Improving study methods of computer engineering undergraduates in Singapore


IMPROVING STUDY METHODS OF COMPUTER ENGINEERING UNDERGRADUATES IN SINGAPORE

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Abstract

The Nanyang Technological University admits predominantly two large groups of entrants annually for its computer engineering undergraduate course, namely, the junior college graduates with GCE 'A' levels and polytechnic graduates with Technician Diplomas. This study is aimed at assessing these engineering undergraduates common difficulties and identifying differences in their study processes and habits in order to provide guidelines to help them attain better study methods.

A survey methodology utilising two sets of questionnaires to assess the two dimensions of study processes and study habits were carried out using a sample of 55 undergraduates. On the basis of the results of the study, it was found that contrary to expectations, both groups of students are not distinctly different in their study process and habits. The students demonstrated a preference in adopting the surface approach to learning with focus on rote learning strategies to minimally meet course requirements. This is contrary to the general trend in higher education that advocates the deep or deep-achieving approach to learning. In this paper, a framework to reverse such a trend and improve students’ study methods is proposed. It adopts a parallel approach to help students at the individual, small group and class level. Through this framework, it should be possible to transform students to adopt a deep-achievement approach in their learning in order to benefit from the university’s education system.

Introduction

Upon entering the School of Applied Science of Nanyang Technological University (NTU) in Singapore, each student receives an information handbook and is assigned an individual counsellor who is a member of the teaching staff of the school. The handbook contains information on the course curriculum, lecture and laboratory time tables, guidelines for laboratory log-book keeping, report writing, assignment and examination requirements, student counselling services and guidelines, and answers to a list of frequently asked questions.
The student meets the counsellor during the 'add-and-drop' period at the commencement of each semester for subject endorsement and advice. This is the time when a student will decide and register for subjects that he or she wishes to take during the semester. The counsellor will endorse these subjects prior to final approval by the school. In this arrangement, each new student will meet with his or her assigned counsellor within a few days after joining the school.

The counsellor plays an important role of a mentor to guide the student throughout his or her stay in the university. One of the main objectives of a counsellor is to facilitate discussion and provide advice on problems encountered by students in adapting to life as an undergraduate, particularly in areas of study (course-work and examinations), time management (extra-curricular activities and studies) and career guidance.

New staff joining the school are briefed on the counselling scheme and given an academic information handbook. Typical information in the handbook includes teaching, examination, research, industrial attachment and administrative responsibilities, student counselling guidelines and other information. As new staff are recruited globally, each with his or her own perceptions and expectations of the requirements of the university and the students, such a handbook proves extremely useful and beneficial to help staff adjust quickly and be aware of the requirements of the school.

Regular student and staff briefings, surveys and feedback sessions are organised during the semester to assure the effectiveness of the counselling scheme. This study is aimed at assessing common difficulties, study processes and habits of new computer engineering undergraduates in order to provide additional guidelines in these handbooks. The research aims to help students attain better study methods and improve the quality of education in the university.

Local undergraduate entrants to the university are made up of two groups of graduates, namely, junior-college (JC) graduates with GCE 'A' levels and polytechnic graduates with technician diplomas. These two groups of entrants are perceived to be different, each with different problems, motivation levels, study methods and attitudes. The research attempted to explore these taken-for-granted differences so that, if necessary, two separate sets of guidelines could be formulated. This perceptual difference stems from the general acceptance that the main emphasis on JC students is geared towards attainment of good grades at the 'A' level examinations, while the polytechnic students are subjected to more hands-on training to produce diploma holders who will enter the workforce directly as engineers upon graduation. In addition, JC graduates are also thought to be less prepared for the practical, inquiry-type of teaching and learning conducted in engineering-based courses (such as computer engineering) in the university.

After the completion of their post-secondary studies, all local male citizens are required by law, to serve two and a half years of National Service in the Singapore Armed Forces, either in the army, navy or air force. In addition, polytechnic graduates are normally expected to work for at least two years before they are eligible to apply for admission to the university. Many of the polytechnic graduates support themselves financially at
university. Therefore, these graduates are thought to be more mature, highly motivated and better prepared. In terms of age, polytechnic graduates are generally three years older than their JC counterparts.

