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**THE CHANGES IN MATHEMATICS EDUCATION CURRICULUM FOR A
TECHNICAL UNIVERSITY IN MALAYSIA**

MOHD SAZALI Khalid

hjsazali@uthm.edu.my

Information Technology and Science Computer Faculty,
University Tun Hussein Onn, Malaysia

SULAIMAN Yamin

sulaimn@uthm.edu.my

Technical and Vocational Education,
University Tun Hussein Onn, Malaysia

SITI FADZLINA Mohamad Asri

ctfadzlina@mohe.gov.my

Polytechnic Education Department,
Ministry of Education, Malaysia

Abstract

Today mathematics is regarded as an ordinary subject like languages even though it is the main core subject in engineering discipline. With IT applications, learning mathematics becomes simpler, faster and widely accepted. Currently, in the University Tun Hussein Onn Malaysia (UTHM) the total marks of the final mathematics examination comprised of 20% project done through group work. The objective of this paper is to demonstrate what the students had understood mathematics using experiential learning. The methodology used case studies of participants in a few statistics projects using 350 students (more than 60% girls) who were first year I.T. undergraduates within 3 months. A project was selected to determine why road users broke traffic rules. SPSS package was used to analyze descriptively and the participants confessed to enjoying social skills during data collection i.e., interviewing, designing, presenting and producing reports. As a result, delivering mathematics nowadays is quite different from 40 years ago.

Keywords: engineering mathematics; statistics project; functional graduates; performance gap, PISA, TIMMS report.

Introduction

In Malaysia 30 public universities are categorized into Research and Technical types. The former specializes on research and development activities that bring in some gains through international inventions while the latter focuses on teaching and development. Here the technical universities are the focus of this paper. Polytechnics Malaysia was developed as the feeder for Malaysian industries more than 40 years ago beginning in 1965 with the establishment of Ipoh Polytechnic Ungku Omar. Its' diploma programs for six semesters were designed with the help and continuous discussion of industrial people and academicians. Polytechnics MOE work together

with industrial personnel and academicians to put the Engineering Mathematics in Polytechnic at par with the diploma program at the higher learning institutions in terms of its credit hours, but most importantly the content remains for semi-professional workers. The Engineering students in Polytechnics Malaysia for instance, need to take Engineering Mathematics subjects for 5 (five) semesters in their 3 (three) years of study. Even though, the content of the subjects were equivalent to SPM (GCSE "O") levels during the first year of the Polytechnics, it remains the most difficult subject for many students. (Mohd Sazali, 2010). Malaysian Technical University Network (MTUN) was built to help the polytechnic graduates continuing their education at degree level and beyond. Under MTUN are UTHM (Universiti Tun Hussein Onn Malaysia) in Johor, UMP (University of Malaysia Pahang), UTeM (University Technical Malaysia Melaka) and UniMAP (University Malaysia Perlis). The Polytechnic academic program runs 15 weeks per semester. This is in line with the curriculum design in MTUN which adapted their program from technical universities in Germany. According to UTHM's Academic Management Centre, the yearly intakes of new undergraduates who are originally from polytechnics makes up 10% - 20%. The rest came from ex-Diploma graduates from MTUN universities themselves which is 20%, 30% STPM (equivalent to GCSE 'A' Levels) and 30% Matriculation colleges MOHE respectively.

UTHM is striving to be a world class university in engineering, sciences and technology for sustainable development by 2025. However, in complying with MQA Standards, competency of lecturers, in-house facilities and the students' initiatives are part of the challenges that both Polytechnics and UTHM must keep up. Polytechnics hope to be the favourable institutions among post SPM students without sacrificing the quality of its graduates and employability factor. In this paper, we are focusing on mathematics in MTUN universities and only on the practice of Continuous Assessment (coursework) that carries 60% and the final examination papers (theories) 40%. The objective of this paper is to highlight some changes that have taken place in mathematics education in Malaysian polytechnics for the last 40 years. There have been marked changes in the curriculum and syllabus and at present in spite of ICT intervention learning mathematics continues to become interesting issues.

Spectrum of Issues

There are some issues here for a start. First issue concerns the changes in the delivery of mathematical and science subjects. In 1950's - 1977, Malaysia used English. In 1978 we used Malaysian Language. Then in 2002 - 2011 we used English again since Malaysia aimed to be one of the famous education hubs in this region. Then 2012 came when the schools used Malaysian language again. This has an impact on both local and international students in UTHM. Since mathematics subjects are classified as common core courses whose weight ranges between 6 to 12 credits for a degree program, it does affect the students' performance in their 3.5 year study program.

