A Comparative Study of Learning Motivation among Engineering Students in South East Asia and Beyond
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Engineers are vital to any prospering society and the effective and adequate training of the next generation of engineers is therefore crucial. Essential to the success of engineering education is the learning motivation among the students. Learning and motivation are highly complex facets of human behavior. People do learn from their experiences, while their willingness to learn is affected by a set of determinants.

Motivation is believed to be an enabler for learning and academic success. Therefore, the aim of every learning oriented entity is to explore the factors that enable and motivate individuals to learn. Motivation in learning is described as the desire to use the knowledge and skills mastered in associated learning activities. It constitutes a central force when going through process of learning activities.

Recent research primarily focuses on the need for achievement, which interacts with other variables to influence performance, and examined its relationship with work behaviour. Meanwhile, cognitive ability is found to moderate the relationship between need for achievement and performance.

Personal goals are important in determining performance. The mediating roles of self-efficacies of students towards academic achievements have been proved.

Research focusing on several important issues related to the theory of goal setting was carried out in the 1990s. This includes the study of goal difficulty-performance relationship, goal commitment in goal setting, personal goals and self-efficacy and effectiveness of goal setting. Self-efficacy generally refers to what a person believes he or she can do in a particular task. People with high-level self-efficacy are likely to set high goals and to perform well. Self-set goals are often more desirable than assigned goals because they automatically engender higher-level commitment. Cohesiveness within teams also positively relates to goal commitment.
Not surprisingly, team learning has been proved to be gaining importance as a developmental strategy. Team performance improvement is a result of collective-intelligence of a team, which exceeds the sum of intelligence of individuals. Knowledge gained by teams has been associated with realizable benefits in the form of improved performance.

To investigate the learning motivating factors of selected groups of students, a questionnaire for student learning teams motivating factors study was developed. The questionnaires comprised two parts. The first part solicited demographic information (program, mode of study). The second part addressed the motivating factors which may affect students’ learning motivation.

The preliminary questionnaire was used in the pilot study to help identify the key motivating factors and thus as basis for further refinements. The pilot study was carried in early 2007 (samples were collected from Norway, Hong Kong and Taiwan to assess differences related to culture).

The questionnaires comprised four parts. The first part asked for demographic information, such as level of study (undergraduate or postgraduate), mode of study (full time or part time), gender and the learning approach (if students were taking team-based/ action-based learning courses). The second part enabled the identification of the factors having positive motivating effect on learning. There were 23 statements of 6 motivating factor dimensions and their perception towards the learning approaches (team-based learning and action-based learning). A 1-6 Likert-scale scoring system was adopted, stating from ‘disagree very much’ to ‘agree very much’. The high score represented the strong positive motivating effect on learning. The discerning point was set to 3.5, i.e., in the middle of scale. The finalized questionnaires were first authored in English and then translated into traditional Chinese.

The questionnaire was developed in two stages. First, the pilot group was asked to evaluate the appropriateness of the learning motivating factor questions. These results provided a preliminary basis for a pilot instrument for further tests. Another round of larger scale pilot study was carried out in early 2007 for further refinements, which further confirmed the appropriateness of the statements set.

Data collection started in Hong Kong in January 2008. A total of 144 students from City University of Hong Kong were invited, and 79 returned the questionnaires. The data collected in Hong Kong included 67 undergraduate students, 12 postgraduate students, composing of full time and part time students. The students in Hong Kong were contacted during the class time to secure a high response rate while some of them were via e-mail with their forms submitted electronically. The data was manually entered into Microsoft Excel spreadsheets which were later imported into SPSS for statistical analysis.

Table 1. The results obtained for the 6 key motivating factors.
The results show that most of the constructs have strong evidence to indicate that they have positive motivating effect on learning except 'Punishment', this attracts our attentions and concerns.

Correlation of factors has also been testified. The simple correlation analysis indicates that all the motivating factors are significantly correlated with learning, except for 'Punishment'. The stepwise regression analysis was also carried out to help identify the predictors that most adequately predict responses on a dependent variable.

The stepwise regression model shows that all the five motivating factors entered into the regression model. The F change was significant at the 0.001 level. The R square value was sufficiently high (0.651) to show that the variation in this model accounted for most of the variance in the learning as perceived by students.