This study uses a two-stage survey methodology to examine study processes and habits of these two groups of students with the aim of identifying differences, unique patterns as well as common difficulties. With this, a framework for improving the study methods of undergraduates is proposed. This paper is divided into five sections. Section 2 introduces the concepts of study process and habits and provides information on the methodology used in the study. Results from the survey and analyses are presented in Section 3 to highlight common difficulties, contrast study processes and habits, and to co-relate factors among them. Section 4 proposes a framework for improved study methods. The paper concludes with a summary and pertinent findings of the study.

**Basic Concepts and Study Methodology**

Study process is concerned with the approaches used to master academic material such as note-taking, writing skills and the process of learning and utilising academic materials. On the other hand, study habits refers to the behaviours associated with studying (excluding methods used to learn or utilise academic material) such as time management and anxiety reduction.

Research in students' approaches to learning has shown that they tend to engage themselves between rote and meaningful learning (Ausubel, 1985) and alternately, through the three approaches of surface, deep and achieving learning (Biggs, 1987). Bigg's model has been adopted widely within the Asian context to provide a framework of research to address the learning strategies adopted by students and university graduates (Samuelowicz, 1987; Chang, 1989; Watkins et al., 1991; Biggs, 1992).

In the **surface approach**, the motive for students is to meet requirements minimally which essentially become a balancing act between failing and working more than is necessary. This is achieved through a strategy of learning only the essentials and reproducing them through rote learning (memorisation).

In the **deep approach**, the motive stems from an intrinsic interest in what is being learned in order to develop competence in subject areas. This requires the discovery of meaning through reading widely and inter-relating with previous relevant knowledge.

In the **achieving approach**, the motive is to enhance ego and self esteem through competition and to obtain the highest grades irrespective of whether the material is interesting. The strategy is to organise one's time and working space in order to follow up on all suggested readings, time schedules and behave as a 'model student'. As such, it is possible for a student to combine an achieving approach with either a surface or a deep approach (i.e., surface achieving or deep achieving).
In carrying out the study, a two-stage survey methodology was used to derive common difficulties faced by these two groups of students and obtain data to allow comparisons between study processes and habits to be made. A sample of 55 students out of a total annual intake of 300 was randomly chosen for the survey. As the survey was rather long and time consuming, a sample was preferred over the whole population for practical reasons of administration and analysis. Of the 55 surveyed, 29 were polytechnic graduates (52.7%) while the remaining 26 were JC graduates (47.3%). No attempt was made to distinguish results from different genders as the course is predominately male oriented.

In the first stage of the survey, conducted three months after admission, respondents were asked to reveal their perceptions about the course at that point in time, confirm their ability to cope with the course load and curriculum and the three most severe problems they have encountered. Information from this survey was compared with records of common difficulties obtained from student counselling feedback from the past. This revealed a set of common difficulties faced by students (see next section) in line with expectations.

In the second stage of the survey, the study adopted two questionnaires, namely, the Study Process Questionnaire (SPQ) (Biggs, 1987) and Study Habits Questionnaire (SHQ) (Bragstad & Stumpf, 1982), to allow patterns of study processes and habits to be identified and analysed.

The SPQ is a 42 item self-report questionnaire designed to assess the extent to which a respondent endorses different approaches. Each item is a self-report statement of a motive or strategy. The respondents rate themselves on the statement on a 5-point scale, from 5 (being an item that is always or almost always true of me) to 1 (being an item that is never or only rarely true of me). "I choose my present courses largely with a view to the job situation which I graduate rather than out of their intrinsic interest to me" and "I find that at times studying gives me a feeling of deep personal satisfaction" are the first two items that are indicative of the type of statements found in the questionnaire. The questionnaire will yield scores on the three basic study approaches and allow one of the six profiles to be obtained: deep, achieving, deep-achieving, surface-achieving, surface, low achieving. On the basis of such categorisation, a set of individual guidelines can be applied for counselling purposes.

Similarly, the SHQ is a 50 item self-report questionnaire designed to obtain information from a respondent about their study habits. The original version of the SHQ is modified in the survey to have five grades on each item. Additionally, each item is negated in order to accumulate correct scores. This change is necessary to maintain consistency between these two sets of questionnaires and for ease of subsequent computations and comparisons. "I don't have much trouble finishing tests on time" and "I set aside a regular time for studying every day" are the first two items of the questionnaire. This questionnaire will yield scores on seven basic study habits of concentration, remembering, organising time, chapter study, listening and note-taking, test-taking and motivation to study.
Comparison of Junior College and Polytechnic Students Study Approaches

In line with expectations, the first stage showed that both groups of students experienced similar problems without any clear indications that some problems are attributed solely to one group or the other.

