving abilities in terms of the attitude, approaching and quality show significant differences in the part-time working experience, learning achievement ranking in the class and the service experience during the tertiary education and the senior high school.

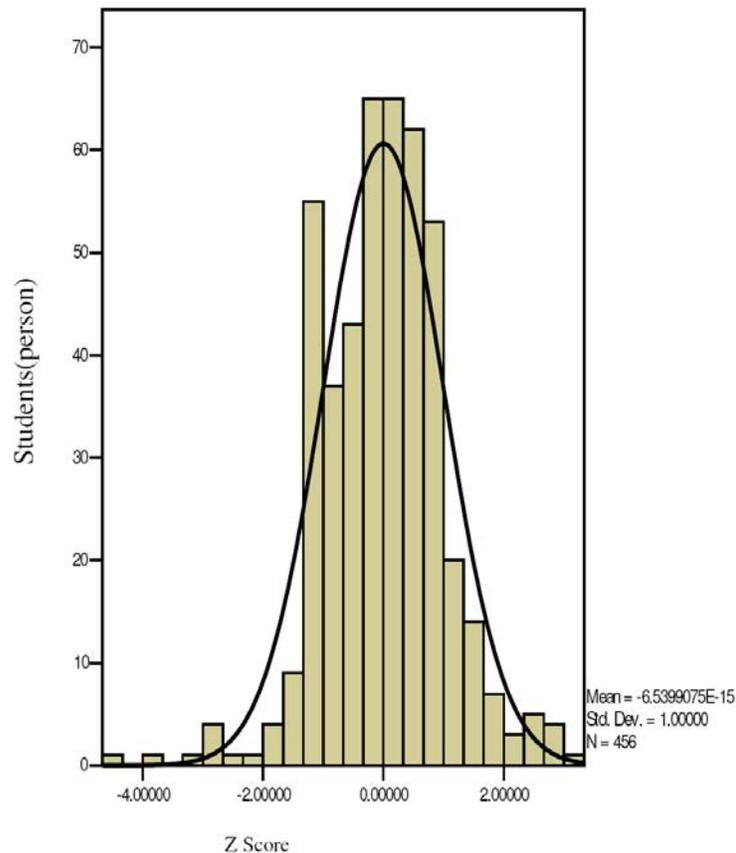


Fig.1 Z scores of the problem solving attitude of the senior students

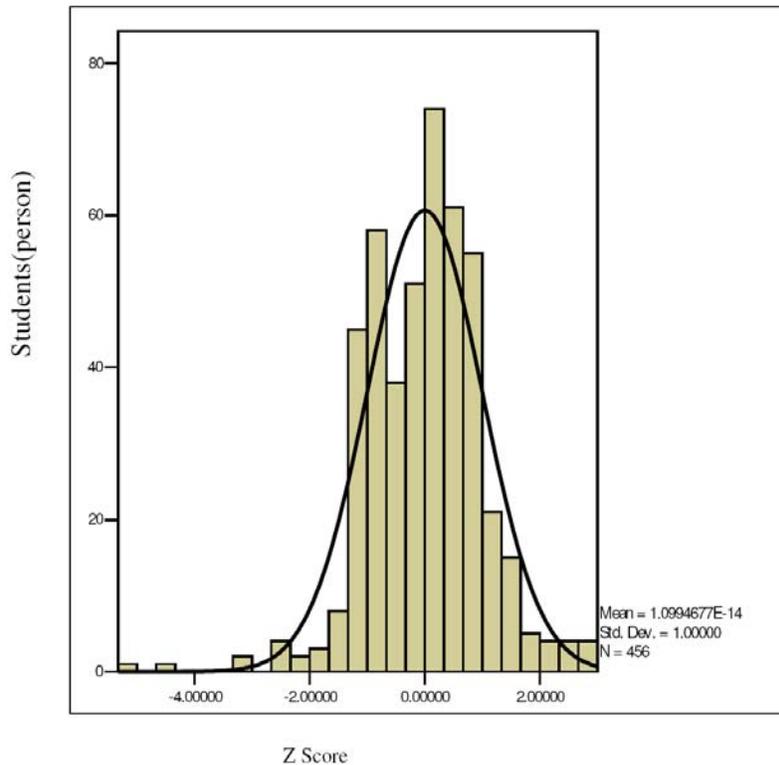


Fig.2 Z scores of the problem solving ability of the senior students

Conclusions

The inventory divided into three dimensions of the attitude, approach and the quality of the problem solving abilities. Each dimension has 30 questionnaires for the pretest has been brought to the 36 students to derive the reliability and the validity. The pre-test gets a higher reliability of Cronbach's α of 0.696 while the standardized Cronbach's α of 0.773. Out of 523 questionnaires distributed, 456 were completed and used in this study. By the SPSS one finds that: (1) there were 76 questionnaires in the inventory which shows a higher interrelatedness on the commercial inventory. (2) The problem solving abilities have no significant interrelatedness on the gender, major or the recent graduates. (3) the problem solving abilities have significant different between students with different score ranking, with part-time job, class cadre during the high school and college. Based on the findings of this study, some suggestions were provided at the end of the study for the reference of the inventory users and the future researchers. The feedbacks of the ability assessments of each student to the related teachers to improve the teaching modules are useful for the higher technical and vocational education.

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