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Evaluating the English-learning of engineering students using the Grey S-P chart: a Facebook case study in Taiwan

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ABSTRACT: The aim of this article was to evaluate the English-learning of engineering students by using the Grey Student-Problem chart (GSP chart). The research was conducted with 37 freshman engineering students in a private university in central Taiwan using Facebook wall posts to make English sentences, and the GSP chart to evaluate the engineering students' English performance. The two vocabulary tests, based on the General Service List (GSL), with ten questions were given as the pre-test and post-test. To uncover the usefulness of learning vocabulary on Facebook, the vocabulary tests' scores were compared using the GSP chart. The findings suggest Taiwanese engineering students performed better on the English vocabulary examination after practising making English sentences on Facebook. The Web-based tool provides a ubiquitous English-learning environment for engineering students, and is believed to increase students' English vocabulary acquisition, as well.

Keywords: Grey Student-Problem chart, Facebook, General Service List, ubiquitous English-learning, English vocabulary acquisition

INTRODUCTION

English has become more important in Taiwan given the trend of globalisation and internationalisation. Therefore, the Ministry of Education (MOE) in Taiwan put a lot of effort into improving students' English skills [1-3]. The MOE also noticed that university students' English performance is worse than the younger generation [4]. Hence, this article aims to apply Facebook to English-learning among freshman engineering students at a private university in central Taiwan. It is hoped that through making English sentences on Facebook, the engineering students could not only share their ideas, but also increase their English vocabulary acquisition. Also, with this ubiquitous English-learning environment, the teacher and students can share their Facebook posts no matter the time or location [5]. Students were divided into six groups, and needed to work within their groups to finish the assignment. Through the collaborative learning experience, the team members were expected to generate more ideas and reduce the stress of doing the task [6][7]. Moreover, students today are digital natives, while teachers are digital immigrants [8]. If teachers could teach students the way they prefer to learn, it may help improve attainment [8][9]. This project was, therefore, developed to focus on:

1. How engineering students' engagement with Facebook influenced their English vocabulary learning.
2. Evaluation of engineering students' English progress in a quantitative way.

METHOD

Facebook as a Learning Platform

Since early 2004, the invention of the Social Networking Site (SNS), Facebook, has influenced learning styles in higher education [7][9]. According to Kwong, the general concept of Facebook was to increase social networking and interactions among Harvard freshman students, and later in 2005, Facebook was opened up to the people outside the university network, so that everyone in the world could use it to frame their profiles, share photos, announce upcoming events, join interesting groups, etc [10]. Compared with other learning platforms, like Moodle, which is more teacher-centred, Facebook has become a popular platform for students to post, share or provide feedback with just one click [11][12].

Some have reservations that this kind of social networking platform distracts students from their academic studies, and, in any event, the question is asked: is it useful in the formal classroom setting [12]? However, if teachers could utilise this convenient and user-friendly Web tool, design suitable curricula, and evaluate students' learning in an objective

way, students may increase their motivation for class participation [13]. For instance, both the instructor and the students could check the bulletin board, send e-mails or messages and share video clips on Facebook.

Undoubtedly, this digital natives generation seems to be more interested in the Web 2.0 environment (i.e. blogs, You Tube, Twitter) than the traditional classroom. Therefore, teachers need to consider modifying their teaching methods not only to fit students' pace of learning, but also to create a student-centred learning environment [14]. To date, the communication between students and teachers has been done via e-mail, but this seems to be more private and other students do not share ideas with their peers. In order to increase the interactions between instructor-student or student-student, educators may want to apply a new technology in teaching, and to set up their own Facebook sites to keep in touch with the students in a ubiquitous English-learning environment, where students can browse the English-related articles provided by the teacher on the Internet and the instructor can reply in public [5].

GSP Establishment Through Grey Relational Analysis

This section gives a brief introduction to establishing the GSP chart through Grey Relational Analysis (GRA) [15-21].