Many students come to the university with considerable enthusiasm and aspirations to face new challenges offered by the course. The objective of university education seems clear at the beginning. However, after a few months of hectic university life, many students face problems adjusting to the new workload and lifestyle (which include independent living in university hostels away from the family for the majority of the time). Some students who seem initially motivated soon lose their initial enthusiasm. They feel overwhelmed by lecturers’ expectations of independent study and enquiry as well as tutorial and laboratory assignments. Students who enter the university without adequate preparation often cannot make sense of the teaching, lag behind and quickly becomes demoralised. Some students even begin to question their choice of course.

Many students have problems studying. Our past experiences show that students seeking help from counsellors have often cited study problems as one of their main concerns. Some male students after National Service, appeared to have 'forgotten how to study and 'forgotten most of the material studied previously'. Study problems may not necessarily imply that students are poor in terms of study processes, rather, it can be a case that students fail to apply those processes due to deficient study habits.

The two questionnaires from the second stage of the study should therefore allow us to confirm some of these observations and to identify differences among their study processes and habits. In both cases, raw data from respondents were converted and processed to yield a set of mean scores for comparison.

![Bar Chart]

**Figure 1.** SPQ: Mean Scores of the Three Study Approaches
Figure 1 shows the mean scores (out of a total of 100%) for the SPQ questionnaire. In terms of study approaches, both groups were evidently characterised by the same order of preferences, namely, surface approach, followed by deep approach and achieving approach. Higher mean scores were reported for all cases of polytechnic graduates. These scores indicate that the surface approach whose strategy of bare-essentials through rote-learning is most favoured by both groups of respondents. However, the 70.34% score of polytechnic graduates in surface approach is above the "average" value reported by Biggs (Biggs, 1987). According to him, steps should be taken to remedy this as such students tend to underestimate their own performance relative to peers and are dissatisfied with their performance. However, using a t-test, there is no significant difference in scores between the two groups (P > 0.05), which suggests that their study approaches are not different (Table 1).

Table 1. Results of t-test on study approaches

<table>
<thead>
<tr>
<th>Study Approaches</th>
<th>Mean Difference</th>
<th>Standard Deviation</th>
<th>t-value</th>
<th>Degree of freedom</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>&gt;0</td>
<td>7.65</td>
<td>-1.0489</td>
<td>53</td>
<td>0.2990</td>
</tr>
<tr>
<td>Deep</td>
<td>&gt;0</td>
<td>9.14</td>
<td>-1.2640</td>
<td>53</td>
<td>0.2130</td>
</tr>
<tr>
<td>Achieving</td>
<td>&gt;0</td>
<td>8.74</td>
<td>-10.448</td>
<td>53</td>
<td>0.3008</td>
</tr>
</tbody>
</table>

In addition, it is observed that both groups scored low in the achieving approach. This approach which exhibits characteristics of high self motivation and efforts to make use of material in order to learn rather than relying on rote-learning, is lacking among the undergraduates. This may have implications in subsequent years since basic foundation material covered in the early years forms the basis for the introduction of more complex material in later years. Students are thus likely to face more difficulties subsequently.
Table 2. Results of t-test on study habits

<table>
<thead>
<tr>
<th>Study Habits</th>
<th>Mean Difference</th>
<th>Standard Deviation</th>
<th>t-value</th>
<th>Degree of freedom</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration</td>
<td>&gt;0</td>
<td>3.50</td>
<td>0.6307</td>
<td>53</td>
<td>0.5310</td>
</tr>
<tr>
<td>Remembering</td>
<td>&gt;0</td>
<td>3.08</td>
<td>-0.8129</td>
<td>53</td>
<td>0.4199</td>
</tr>
<tr>
<td>Organising Time</td>
<td>&gt;0</td>
<td>3.04</td>
<td>1.2210</td>
<td>53</td>
<td>0.2271</td>
</tr>
<tr>
<td>Chapter Study</td>
<td>&gt;0</td>
<td>3.03</td>
<td>-0.4023</td>
<td>53</td>
<td>0.6890</td>
</tr>
<tr>
<td>Listening &amp; Note-Taking</td>
<td>&gt;0</td>
<td>3.69</td>
<td>1.1490</td>
<td>53</td>
<td>0.2557</td>
</tr>
<tr>
<td>Test-Taking</td>
<td>&gt;0</td>
<td>4.20</td>
<td>0.5665</td>
<td>53</td>
<td>0.5734</td>
</tr>
<tr>
<td>Motivation</td>
<td>&gt;0</td>
<td>3.27</td>
<td>1.3731</td>
<td>53</td>
<td>0.1755</td>
</tr>
</tbody>
</table>

