Journal of Engineering and Applied Sciences 13 (2): 275-281, 2018
ISSN: 1816-949X

Cognitive Performance of Technical Students in an Undergraduate Entrepreneurship Course

[1]Chee-Ming Chan, [2]Alina Shamsuddin and [3]Azeanita Suratkon
[1]Centre for Graduate Studies,
[2]Centre for Academic Development and Training,
[3]Faculty of Civil and Environmental Engineering,
Universiti Tun Hussein Onn Malaysia, Johor, Malaysia

Abstract: In the national higher education shift towards nurturing holistic graduates with entrepreneurial mindset the basic course of entrepreneurship has since become a core and compulsory in all undergraduate programmes. The course was taught in the second year of a 4 years undergraduate Civil Engineering Technology programme. With only formative assessment adopted for the course, the cognitive domain assessment was based solely on the submission of 5 assignments and sitting of a single test in the 14 weeks semester. Both tasks were aligned to meet the course learning outcome with emphasis on knowledge acquisition, i.e., to explain the concept and fundamental tenets of entrepreneurship, levelled at tier 3 of the cognitive domain learning taxonomy which corresponds with 'application'. The assignments and test were organized according to the sequential chapters of the course, helping students to gain understanding of the subject in tandem with and the learning of other core technical courses. Analysis of the cognitive task assessments showed areas of strength and weakness among the students with respect to entrepreneurial concepts, shedding light on the learning inclination and interest of technical students in a generic course as this.

Key words: Entrepreneurship, cognitive, learning, formative, assessment, academic performance

INTRODUCTION

The increased dissolution of international boundaries and communication barriers globally has inadvertently heightened the challenges faced by university graduates these days. The resulting increased cross-country interactions in trade, education and collaborative alliances mean that graduates are not only expected to be technically competent in their respective fields of study but also adequately skilled for meeting the demands of the globally connected economy.

As an initiative towards nurturing graduates with 21st century aptitude and mindset the Ministry of Higher Education Malaysia (MOHE) has since , 2015 launched 10 major shifts in the core functionality of the nation's higher institutions of learning. This involves an integrated transformational step in grooming leaders of tomorrow at tertiary level with the primary focus on cultivating holistic human capital of sound technical competencies and equally profound humanistic values. An important emphasis is placed on the cultivation of an entrepreneurial mindset, substantiated by a set of unique traits to enhance the graduate's tenacity and adaptability in facing the ever evolving challenges of current global job market.

Entrepreneurial activities are propounded to be an accelerant to technological and innovative development as well as job creation (Reynolds *et al*., 2001) elements highly desired and necessary for the continuous growth of a nation. Indeed, possession of the basic knowledge of entrepreneurship has been associated with greater entrepreneurial enthusiasm and likelihood of starting new businesses among fresh graduates (Kolvereid and Moen, 1997). In addition, past surveys have shown entrepreneurial traits to be transferrable via. teaching and not necessarily an inherent skill set or fixed personal characteristics (Van der Sluis and Van Praag, 2007). These observations all point to the importance of inculcating entrepreneurial values among university students, especially those who are not enrolled in business studies where the course would be rudimentary and requisite one.

In the past decade, the promotion of entrepreneurship as an academic discipline has led to the proliferation of a variety of courses and programmes across the different fields of study (Piperopoulos, 2012) including technical programmes like Civil Engineering Technology. Neck and Greene (2011) further highlighted the advantages of graduates equipped with

Corresponding Author: Chee-Ming Chan, Centre for Graduate Studies, University Tun Hussein Onn Malaysia, Johor, Malaysia