The 'Pulling forces' and 'Group Pressure' were significantly correlated with learning at 0.01 levels, and the standardized coefficients are rather large to indicate a significant correlation with learning. This implies, a change in these two components will definitely influence learning, and vice versa. The result supports the positive and corresponding relationship between these variable, thus justifying the assumptions on the influence of these components on learning while team and action based learning is facilitated.

In general, the extrinsic factors (i.e. ‘Pulling forces’, ‘Group Pressure’ and ‘Learning approach) may usually have some motivating effect while the intrinsic factors (i.e. ‘Individual attitudes and expectations’) are dominating.

From the correlation and stepwise regression results, it has been found that ‘Pulling forces’ and ‘Group Pressures’ are the two keys for motivating team-based and action-based learning. It can be easily understood that for the team-based action learning to be facilitated, a supportive environment with enabling extrinsic factors such as rewards and a group-based setting is essential.

In the meanwhile, the ‘Individual attitude and expectation’ still plays an important motivator role, what people expect and value of the a task may play an important role in defining whether this factor is effective in motivating people in team learning.
There was a tendency for the subjects to choose some of the factors as having great motivating effect such as high expectation of outcomes and group pressure. This implies that if the expectation is too high and the group is not capable of meeting it or the pressure is too large and causes some of the members in the group to lose confidence, the effect on overall team learning may be the reverse. In order to overcome this problem, to have a good understanding among the group members is very important. With good communication, desired cooperation and team commitment could often be realized, which would in turn help to motivate the learning team members.

The study also provides a means to examine how these factors influence learning among engineering students. Some of the extrinsic factors are closely related to one’s personality. For example, for some of the extrinsic factors like challenging work/job or punishment, how they influence and to what extent are greatly dependent on the personality of the group members and their individual value. This further reinforces the importance of proper settings for team based learning.

Additionally, the findings from the study thus give insights into the development of teaching inventories for engineering students. Both the learning group setting and learning objectives should be taken into consideration when course is being developed. To enable students to learn effectively, a supportive setting with enabling pulling forces (i.e. rewards, achievement, clear goals) and cooperative group-based learning environment (i.e., group pressure) should be provided. Knowing ‘What’ are the influencing factors, it leaves with the question about ‘How’ to find the factors that could motivate team learning effectively. One way is to try to correlate the factors identified with the team performance. As educators in the high education strive to provide good education, facilitating learning frameworks and approaches are designed and put into place in an attempt to achieve this goal. Educators thus need to be aware that the best course contents and structures are not enough. The motivation and learning setting affect the success of course designed to insure learning. Learning will not happen without motivation and supportive environment. Academics need to be aware of and account for the effects of student motivation in any studies that they conduct. If student motivation is lacking, the effectiveness of any intervention designed will be reduced. They also need to insure that continuing attention is paid to insuring that students are motivated at both individual and collective levels and have a clear vision of the subject being studied, both to increase the effectiveness of learning and higher level of performance.
The mechanisms that enable arm motion to enhance vertical jump performance—A simulation study

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Journal of Biomechanics 2008, 41 (9), 1847-1854

Although numerous studies have reported increased height with arm swing in standing vertical jumps, contradictory results have also been reported. Knee joint torque/work was found to decrease [1][2] or increase [3] in arm swing jumps. Increase in ankle joint torque/work was substantial in most studies but insignificant in some other researches [3][4]. This inconsistency may be due to different training or proficiency levels of the subjects, but these proficiency-related factors are difficult to control in experimental studies. Moreover, errors in data recording and smoothing are inevitable. The purpose of this study is to investigate the mechanisms which enhance vertical jumping performance by arm motion. Forward simulation without the disadvantages (e.g. errors in data recording or subject skill/psychological factors) in actual experiments is employed for the present study.

Two planar human body models with 4 and 5 segments (4S and 5S, respectively) are used to simulate the standing vertical jumping from a static initial posture to takeoff. Body segments are connected by frictionless hinge joints. Segments represent the feet, shanks, thighs, and head-arms-trunk (HAT) in model 4S. In model 5S the HAT is partitioned into head-trunk (HT) and arms with fixed elbow joint [1]. Torque $T$ generated at each joint is assumed to be the product of three functions: $T = T_{\text{max}}(\theta)h(\omega)A(t)$.