The second is about the competency of the lecturers teaching mathematics. In UTHM, the assumption was that many undergraduates including students from the

Arabic countries have mastered mathematics up to a certain minimum level where they can easily follow the Learning and Teaching pedagogy in English. Since the students' intake varies from UTHM diploma graduates, Polytechnics graduates, Matriculations graduates and International students, the recipe for getting the right lecturers for mathematics and statistics remains a challenging task for UTHM. The contract lecturers who have more than 25 - 30 years teaching experience were employed to control the teaching and learning contents.

Next, in the early 2000's, the introduction of outcomes based education (OBE) as part of the restructuring process in higher education curriculum added more challenge to the staff. Despite all arguments, discussion and comments, it embarked not just on the curriculum but also on the assessment. Both curriculum and assessment are inter-related (Sulaiman, 2011; Noraini, 2007). The curriculum content in higher education was designed to develop the cognitive and psychomotor behaviour of a student. However, it was not easy to develop and measure of the affective part. The restructuring of the curriculum's outcome to ensure each course could develop the affective value of each student is arguable because the affective part could not be develop within 5 to 6 months period but required a whole study duration of a student at UTHM. Besides, from a motivation point of view, a student can learn more productively if the knowledge s/he had gained so far can be applied in the daily life. (Mohd Sazali & Helmi Adly, 2012). By building a bridge, for example, the students can gradually appreciate the connection between the physical and mathematical theories in their classrooms and the final completion. This is the basis of a contextual or experiential learning. The students wanted to see the connection between the theories and the application of the body of knowledge. As a result since 2003 UTHM took up Problem Based Learning in its three main engineering faculties as propagated by Singapore Republic Polytechnic and through the exploration between the team members in solving a series of projects throughout their undergraduate study, the learning benefits were found to be encouraging.

The fourth issue started in year 2010, where the polytechnics' lecturers in the Department Mathematics, Science and Computer (JMSK) saw the urgent need to address repeating students in mathematics. To control this, different types of assessment tasks have been ventured and applied. One of them is the curriculum was revised gradually based on the input from the industries and professional parents. Surprisingly for Computer Science and Information Technology's students, the change in the I.T. curriculum design helped the students to learn Discrete Mathematics instead of Calculus or Business Mathematics. It is believed the skills in Discrete Mathematics as put by the curriculum could enhance the critical thinking and problem solving skills. One method been tried was employing collaborative learning principles in doing various projects and this was assessed as part of the coursework marks. By doing so, hopefully Malaysian universities can truly produce functional graduates. (AKEPT, 2013).

The fifth issue is that in order to transform the Polytechnic as one of the favourable technical institutions as stated in Polytechnic Transformational Plan, was by working closely with Malaysian Technical Universities Network (MTUN) (DPE,

2009). Work has been done on re-organizing the content accordingly such as adding some statistical topics. In order to increase students' enthusiasm in learning Engineering Mathematics, the usage of graphing calculator, Geometer's sketchpad software and GeoGebra applications were applied. Currently, RECSAM is playing some role with Polytechnics Seberang Perai (PSP) as the pioneer in applying ICT for the teaching and learning of Engineering Mathematics. But care has to be taken because ICT does not guarantee 100% success as indicated by Mohd Sazali (2010) in Polytechnic Kota Bharu, Kelantan.

The sixth issue involves the assessment conducted at pre-university level in this country. The Malaysia Examination Council (MEC) converted the STPM / HSC / GCE "A" level into a new modular format beginning 2012. This year saw the first cohort of students who took a modular assessment at STPM levels. They had already undergone 2 semesters and will be taking the last module at the end of 2013. The advantage of this format is the students can improve their grades in every semester by carrying any subject they did poorly in the last semester. MEC believes this could sustain the students' motivation when enrolling into undergraduate programs.