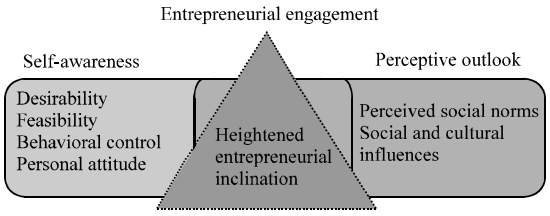

Fig. 1: Cultivation of entrepreneurial intentions

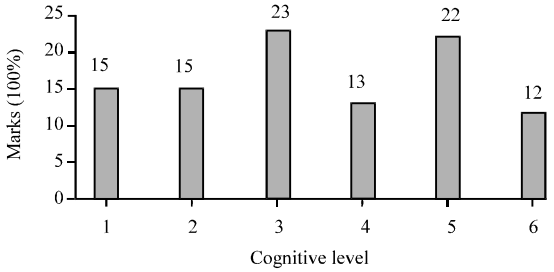

Fig. 2: Cognitive distribution in test

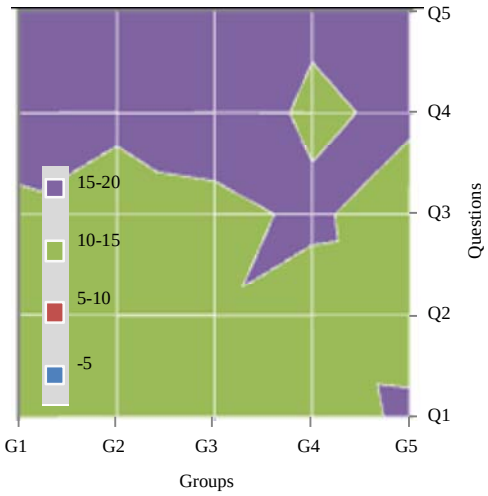

Fig. 3: Marks distribution for test by group (as per 20%)

entrepreneurial skills, attitudes and abilities in making a positive difference at work. Exposure to entrepreneurial courses would either awaken or sharpen the student's entrepreneurial intentions (Zellweger *et al*., 2011). In other words, positioning students in the realm of enterprising consciousness gives them a valuable competitive edge in addition to the technical competencies acquired from the core technical courses.

The inter-related self-perception and perceptive outlook on entrepreneurial intentions were found to determine a person's inclination towards enterprising endeavours (Linan *et al*., 2011). As illustrated in Fig. 1, one's self-awareness of inborn enterprising disposition overlapped with receptive regard of supporting social and cultural influences would culminate in potential involvement in new business startups or other industrious ventures. The self-belief and self-assurance are crucial to initiate the first step in new business undertakings (Pittaway *et al*., 2011). Such traits and characteristics are also desirable in technical graduates for the confidence and dexterity that derive from a cultivated entrepreneurial mindset.

Entrepreneurial characteristics and self-efficacy enable confident performance of various tasks associated with business startups (McGee *et al*., 2009) not unlike the myriad challenges encountered in the technical field on a regular basis. Besides, Douglas (2013) claimed such positive traits as a trigger to entrepreneurial intentions. Whether, it is for potential engagement in profitable business ventures or aggressive ascension of the career's ladder the ingrained entrepreneurial attributes would make astute graduates adapting in a world of IT revolutions coupled with e-Commerce opportunities (Oluyinka *et al*., 2013).

This study examines the cognitive aspect of an entrepreneurship course delivered to year 2 Civil Engineering Technology undergraduates at the university. The cognitive domain assessment was made based on assignments and test completed by the students in a 14 weeks semester. By group, analysis and discussions are presented on the student's topical understanding of the course based on assessment of the corresponding tasks given. A total of 5 topical assignments were submitted by the students while the test consisted of 5 questions encompassing all the topics of the course. As such an overview of the student's cognitive performance can be established for improvement in future delivery of the course.

Course background: BPK20802 entrepreneurship is a compulsory course for civil engineering technology year undergraduate students at the university. It consists of 2 h lecture accompanied by 4 h of self-regulated practical session weekly. The course encompasses 7 main topics, i.e., introduction to entrepreneurship, entrepreneur characteristics and motivation, screening the business environment, starting a business, marketing, business operations and financing a new business. The cognitive domain assessment included a test and 5 assignments which for ease of the overall discourse are given equal marks of 25% each (Fig. 7). However, the actual marks allocated for the test and assignments in the individual analysis were 20 and 10%, respectively (Fig. 2-6).