Here $T_{\text{max}}(\theta)$ depending on joint angle is the maximum isometric torque for both extremities. Joint angular velocity the dependence is modeled by $h(\omega)$. Hence the model preserves features of muscle force production depending on maximum isometric force, muscle length, and shortening velocity. The coordination strategy is characterized by activation level $A(t)$ which corresponds to the effective activation of muscles across the joint.

The objective is to optimize $A(t)$ such that jump height $J_o = (y_f + v_f^2/2g)$ is maximized. Here $y_f$ and $v_f$ are center of mass (CM) vertical position and velocity at the takeoff instant because jump height is purely determined by the 2 variables. The optimization is subject to constraints such as the takeoff condition which requires zero ground reaction force (GRF) calculated with simulated CM acceleration. To prevent joint hyperextension, joint ranges of motion are also constrained. In addition, a rotational spring-damper system generating exponentially increasing passive torque is applied at the toe joint to prevent
the heel from penetrating the ground [5].

Simulated jumps with arms (5S) and without arms (4S) are compared (Table 1 and Fig. 1). With arm motion height is increased by 0.091 m. About 62% of the height increase is due to increased vertical velocity at takeoff, and 38% is from higher CM position (due to raised arms). Although movements start from squat postures, minor joint flexion (countermovement) still occurs prior to upward extension. Arm motion results in longer contact duration and greater total work done (Table 1). The duration in which hip angular velocity starts to increase is about 0.11s longer in 5S.

<table>
<thead>
<tr>
<th>Feature</th>
<th>4S</th>
<th>5S</th>
</tr>
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<tbody>
<tr>
<td>CM height at takeoff (m)</td>
<td>0.9296</td>
<td>0.9639</td>
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<tr>
<td>CM vertical velocity at takeoff (m/s)</td>
<td>2.5095</td>
<td>2.7213</td>
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<tr>
<td>Maximum CM height after takeoff (m)</td>
<td>1.2506</td>
<td>1.3413</td>
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<tr>
<td>Total contact duration (s)</td>
<td>0.4344</td>
<td>0.5831</td>
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<tr>
<td>Ankle joint work (N-m)</td>
<td>104.2856</td>
<td>96.8006</td>
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<tr>
<td>Knee joint work (N-m)</td>
<td>104.8377</td>
<td>86.2193</td>
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<tr>
<td>Hip joint work (N-m)</td>
<td>163.3235</td>
<td>239.6418</td>
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<td>Shoulder joint work (N-m)</td>
<td>N/A</td>
<td>54.7499</td>
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<tr>
<td>Work done during contact (N-m)</td>
<td>372.4469</td>
<td>477.4116</td>
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</table>

Table 1 Features of simulated jumps with (5S) and without (4S) arm motion

The expected pattern of relaxation followed by maximal extension ($A(t) = 1$) is observed in all joints in both jumps (Fig. 2). In the 4S jump the knee starts to relax first and also activates first, followed by hip and ankle activation. In the 5S jump the shoulder relaxes first but the actual activation starts in the sequence of hip, shoulder, knee, and ankle. Except the shoulder, joint torques decrease to about zero at takeoff.
Different vertical GRF profiles are observed in jumps with and without arm motion (Fig. 3). In 5S jumps a small pulse (slight increase and decrease of force) exists before the GRF reaches its maximum. Two kinds of GRF patterns are obtained in searching for optimal 5S jumps. One involves shorter or nearly identical upward thrust duration compared to 4S jumps but with larger GRF before takeoff (5S, Fig. 3). The other pattern (5Sa) with slightly less jump height contains longer upward thrust duration but about the same maximum GRF compared to the 4S jump. The vertical component of the force applied to the arms at shoulder is mostly positive throughout ground contact, implying that the arms are pushed upward by the trunk for most of the time.

Substantial negative power (implying eccentric muscle contraction) prior to maximum power production is observed in almost all joints in 5S jumps. But in 4S jumps this is noticeable mainly in the knee and slightly in the hip. With arm swing joint work is 7% less in the ankle, 18% less in the knee, but 47% more in the hip compared to the no-arm jump (Table 1). Together with the additional shoulder joint work, total work production is 28% more in the 5S jump.