The final issue is the worrying trend when many professional parents are sending their children to either English International Schools or Chinese Private Schools in most urban areas in Malaysia. They complained that the teachers in government schools are lacking in contents as far as English, Mathematics and Sciences are concerned plus they saw there is more time given for motivation talks. This holds true in one way or other if from the first author's observation there is a declining number of Chinese students enrolling at diploma engineering and accounting courses offered by polytechnics MOE in 2010 as compared to the 1990's. However, during 1980's to 2000 saw the mushrooming of private universities and colleges in Malaysia. Some Chinese parents wanted their children to finish the diploma studies less than three years as practiced by polytechnics MOE. In TIMMS 1999 to 2011 reports, learning mathematics in English did not give any additional advantage when Australia suffered with their students declining performance in mathematics among their 11 + students. The content and pedagogy processes by the teachers could be the very few factors causing this. (Mays, 2005). Maybe the teachers' attitude played some role too. With ICT, many versions of mathematics' answers are available from many sources and it seems not many students wanted to struggle proving mathematical theorems anymore. Visualise learners in this age wanted everything to happen instantly. (Cooke, 2003; Mohd Sazali & Helmi Adly, 2012). They lacked proving mathematical experience as demanded in higher study in spite of gaining some affective qualities. (Bishop, 2008).

These issues have to be taken up seriously by the relevant authorities when it was found out that the performance gap between Malaysian students against their counterparts is not so encouraging. In the 2009 Programme for International Student Assessment PISA '*.. findings shows that almost 60% of our students fail to meet minimum benchmarks in mathematics. About 43% do not demonstrate minimum*

proficiency in science, and 44% do not show minimum proficiency in reading – the baseline required to participate in life .’ (Ding, 2013)

Methodology

Statistics is a part of mathematics. UTHM students took statistics in the earliest semester. The theory part was directly put under the main lecturer while the laboratory part (learning Excel and other packages etc) was handled by the young tutors. About 12 different statistics projects were designed each running for 8 weeks beginning March – April 2013 within BIT11603 STATISTICS subject in a computer faculty and this was supervised by the first author. Each project assigned to different group consisting of 5 – 6 students randomly picked as spelt out using Collaborative Learning principles i.e, they have their project leader, two statisticians and a presenter. A package called SPSS Version 21.0 was used to process the data. One of the 12 projects was “A study on human behaviour beating traffic offences at a University Park, Parit Raja”. See Figure 1. As a start they were warned the project carries 20 percent of their 60% coursework marks. The rest 40% will be assessed in the final examination paper.



Figure 1. Location of the study taken at University Park, Parit Raja

The procedure of executing the project during laboratory time schedule was: they set the dates to collect data. The length of data collection was a month. The time must be consistent in each week because it would be easier to compare between human behaviour with respect to any particular day and times around the UTHM vicinity. This would control the extraneous variable (if any). The independent variable was the two exit points at the vicinity and the dependent variable was the number of traffic offenders. The group assigned their members to collect the data respectively i.e., using a form where they tallied the traffic offenders, got the total

number of offenders per hour on that particular day, camera video the offenders as proving exhibit and lastly an audio recorder to conduct few interviews with the pedestrians at a restaurant. The questions were constructed as recommended by Sekaran (2003). All along they were assisted by the young tutors in the computer laboratories. After four weeks they processed the data. They interpreted the figures and wrote their report together and showed to the tutors for confirmation. After compilation of the report they presented their findings using a software called Power Points (Microsoft) – for a few weeks to the main lecturer before their final semester examination.

Results

The following results were obtained regarding human behaviour at 'No Entry' points near to Mc Donald Parit Raja, Johor. See Table 1 below.

Table 1: Descriptive Statistics

		Number of Disobeyed Traffic Users		Extra
Week/ Day	Time	First Point	Second Point	comments
1 st / Monday	0700 - 0800 pm	19	12	
1 st / Wednesday	0700 - 0800 pm	16	10	Night Market
2 nd / Monday	0700 - 0800 pm	21	8	
2 nd / Wednesday	0700 - 0800 pm	34	12	Night Market
3 rd / Monday	0700 - 0800 pm	20	13	
3 rd / Wednesday	0700 - 0800 pm	45	21	Night Market
4 th / Monday	0700 - 0800 pm	23	11	
4 th / Wednesday	0700 - 0800 pm	16	11	Night Market
Mean (μ)		24.25	12.25	
Standard Deviation (σ)		10.14	3.85	There could be an error with bigger σ . Perhaps need to redo observation at the 'First Point'.

The report was - many road users purposely disobeyed the traffic rules within the time 0700 - 0800 pm during the four consecutive weeks. From the interviews these were the common answers from the traffic users: a) it was easier to go this way rather than that way, b) it is shorter and economical to go this way and c) today is the Night Market so I better go this way. In short some of the community wanted to save time in making to their destinations.

Discussion

There are two things to be highlighted regarding the above results. First is about discussing the project worthiness as far as the mathematics curriculum is concerned and secondly highlighting on the changes that has taken place between mathematics education in 1970's and 2010's university scenario by adopting experiential learning in UTHM.