The two groups had similar study habit according to the results of the SHQ questionnaire (Figure 2). In terms of absolute numbers, the JC graduates scored higher means in terms of concentration, organising time, listening and note-taking, test-taking and motivation. However, there were no significant differences between the two groups at any of the dimensions (Table 2). Contrary to belief, these findings suggest that the study approaches
and habits of JC and polytechnic graduates are not really different in spite of their supposedly different post-secondary study emphasis and route to the university.

**Correlation Between Study Approaches And Study Habits**

Table 3: Correlation matrix of study approaches and habits

<table>
<thead>
<tr>
<th></th>
<th>Surface Approach</th>
<th>Deep Approach</th>
<th>Achieving Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Concentration</strong></td>
<td>0.29767 (0.0245)</td>
<td>0.05248 (0.6884)</td>
<td>-0.0054 (0.9682)</td>
</tr>
<tr>
<td><strong>Remembering</strong></td>
<td>0.50997 (0.0001)</td>
<td>0.28219 (0.0334)</td>
<td>0.38033 (0.0035)</td>
</tr>
<tr>
<td><strong>Organising Time</strong></td>
<td>0.42992 (0.0008)</td>
<td>0.1803 (0.1795)</td>
<td>0.26476 (0.0466)</td>
</tr>
<tr>
<td><strong>Chapter Study</strong></td>
<td>0.25224 (0.0584)</td>
<td>0.3127 (0.0179)</td>
<td>0.40428 (0.0018)</td>
</tr>
<tr>
<td><strong>Listening and Note-Taking</strong></td>
<td>0.05080 (0.7074)</td>
<td>0.29959 (0.0236)</td>
<td>0.36779 (0.0049)</td>
</tr>
<tr>
<td><strong>Test-Taking</strong></td>
<td>0.42826 (0.0009)</td>
<td>0.37508 (0.0040)</td>
<td>0.42713 (0.0009)</td>
</tr>
<tr>
<td><strong>Motivation</strong></td>
<td>0.17955 (0.1814)</td>
<td>0.37996 (0.0036)</td>
<td>0.24278 (0.0688)</td>
</tr>
</tbody>
</table>

**Significant** | **Non significant**

The two complete sets of SPQ and SHQ results could be cross-linked to further explore the relationship between study approaches and habits. Table 3 shows the correlation matrix along the dimensions of study approaches and study habits. Each entry in the table consists of a correlation value and a corresponding value of significance of the correlation (shown in brackets). Entries that have significance values < 0.05 are highlighted in the table. This implies that such values are significant.

Observations from the results provide further confirmation of established research findings. Surface approach strategies conform to remembering, concentrating, organising
time and taking tests. It is aimed at remembering and reproducing through memory what is learnt in a test or examination without demonstrating deep understanding of subject material. It demands time organisation since the motive is to work as little as possible and meet requirements minimally.

Deep approach strategies, on the other hand, require a high motivation level with a desire to learn. It conforms to remembering, chapter study, listening and taking notes, all of which contributes to deep learning through inter-relating knowledge gained with previous relevant knowledge.

Finally, in the achieving approach, it is observed that apart from concentration and motivation, all other aspects of study habits are significant. Taking tests with the aim to achieve the highest grades regardless of interest in subject material can be coupled with either strategy of surface and deep approach. Between the two, the surface-achieving approach appears to be the preferred choice.

**A Proposed Framework for Study Method Improvement**

The study has so far shown that the JC and polytechnic graduates are largely not dissimilar in study processes and habits despite the difference in emphasis in post-secondary education and route to university. This may reflect on the homogeneity of the ten years of primary and secondary school education system in Singapore that have largely moulded their learning skills and study approaches. Therefore, one set of guidelines would suffice for both groups of students.