1. Raw data establishment:

$$x_0 = (x_0(1), x_0(2), \cdots, x_0(k), \cdots, x_0(m)); k = 1,2,...,m \quad \text{Reference Vector} \tag{1}$$

$$\left.\begin{array}{l} x_1 = (x_1(1), x_1(2), \cdots, x_1(k), \cdots, x_1(m)) \\ x_2 = (x_2(1), x_2(2), \cdots, x_2(k), \cdots, x_2(m)) \\ \quad \vdots \\ x_i = (x_i(1), x_i(2), \cdots, x_i(k), \cdots, x_i(m)) \\ \quad \vdots \\ x_n = (x_n(1), x_n(2), \cdots, x_n(k), \cdots, x_n(m)) \\ i = 1,2,...,n \end{array}\right\} \quad \text{Comparative Vector} \tag{2}$$

2. Generation of the grey relation: try to standardise the data by using three methods – larger-the-better, smaller-the-better, and nominal-the-better. In this article, the method of larger-the-better is used, and it is shown as follows:

$$x_i^*(k) = \frac{x_i(k) - \min\limits_i x_i(k)}{\max\limits_i x_i(k) - \min\limits_i x_i(k)} \tag{3}$$

where $\max\limits_i x_i(k)$ means the maximum number in j and $\min\limits_i x_i(k)$ means the minimum number in j.

3. Calculation of the grey relational: apply Nagai's equation to calculate the grey relation [16-18]. Among them, the reference vector of the local GRA is X_0, and the comparative vector is X_j. When Γ_{0i} is close to 1, it means that X_0 and X_j are highly correlated. The equation is shown as follows:

$$\Gamma_{0i} = \Gamma(x_o(k), x_i(k)) = \frac{\overline{\Delta}_{\max} - \overline{\Delta}_{0i}}{\overline{\Delta}_{\max} - \overline{\Delta}_{\min}}$$

$$\overline{\Delta}_{0i} = \left\| x_{0i} \right\|_\rho = \left(\sum_{k=1}^{n} [\Delta_{0i}(k)]^\rho \right)^{\frac{1}{\rho}} \tag{4}$$

where $\overline{\Delta}_{\max}$ and $\overline{\Delta}_{\min}$ represent $\overline{\Delta}_{0i}$'s maximum and minimum, respectively.

GSP Chart Theory

The Grey Student-Problem chart (GSP chart) originated from the Student-Problem chart (SP chart), which was proposed by Takahiro Sato in the 1970s. Based on the SP chart, it is possible to analyse the data in a quantitative way, and to diagnose students' learning through the calculation of the Problem Caution Index (CP) and Student Caution Index (CS) [22]. However, the SP chart only codes the data as either 0 (incorrect answer) or 1 (correct answer), but it fails to reflect the actual values in the scoring [21]. Therefore, Nagai Masatake combined GRA and the S-P chart to establish the GSP chart, which allows for a more specific analysis of the data [16]. Compared to the SP chart, the GSP chart can deal with uncertain, multivariate, and discrete data through mathematic equations, and then present the results as figures [16][19-21]. The GSP also combines the Rasch model to create measures, and the equation is shown as follows [19-21][23].

$$\Pr(X_i = 1 | \theta) = c_i + \frac{1 - c_i}{1 + \exp[-1.7 a_i(\theta - b_i)]} \tag{5}$$

where θ represents test-takers' abilities; a_i is the item discrimination parameter; b_i is the item difficulty parameter; c_i is the item guessing parameter. $\Pr(X_i = 1|\theta)$ is the probability of a test taker (ability $= \theta$) to answer the question correctly [21]. The item difficulty parameter, points on the theta continuum, corresponds to a 50% probability of endorsing the item [21].

RESEARCH DESIGN

Participants

A total of 37 freshman engineering students in the Freshman English course took the English vocabulary pre-test and post-test (based on the GSL words). The GSL is a set of 2,000 words selected (based on the frequency of usage) to be of the greatest *general service* to English learners. The engineering students' ages ranged from 18 to 20, and most of them have learned English for at least six years before taking part in this research. Their English level is defined as CEF A2, after taking the unified placement test (Standford test) at the beginning of the academic year.