First, the content of pure mathematics in degree programs in 2012/13 has somehow been transformed into social sciences mathematics that demands not only mathematics skills but much more skills as spelt out in experiential learning principles. The mathematics, statistics contents per se were taught in the lectures as much as the related soft skills needed in completing the various projects. In the above project, the group of students learnt that many road users were disobeying traffic rules and all these are due to the attitude problem. The only statistics they employed was the understanding of descriptive statistics like means and standard deviation. The highest understanding portrayed in statistics could be seen how they interpreted significant levels in hypothesis testing, values of kurtosis and skewness. All these were shown at the presentation day. Each group spent 30 minutes to present their findings. As a result, many weeks were spent to cover all the participating groups. This was quite taxing on the part of the lecturer(s). They learnt that it was not easy to get data and they need the participation and co-operation of the public to study any issue. Most importantly some presentations had to take place during the time the statistics lectures should be running and it was quite difficult to award marks among the participating members in each group and this marks contributed directly into each individual coursework marks as the final assessment. In other words, there are few grey areas how good the student is in mathematics including statistics.

Secondly, there are marked changes in mathematics education from primary level to university level from 1970's when there was no project based examination as remembered by the first author while in 2012 syllabus, it has incorporated mathematical statistics projects as part of the assessment. It was solid mathematics paper with theorems and proofs at the GCSE "A" and university levels in 1970's but now it seems that mathematics theories in UTHM for example is taught with the statistics projects. From the lecturers' point of view, a cut off point has to be negotiated between teaching purely the contents of mathematical statistics and them supervising the student's coursework marks.

In addition to that, the changes in the medium of instruction in teaching mathematics, science and technology in English in this country created some problem among the students. Different terminologies used by lecturers, such as 'add' or 'plus', 'subtract' or 'minus', 'over' or 'divide' for examples sometimes gives different meanings to the students in understanding and solving mathematical problems. This issue gave impact especially when students from different backgrounds and countries learning mathematics together in one classroom. This is

harder for those students who brought mathematics as baggage into the mathematics program. However, as expected few sleeping partners in the projects scrapped through in the final assessment mainly through the coursework marks. This was unheard of in 1970's.

In contrast, some of the lecturers nowadays, has the tendency to teach similar style as what they had being taught decades ago. (Mohd Sazali and Helmi Adly, 2012; Marzita, 2002). They would teach the degree syllabus assuming that the candidates have obtained the minimum level of competencies such as GCSE 'A' levels and STPM/ HSC before enrolling the Discrete Mathematics and Statistics courses. The question he would likely faced is the mathematics competencies of the polytechnic graduates MOE. Can they follow the syllabus and curriculum of mathematics at degree level?

At degree levels, the polytechnic students must have done diploma mathematics which constitute five semesters. Each semester must cover at least 5 different topics. (Mohd Sazali and Helmy Adly, 2012). But in UTHM some Certificate Polytechnic graduates had joined the degree I.T. program after working 2 to 5 years as technicians and junior programmers in the industries. So somehow, somebody is assuming the mathematics qualification at certificate level in Polytechnics MOE is at par with STPM/ GCSE "A" Levels/ Matriculation Colleges MOE.

An argument arose from the fact that many ICT practitioners believe ICT is developing very fast. It is believed many students will get more benefit with elective IT subjects than giving more mathematics exposure in the degree programs. From the industrial survey, many IT workers admit there is little mathematics in their daily tasks. But is this always hold true at all times? The question now is how about those who wish to pursue higher degrees in computer sciences and technology abroad that demand more readings from international journals with serious mathematical symbols and proofs. Would more knowledge in mathematics and statistics at deeper ends (incorporating proofs and theorems) helpful for them in the long run in completing the post graduate studies?

Recommendations

Even though the students enjoyed doing the mathematics and statistics project, as lecturers we have to be careful with experiential learning in mathematics and statistics. Since these core subjects are offered for a year only in UTHM Johor instead of two or more years rigorously learning them as it was with the case 40 years ago in established universities abroad. A balancing point has to be explored so that the limited time in learning the theories of mathematics and statistics suffice for the students' future lives. Even though there is a debate whether the students can create more sense making through day to day application of mathematics, the pure mathematicians think otherwise i.e., something has to be done carefully in order to prepare some potential students for their post graduate studies. Since 1999 TIMMS report revealed that Malaysians at 11+ and 14+ are lagging behind in mathematics as compared to other developing countries , we wanted to see that mathematics and statistics content at the degree level are always maintained at par with overseas. This is in the hands of the highly respected curriculum developers in MOE so that the

required topics in mathematics and statistics here are going parallel to what is happening in USA, Europe and Japan. In Australia it was observed there were few takers doing post graduate studies in pure mathematics (Mays, 2005) and it would be sad if this is experienced in Malaysia as well. If this trend continues it is hard to imagine the impact of experiential learning towards Malaysians' international breaking through in various competitions and inventions.