From the simulation results theories explaining the mechanisms enhancing jump performance by arms can be examined. The force transmission theory is doubtful because the change in vertical GRF does not exactly correspond to shoulder joint force caused by arm motion. The joint torque/work augmentation theory is acceptable only at the hip rather than the knee/ankle because only hip joint work is considerably increased. The pull/impart energy theory is also acceptable because shoulder joint work is responsible for about half of the additional energy created by arm swing.

References

1. Ashby, B.M., Delp, S.L., 2006. Optimal control simulations reveal mechanisms by which arm

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The Pd/TiO₂/n-LTPS Thin Film Schottky Diode on Glass Substrate for Mass Market Hydrogen Sensing Applications
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Recently, hydrogen in being considered as a new energy source for its abundance, however, hydrogen is also a colorless, odorless, and extremely flammable gas with a lower explosive limit of 4% in air. Hence, hydrogen sensors have been widely studied, and applied in many fields, such as space launch vehicles, industrial leak detection, and automobile fuel additives. Nevertheless, most of these sensors were based on electrochemical techniques, thus for compact structure and more convenient preparation, the semiconductor type hydrogen sensors prepared on Si or III-V compound substrates were also extensively studied. However, these substrate materials are expensive for fabricating low cost, room temperature sensors for mass markets. In this work, we developed a new type of low cost hydrogen-sensing device with the n-LTPS (n-type low temperature polysilicon) thin film for the purpose applications. The n-LTPS was formed by applying ELA anneal and Phosphorus (P) plasma treatment sequentially on an amorphous Si (a-Si) thin film on glass substrate. After the plasma treatment, the n-LTPS has a high doping concentration of $3 \times 10^{16}$ cm$^{-3}$ to generate a large quantity free carrier. And its surface is rough (see AFM photo in the insert of Fig. 4), so that the n-LTPS has a higher surface-to-volume ratio for adsorbing a larger number of hydrogen atoms to react, thus improving the sensing performance. The LTPS has been successfully used in preparing high-speed thin film transistor (TFT) for large area TFT-LCD or organic LED display applications. To our knowledge, this is the first time to apply the material for hydrogen sensing.

In this paper, we report both fabrication and characterization of the new sensing device with Pd/TiO₂/n-LTPS/glass structure in details. The material and preparation cost of the device are lower than that prepared with bulk Si or compound material. Specially, the developed MOS Schottky diode has a very good selectivity for hydrogen gas over other interfering gases, thus promising for mass applications in low cost and high hydrogen sensing.

Figure 1 shows the measured current-voltage (I-V) characteristics of the Pd/TiO₂/n-LTPS MOS Schottky diode under forward/reverse biases and various H₂ concentrations with HP4145B at room temperature (27 °C). As shown, the sensing
currents increase with increasing hydrogen concentration for both forward and reverse biases. In air ambient, the leakage currents are lower and constant under reverse biases, in contrast to the increase with increasing forward bias. We suspect in air ambient and under reverse bias, the barrier is high (see insert of Fig. 2) thus blocking the transport of carriers, and results in a lower current. While as exposing to a hydrogen gas ambient, hydrogen molecules are adsorbed on the surface of Pd catalytic metal, and dissociated into hydrogen atoms. Subsequently the H₂ atoms diffuse through the thin Pd metal film and accumulate in the interface Pd/TiO₂ to form a dipolar layer on there. The dipolar layer builds a local field to lower the Schottky barrier height, thus enhancing the electrons to inject from the metal side into the n-LTPS layer and results in a higher current. The higher H₂ concentration causes the larger barrier lowering, consequently, the current increases with increasing the hydrogen concentration.