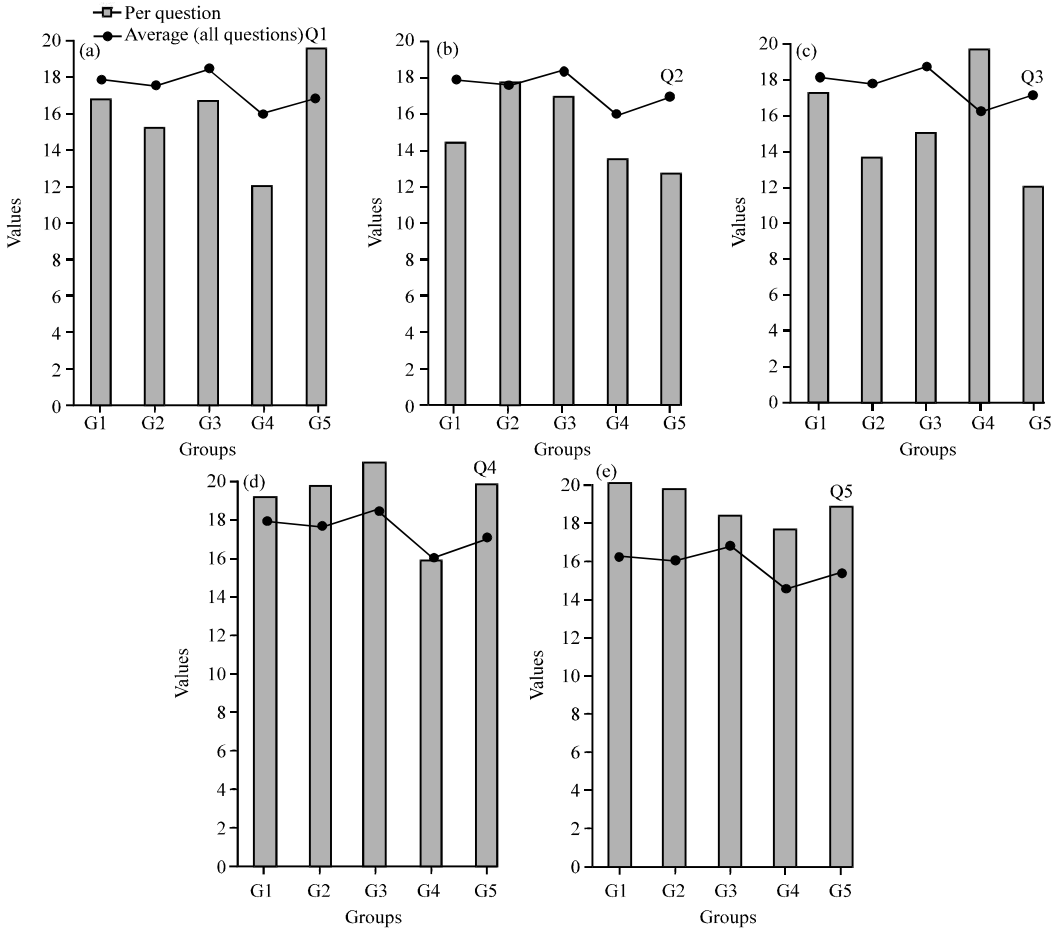

Fig. 4: a-e) Marks per question for test (as per 20%)

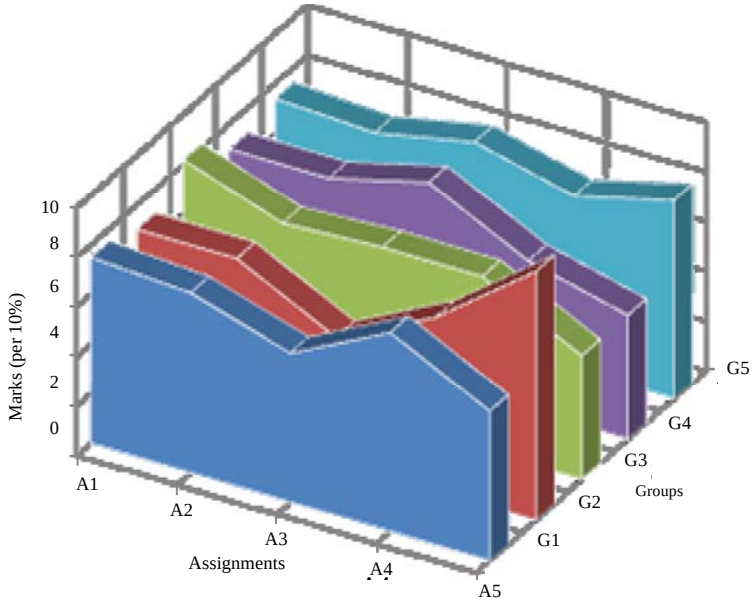

Fig. 5: Marks distribution for assignments by group (as per 10%)