Conclusion

This paper has addressed two things. First the core mathematics in an undergraduate program in UTHM, Johor has somehow being transformed successfully into mathematics as practised by social scientists. The social skills and SPSS package has been being incorporated into ICT mathematics and statistics subjects as projects completed by group work that carry a third of the coursework mark in the assessment part. The highlight was through experiential learning the UTHM students could see the application of mathematics in day to day of their daily lives. Secondly, the argument was in order to accommodate the loss of some of its true mathematical contents (might have happened in the processing stages of teaching and learning) an effort to extend the time in the treatment of mathematics and statistics in the higher semesters has to be further researched. This is to ensure an increasing number of takers undergoing post graduate studies in mathematics locally for a sustainable growth in mathematics' body of knowledge globally.

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References

- AKEPT (2013). *Introduction to Program ACELLT Leadership Development Training in Learning and Teaching in Higher Education (Level: Basic)*. 2-4th April, 2013. Nilai.
- Bishop, A.J.(2008). *Chapter 16- Mathematics teaching and values education- An intersection in need of research*. In Philip Clarkson and Norma Prestage (Eds.) *Critical Issues in Mathematics Education*. New York: Springer.
- Cooke, H. (2003). *Success with Mathematics*. Routledge Study Guides. Milton Keynes: Open University Press.
- Department of Polytechnic Education (2009), *Direction of the transformation of polytechnic: The sustainability of the production of national human capital*. Ministry of Higher Education. Kuala Lumpur.
- Ding, C.(2013). *Opinion - "The spark to make the grade"*. Sunday Star Malaysia. Educate Supplements. 28 July 2013. Pp 5.
- Lehman, E., & Leighton, T. (2004). *Mathematics for Computer Science*. USA: MIT, PriU Press
- Marzita Puteh (2002). *Anxiety in Mathematics Teaching*. Tanjung Malim: UPSI

- Mays, H. (2005) *Mathematical knowledge of some entrants to a pre-service education course, Making mathematics vital: proceedings of the twentieth biennial conference of the Australian Association of Mathematics Teachers*, pp. 186-193, AAMT, Adelaide.
- Mohd Sazali Khalid (2010). *The effect of Collaborative Computer Aided Learning on Learning Pre-Algebra among Polytechnic Students*. Unpublished Ph.D thesis. Parit Raja: UTHM
- Mohd Sazali Khalid & Helmi Adly Mohd Noor (2012). *The teachings and Learning Mathematics using CDiCL: Sense making using computers within Teamwork*. Parit Raja: UTHM
- Noraini Idris (2007). *Classroom Assessment in Mathematics Education*. Shah Alam: McGraw Hill
- Sekaran, U.(2003). *Research Methods for Business. A skill building Approach*. 4th Ed. Danvers, MA: Wiley & Sons , Inc.
- Stahl, S. & Johnson, P.E.(2007). *Understanding Modern Mathematics*. London: Jones & Bartlett Publishers International
- Sulaiman Yamin (2011). *Assessment Test and Anxiety and Achievement* . Syarahan Perdana. 18 Ogos 2011 UTHM Main Convocation Hall. Parit Raja, Johor.
- TIMMS (1999). *Third International Mathematics and Science Study at the Eighth Grade. International Mathematics Report*. By: Mullis I.V.S., Martin, M.O., Gonzalez, E.J., Gregory, K.D., Garden, R.A., O'Connor, K.M., Chrostowski, S.J., and Smith, T.A.. USA: Boston College International Study Center.

Author(s):

MOHD SAZALI Khalid, Information Technology and Science Computer Faculty, University Tun Hussein Onn, Malaysia

Email: hjsazali@uthm.edu.my

SULAIMAN Yamin, Technical and Vocational Education, University Tun Hussein Onn, Malaysia

Email: sulaimn@uthm.edu.my

SITI FADZLINA Mohamad Asri, Polytechnic Education Department, Ministry of Education, Malaysia

Email: ctfadzlina@mohe.gov.my