Data Collection and Analysis

All of the engineering students in the same Freshman English course took the vocabulary pre-test at the beginning of the course. As for the Facebook assignment, the instructor had to create her own profile page on Facebook first, and the group page for the engineering class. Then, the engineering students were asked to register on Facebook and join the group Engineering B, which was administrated by the instructor. Next, the engineering students were divided into six groups, and each group was assigned with a 42-word English vocabulary (based on the GSL), and each group had to upload pictures related to the meaning of the assigned words to Facebook, and make a related English sentence below each picture every week. At this stage, students could choose to take their own pictures or get the pictures on-line. The other groups were encouraged to give comments on each picture and sentence on Facebook, or at least they needed to choose *like or dislike* on Facebook. After six weeks' practise, the participants were asked to take the vocabulary post-test to check their English vocabulary progress. The examples of Facebook wall posts are shown in Figure 1 and Figure 2.

Figure 1: Group work on Facebook (Example I).

Figure 2: Group work on Facebook (Example II).

The students in this research were asked to take the pre-test and post-test vocabulary tests in class to identify their proficiency levels, and check if any differences could be found between the two tests. Moreover, their test scores were collected and analysed using the GSP chart.

Establishing the GSP Chart

By coding the examination results of the pre-test and post-test into the S-P chart, and then applying MATLAB 7.0 to analyse the data [16][19][20], the GSP figures are shown as Figure 3 and Figure 4.

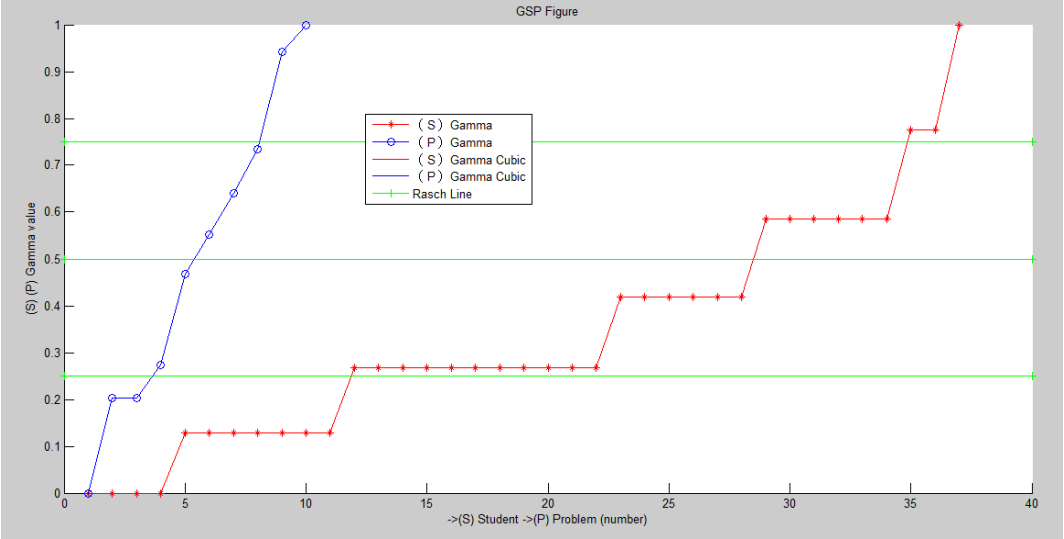

Figure 3: The GSP of English vocabulary - pre-test.