Figure 2 presents the transient response curves of the device operated at –2 V and 27 °C under the introduction (H₂/air on) and the removal (H₂/air off) of the hydrogen gas for various H₂ concentrations ambient. The measurements were repeated 5 times for each H₂ concentration ambient, with a relative standard deviation of 4-5 %. All of the response curves rise very rapidly upon the introduction of H₂/air gas (H₂/air ON). Based on these curves, the response time (τ_res) defined as the time for the current from initial value to 90% of the final steady state value was extracted and listed in the figure. The τ_res decreases with increasing the hydrogen concentration, for example, it decreases from 40 sec for 50 ppm to 17 sec for 8000 ppm. These response times are less or comparable to the reported in Si, or in III-V compound H₂ sensor. Specially, as shown in the insert, the relationship between the sensing current and hydrogen concentration is almost linear in steady state for the hydrogen concentration less than 800 ppm. Over the concentration, owing to the coverage of hydrogen atoms at the Pd-TiO₂ interface, the relation is shifted from a linear with less current change rate. Another figure of merit for a H₂ sensor is the relative signal ratio defined as Sr(%) = ((I_H₂ – I_air) / I_air) × 100%, where I_H₂ and I_air are currents measured under hydrogen and air ambient, respectively.
Fig. 2 Transient response curves of the developed device operated at reverse bias and room temperature for various hydrogen concentrations ambient. The response times ($\tau_{\text{res}}$) are also listed in the figure. The insert (upper) gives the sensing current at 60 sec after introduction of hydrogen/air as a function of hydrogen concentration. While the bottoms insert shows the schematic energy band diagram of the reverse biased Pd/TiO$_2$/n-LTPS/glass MIS Schottky diode.

Figure 3 gives both Sr(%) (top) and $\tau_{\text{res}}$ (bottom) of the device under $-2$ V bias and different hydrogen concentrations ambient for various temperatures. It shows a negative dependence on temperature; for example, as the temperature is elevated from 27 °C to 150 °C, Sr(%) and $\tau_{\text{res}}$ decrease from 3504 to 86, and 17 to 5 sec, respectively, for the hydrogen concentration of 8000 ppm. This is because the kinetic reaction of the hydrogen adsorption is an exothermic reaction, thus according to Temkin isotherm behavior, the hydrogen coverage decreased with increasing temperature. Therefore, we suspect the negative temperature dependence of the Sr(%) to the smaller hydrogen coverage at higher temperature. It worthy to note, the Sr(%) of 3504 for 8000 ppm under room temperature is also higher than the $10^2 \sim 10^3$ of the reported H$_2$ sensors prepared on Si, or $\sim 2600$ on III-V compound substrate. The shorter response time in a higher temperature is mainly caused by the higher catalytic Pd metal reaction rate, the increased hydrogen dissociation, and diffusion coefficients under high temperature.

Moreover, as compared in Fig. 4, the Sr(%) at $-2$ V under 27 °C and 8000 ppm H$_2$/air ambient has 7.6, 14, and 30 times over that in C$_2$H$_5$OH, C$_2$H$_4$ and NH$_3$ various gas ambient with same 8000 ppm in air, respectively. Thus, the device demonstrates a good selectivity for H$_2$ gas over other interfering gases.
containing H atom.

Fig. 4 Comparison of relative sensitivity ratio Sr (%) of the Pd/TiO₂/n-LTPS/glass MIS Schottky diode operated at -2V versus temperatures for H₂, C₂H₅OH, C₂H₄ and NH₃ gases ambient, respectively. The insert gives the AFM images of the LTPS films without (left) and with (right) PH₃ plasma treatment. After treatment, the roughness is increased, thus the reaction area and results in higher Sr (%). The measurements were repeated 5 times for each H₂ concentration ambient, with a relative standard deviation of 4-5 %.

In summary, the hydrogen gas sensing characteristics of the Pd/TiO₂/n-LTPS/glass MOS Schottky diodes were studied in details. Under -2 V biased and room temperature, the MOS Schottky diode has a high relative signal ratio of 3504%, and fast response time of 17 sec in 8000 ppm H₂ gas ambient. These sensing abilities are better or comparable to the H₂ sensors prepared on Si or III-V compounds. In addition, in room temperature, the developed diode shows 7.6, 14, and 30 times higher relative signal ratio in 8000 ppm H₂/air ambient over that in same concentration interference gases of C₂H₅OH, C₂H₄, and NH₃ ambient, respectively. Therefore, the developed device provides a promise for low cost mass market application hydrogen gas sensors operating at room temperature.