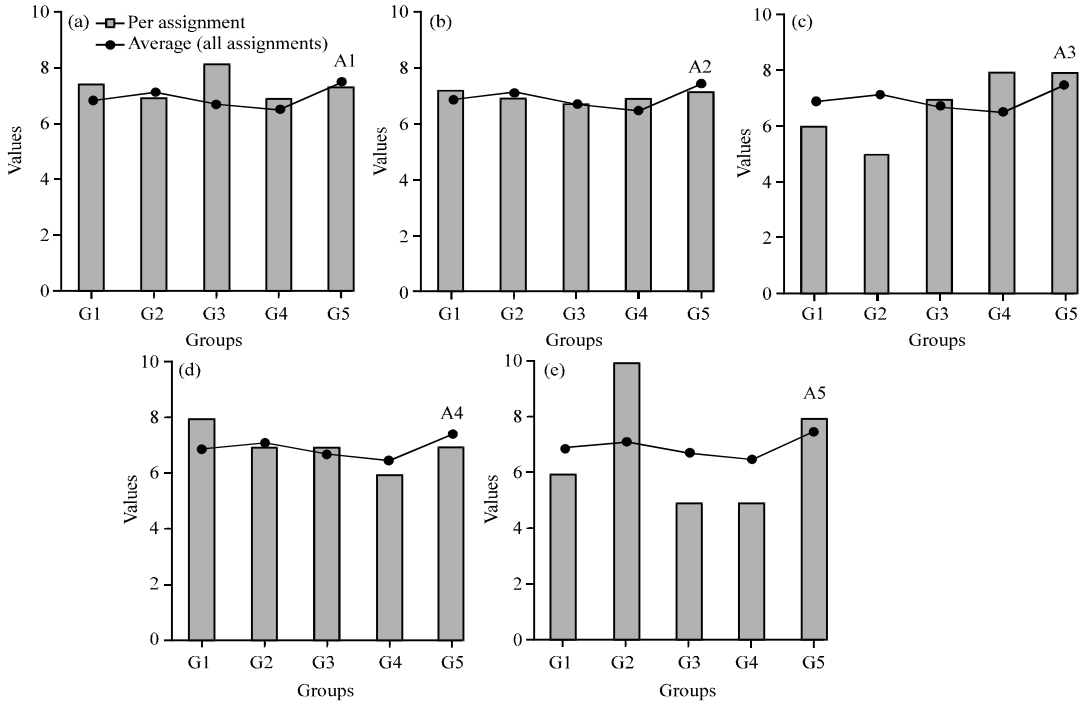

Fig. 6: a-e) Marks per assignment (as per 10%)

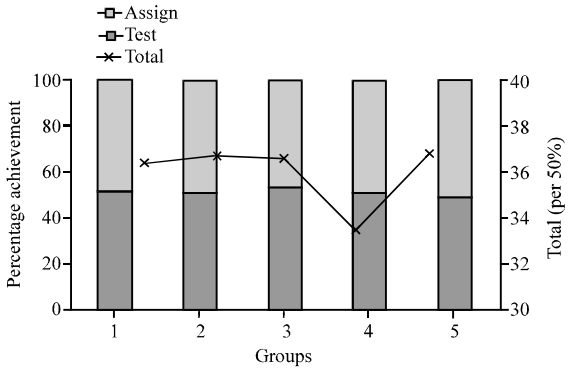

Fig. 7: Overall cognitive performance (per 50% total)

MATERIALS AND METHODS

Cognitive domain; Assessment: Apart from the 50% cognitive assessment, a semester-long project was also completed by the students, constituting 30% psychomotor and 20% affective development. The cognitive learning outcome emphasized on a good grasp of basic concepts and tenets of entrepreneurship. Note that the test and assignments were designed according to the relevant Chapters (C1-C7) as summarized in Table 1.

The test consisted of 5 Questions (Q1-Q5) of 20 marks each, covering all topics as distributed inTable 1. Referring to the 6 levels of thinking in Bloom's taxonomy for the cognitive domain, i.e., knowledge, comprehension, application, analysis, synthesis and evaluation in ascending order the questions were approximately one-fifth each at levels 3 and 5 (Fig. 2). The remaining cognitive focus were fairly equally distributed among the other levels, though overall greater weightage was placed on the student's ability to use the new knowledge (level 3: application) and to differentiate or relate the constituent parts of the topical contents (level 4: analysis).

Table 1: Topical contents of test and assignments

Tests	Assignments
Q1 (C1+C2)	A1 (C1)
Q2 (C3)	A2 (C2)
Q3 (C4)	A3 (C3+C4)
Q4 (C5)	A4 (C5)
Q5 (C6+C7)	A5 (C6+C7)

The Assignments (A1-A5) covered main elements of each topic (Table 1) to help students gain more in-depth understanding of the subject as a whole. Students were tasked with a variety of activities in the assignments to both engage their interest and to hone their skills for looking up relevant resources. These activities included the following with 10 marks allocated for each assignment: (A1) creating mind maps on entrepreneurial theories with reference to the literature (A2) outlining the attributes of a successful entrepreneur (A3) examining the local business environment and identifying supporting factors for new startups (A4) screening the local market for

opportunities technopreneurial startups in the Civil Engineering Technology field with proposal of feasible business ideas (A5) watching Dr. Seus's the Lorax and conducting a post mortem of the key characters from the business/entrepreneurial perspective.