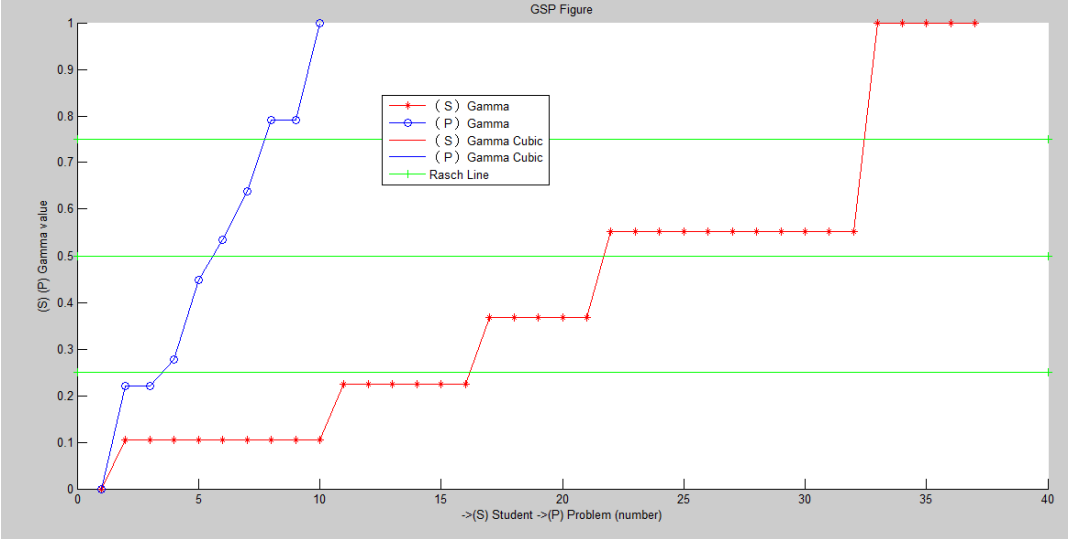

Figure 4: The GSP of English vocabulary - post-test.

ANALYSIS: RESULTS AND DISCUSSION

Based on the *Gamma* value in Figure 3 and Figure 4, engineering freshman students can be clustered into four groups according to their abilities, and the results are shown in Table 1 [19][20][23].

Table 1: Clustered group.

Group	Examination performance	*Gamma* value
A	High	$Gamma \geq 0.75$
B	Intermediate-high	$0.75 \geq Gamma \geq 0.5$
C	Intermediate	$0.5 \geq Gamma \geq 0.25$
D	Low	$0.25 \geq Gamma$

Obviously, there are two types of students whose English ability is above 0.5 in the post-test than in the pre-test. That is, engineering students benefit from learning vocabulary on Facebook, and the progress is shown in Figure 3 and

Figure 4. Moreover, the slope in Figure 4 is greater than Figure 3, which can be interpreted as having a more discriminating *ai* , and this means most of the engineering students performed better in the post-test. However, this Web-based learning may not be ideal for low-level students since there are still 16 students whose abilities (*Gamma* value) are below 0.25 in the post-test. This is probably because the low level students are easily distracted by other games, pop-out ads or interesting video clips while surfing the Internet. Or they may feel isolated, frustrated and anxious while doing the on-line assignment [12]. Therefore, it is suggested that the teacher could supervise these students and provide clearer instructions to let them understand the advantages of on-line learning.

CONCLUSIONS

The results of the study indicated that most engineering students improved their English vocabulary, after sharing their posts on Facebook. Some students even corrected others' errors, and gave feedback on Facebook. Students tended to provide and share more ideas on this social networking site than in the traditional English taught classroom. In the classroom, when the instructor asked questions, few students were willing to answer. However, when there were new posts on Facebook, there were comments given under the posts right away. Most students replied on Facebook, and showed that they enjoyed the flexibility of the on-line learning environment, and more innovative ideas were simulated, which also facilitated learning [12]. According to Maranto, Facebook emphasises categories and aspects of popular culture that teenagers find important [24]. Hence, teachers could combine Facebook with English learning to increase students' learning motivation. However, teachers need to provide clear instructions to ensure the academic usage of Facebook instead of the social one.

The study used the GSP chart to analyse engineering students' performances in a quantitative way. Students' abilities were clustered as shown clearly in the figures, which are better than the original SP chart. With the GSP chart, uncertain, multivariate, and discrete data could be conducted [16]. Also, it is easier for teachers to check individual students' progress using the figures and, then, teachers could not only provide remedial instructions, but also adjust the curriculum design to suit the engineering students' needs [25][26].

Finally, there were only 37 engineering students involved in this research, and it is suggested that future research could use a larger pool of participants. This stude only used quantitative measures to evaluate the data, but it could be better, if there was a qualitative approach, such as interviews or questionnaires to examine the students' proficiency levels.

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