The study has also shown the students' preference towards the surface approach and their reliance upon rote-learning to passing examinations. Studies carried out in various parts of the Asian Pacific region have found that students who adopted the surface approach tend to fare poorly in academic assessments compared to those who adopted the deep and achieving approach (Svensson, 1977; Watkins, 1983; Rossum & Schenk, 1984; Watkins et al., 1986; Chang, 1989; Biggs, 1992).

This preference of surface approach among students may not be of choice but could be attributed to the heavy engineering curriculum structure, course contents, assignments, deadlines, examination pressures and delivery styles of lecturers in local universities (Gow & Kemper, 1990; Watkins et al., 1991; Biggs, 1995). Additionally, lecturers may tend, by choice or under students' pressure, to adapt the task to suit the students' high need for structure, intellectual conformity and heavy reliance upon memorisation.

Another possible factor is the lower quality of the entrants to the course. Entrants who fall just below, or are at the marginal level for which the course is designed would obviously have a higher likelihood of experiencing difficulties in coping with course requirements. All these observations provide scope for further study and confirmation.

With the last chance of full time training in the university before joining the workforce, it is highly desirable for students to transform and engage themselves from surface learning
to more meaningful and deep learning. It has been conclusively shown in research that in comparison with rote learning, meaningful and deep learning results in superior retention of most types of complex material over long periods of time. It also results in greater portability of transfer of complex learned material to other areas of abstract learning and thinking and to problem solving in real life situations in industry (Ausubel, 1985; Pauk, 1989; Gibbs, 1992; Meyer & Jones, 1993).

Making the assumption that radical and major changes in the education system are not likely to happen in the near future, a framework to improve study methods is proposed and shown in Figure 3. Advocating a deep approach to learning, although it is the ideal long term goal, may not practical and achievable due to existing constraints so that the next best target is the deep-achieving approach. This focus is still on the attainability of good grades but through the avenue of reading widely and seeking meaning in an organised and systematic way.

In this framework, a three prong parallel approach at the individual, small group and class level is suggested to transform students in adopting a deep-achieving approach to learning.

**Individual Level**

At the individual level the focus is on self-assessment and monitoring. It is through this process that students can be made consciously aware of their own learning preferences, strengths and weaknesses, and become more self-monitoring on an ongoing basis (Entwistle & Tait, 1992; Costa & Garmston, 1994). Self-report and self-management questionnaires such as SPQ, SHQ may be individually administered by the students themselves on a regular basis.

Results of the self-assessment may lead to two different paths. The first enables inherent weaknesses such as lack of specific study skills, study habits, examination techniques, time-management, stress-management and project-management skills, and so on, to be identified. With these identified, the next stage is to seek improvement in these affected areas. This could take the form of skills-training workshops, seminars, educational video tapes, software packages, individualised help and advice on study and self-management skills through counselling. Such information could be made available in the students’ and staff handbook for reference. Once administered, this constructive self-reflective process should be encouraged on a continual basis.
Figure 3. Framework for Study Methods Improvement
On the other hand, there could be students coming out of the self-assessment stage without any apparent weaknesses. Such students can actually be quite versatile on study skills and self-management techniques but may have failed to apply such skills and techniques in sufficient amounts or in appropriate contexts. **Metalearning**, which refers to the ability to monitor, modify and selectively apply one's own learning process (Flavell, 1976; Biggs, 1987; Einstein et al., 1990), could be applied to help them assess task demands, estimate time requirements, and differentiate the types of strategies that are needed in order to achieve their goals. If necessary, it may involve the acquisition of new skills or relearning old ones. Over time, students should move towards and improve upon their metalearning capability as they become more independent learners.

**Group Level**

Group counselling is another technique in this framework to allow small group meetings to take place and to offer group support and identify common problems among members. Many students have reported that they felt relieved and comforted to know that they are not alone in experiencing study problems. In addition to the advantages exhibited in group *norming* and *cohesiveness*, such meetings provide a medium for staff and peer counselling, exchange of experiences at skills' acquisition and training, and first-hand reporting of application of such techniques to various course assignments and requirements (Costa & Garmston, 1994).