RESULTS AND DISCUSSION

Note that students sat for the test individually but the analysis presented is based on the average performance by Group (G1-G5). This is to ensure consistency of the measurements as the students maintained the same group formation, enabling cohesive peer learning throughout the semester for all tasks including the assignments.

Test: Figure 3 shows the marks distribution of the test for each group. Overall the students seemed to answer well for Q4 and Q5 with marks between 15-20 each while the performance in answering other questions fell uniformly in the range of 10-15. This would appear that the students fared better in topics on marketing, business operations an financing. In Fig. 4 where the overall average achievement of the entire class in the test is plotted against the performance of each group per question. It is apparent that the students did the best for Q4 and Q5 with marks equaling or exceeding the overall average. The prevailing results for Q4 and Q5 may be suggestive of the students gradual improved understanding of the subject. It is also likely due to the simple fact that the topics were covered much later in the semester hence nearer the test date. Nonetheless, it is heartening to note the progressively acquired knowledge and interest of the students for the course.

Assignments: Marks distribution for the assignments are shown in Fig. 5. It is apparent that G5 performed the best with constant attainment of 7 marks and above for all assignments while G2 came in second with only one task given an average 5. Some non-uniformity in terms of performance can be observed in G4 with exceptional good work for A3 but average performance for A4 and A5. The group performance per assignment is presentedin (Fig. 6) with the dashed line representing the average overall marks achievedby each group. Clearly, the performance was most uniform for A1 and A2, followed by A4 with a slightly below avegare attainment for G4. A5, on the other hand, recorded rather disparate performance level among the groups. Revisiting the tasks per assignment, A5 stood out as a more challenging task, requiring students to analyze an animated movie from the business and entrepreneurship perspectives. In comparison, the earlier tasks of A1-A4 posed more direct and factual-based questions not too difficult to address by conducting a literature serach. In other words while students responded positively to the novelty of A5, most of the resulting reports lacked satisfactory substance.

Overall cognitive performance: The overall cognitive performance of the students is summarized in Fig. 6. The combined cognitive achievement is also included in the plot on the secondary Y-axis with a total of 50%, i.e., 25% each for the test and assignments. All groups had very similar total marks 36.4-36.8%) except for G4 with 33.6%, equivalent to 67 per 100%. Nonetheless G4 had quite a balanced marks distribution for both test and assignments with actual achievement of 17.1% and 16.5% for both components, respectively. G2 also demonstrated a balanced performance for both components, i.e., 18.7% (test) and 18.0% (assignments) but clinched the second highest ranking with a total of 36.7%. The largest difference was registered in the marks of G3 where the test surpassed assignments by almost 6% as per total. However, G3 also scored the best in test with an average of 19.6% as a group. All groups fared better in the test than assignments, except for G5, though by a very small margin of 1.7% per total. In addition, G5 had the best score for assignments, i.e., 18.8%, corresponding with earlier discourse on their performance consistency in the group tasks (Fig. 5). Irrespective of the composition marks for all groups, the cognitive learning outcomes seemed to be fairly well attained by the students at 67-74 per 100%.

Topical cognitive performance: Considering that both test and assignments were designed topically (Table 1) performance of the students per topic can be analysed as such. Figure 8 compiles both the cognitive assessment components in equalized marks of 25% each, enabling direct comparison when more than a single activity contribute to a particular topic's learning. The maximum and minimum differences between the marks are also illustrated in Fig. 9, the minimum differences ranged between 0.6 and 3.6% while the maximum differences were found to be between 9.4 and 18.0%. Clearly all groups scored rather closely for the poorer performance range (minimum) but the better performance range recorded a significant 50% difference between the best and lowest ranked group with the largest difference recorded for A4-Q4. Interestingly, the gap between the high flyers and poorer achievers grew as the semester progressed, suggesting the growing cognitive depth of the course with later topics.