Counsellors can make use of group meetings to reinforce the importance of meaningful learning and self-assessment and monitoring. However, it is important for the counsellor to account for variability among students especially at the first few meetings when group norms are at its infancy stage and to avoid laying down absolute rules or a list of 'do's and 'don't's. There should a realistic time table for students to respond to the individual approach. More emphasis on individual counselling may be necessary at the early stages. When common group problems are identified, special workshops or seminars could be arranged for the whole group. The outcome of this approach, therefore, can result in further skills acquisition and retraining, and a need to improve an individual's metalearning process.

**Class Level**

At this level, there should be a continual reinforcement by lecturers on the importance of meaningful and deep learning in higher education. Students should be made aware of the beneficial consequences in such an approach and encouraged to take a keen interest in the course and course material. The motive of higher education -- to train students to acquire skills to analyse, synthesise, conceptualise, think critically, be self-disciplined and able to apply problem-solving skills to real life situations (Donald, 1996), should be delivered in conjunction with course material. Explicit communication of why a topic is necessary and how it should be approached is desirable in order to raise the level of interest in the subject.
For example, in the teaching of Laplace transforms, it should not be introduced as a need to learn a new mathematical technique for solving differential equations and corresponding initial and boundary value problems by transforming it into a set of algebraic equations for which a solution can be obtained. Instead, the emphasis could be placed to show how engineering and non-engineering problems can be formulated and modelled into suitable forms that allows Laplace transforms be used to yield the solution and the interpretation of these solutions in the real world context. In contrast to the earlier mechanistic approach, the latter focus on the application of why there is a need to learn the transforms and shows how it can be applied to solve various problems. With an increase in motivation level, students become interested and involved especially when it is coupled with effective tutorials to further reinforce concepts.

In conducting courses, lecturers make assumptions of students’ motivation levels, their ability to cope, their level of competence in study skills and habits, and preferences for course delivery. They have their own set of expectations for students to meet. Such expectations should be made explicitly clear at an early stage to ensure that students are fully aware of course requirements and assessment methods. This minimises incongruence in expectations that might otherwise arise.

Since students adopting the surface approach to learning have shown a tendency to be heavily involved with peer comparison, easily dissatisfied with their own performance and highly defensive in situations involving public evaluation for fear of losing face in front of their classmates (Biggs, 1987), it becomes important to practice privacy of performance evaluations and to avoid public dissemination of evaluation results such as test scores.

In this framework, there is a need to continuously review the changes that are taking place and provide a feedback loop to initiate the whole process again or to fine tune the various dosages of techniques and approaches over time. Once students have reached the desired goal and become independent learners, metalearning becomes the primary focus and minimal involvement at the small group and class approaches are needed.

The success of this framework hinges heavily on the continuous interest, support and commitment from administrators and lecturers (who are also counsellors) of the school. Counsellors must be proficient in counselling skills and study skills support. A strong rapport between students and lecturers is also needed to build up a level of trust so that effective advice and counselling can take place.

**Conclusions**

This study dispels the belief that the two main groups of university entrants, namely, the JC and polytechnic graduates, are distinctively different in terms of study processes and habits. In undergoing the first year computer engineering course, both groups have shown a strong preference in adopting the surface approach that relies heavily on rote-learning. A number of factors are proposed to explain the apparent preference to such an approach to learning. These factors can form the basis for future study and research. In addition,
these findings can be extended and compared with other engineering schools and other disciplines within the university to ascertain if such observations are peculiar to computer engineering undergraduates only.

The adoption of the surface approach to learning is contrary to the aim of most universities that advocate meaningful and deep learning in order to develop graduates who are able to conceptualise, think and apply their problem solving skills to real life situations. A framework is proposed in this paper to allow students to make the transition to the deep-achieving approach. It is a parallel three-pronged approach aimed at working at the individual, small group and class level. This transformation is not easy as it is difficult to undo the 12 to 13 pre-university years of education that have largely moulded and instilled preferences on students' approach to learning. Recently, there have been a call by the Minister of Education in Singapore for a change to increase the use of pedagogical approaches to simulate students' higher-order thinking and problem solving skills at all levels of education (Lee, 1995). This change should take place, preferably sooner than later.

Disclaimer

This article does not necessarily reflect the beliefs of the authors' employing education authority.

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