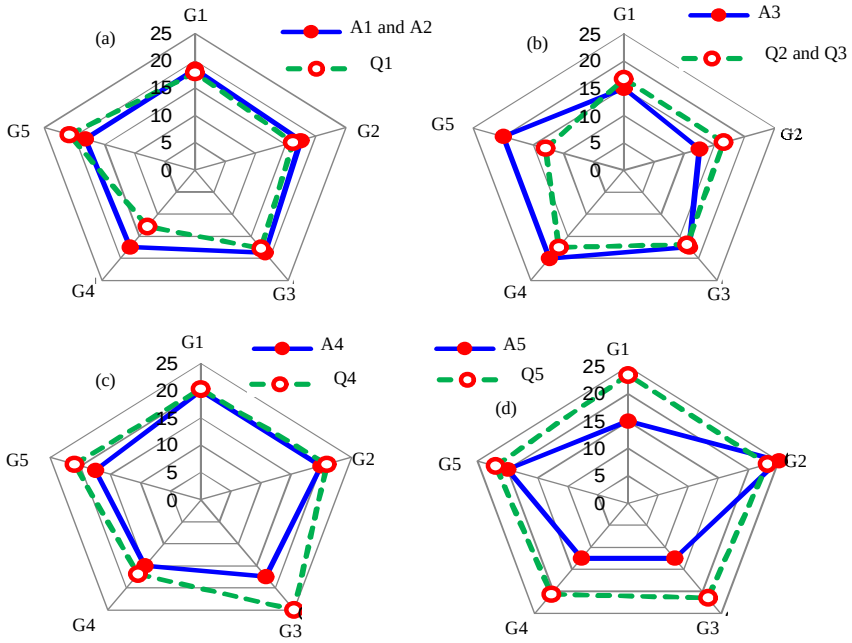

Fig. 8: Topical performance distribution; a) (A1 and A2)-Q1; b) A3-(Q2 and Q3); c) A4-Q4 and d) A5-Q5

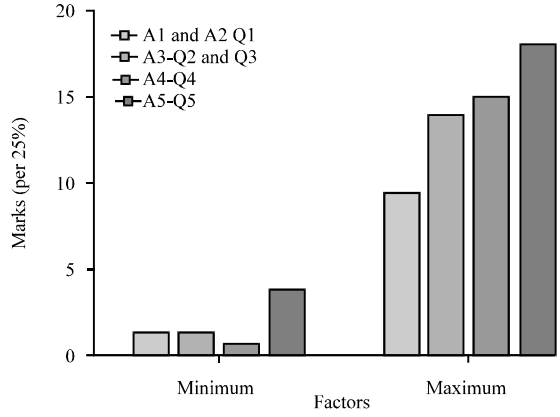

Fig. 9: Differences in topical performance as per test and assignments

In line with the discourse above, the best correspondence between both components can be observed for (A1 and A2) and Q1 (Fig. 8) with demonstration of generally equal performance for test and assignments. For A3-(Q2 and Q3) G5 fared just average in the assignment but did relatively well in the test. Similarly for G3 who scored full marks for Q4 but far less for the matching assignment, A4. The most diverse achievements were noted in A5-Q5 with the exclusion of G2 and G5 who fared comparably for both components. All other groups appeared to struggle with the assignment, scoring a significant 17% difference (average) between the 2 components. These disparities may be indicative of the level of difficulty encountered by the students in completing the assignments too with later topics in the course.

CONCLUSION

Overall the student's cognitive performance reached an average of 72% with the combination of test and assignments. Referring to the university's grading system, this would be equivalent to grade B+. The performance in test insinuates at students 'cramming' in last minute preparation as well as a more positive suggestion of students progressively gaining a better foothold on the subject matter. Assignments-wise, tasks elevated to the 'evaluating' and 'synthesis' cognitive levels may prove too steep a learning curve for some students, resulting in average performance by group. All in all the achievement for test and assignments were fairly equal with all but one group doing slightly better in the latter (i.e., G5). The overall combined marks ranged between 67-74%. Examined topically, the student's performance in both test and assignments showed remarkable diverse trends between the earlier and later topics of the course. The fact that students fared better in the test than in the assignments is suggestive of a possible lack of either understanding of the instructions for the specific tasks or the skills necessary to acquire the relevant information for completion of the work given in the stipulated time frame.

RECOMMENDATIONS

The above analysis and discussions availed useful insights of the student's cognitive performance for the course and helped in laying plans for more effective learning experience of the course in a technical school or faculty. One such example would be a review of the diverged performance in later topics of the course which interestingly skewed towards the supposedly more grueling test than the collective effort for assignments.

ACKNOWLEDGEMENT

This researcher was supported in part by funds provided by ORICC, UTHM. Preliminary data compilation by Nurasiah Mira Anuar is duly acknowledged too.

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