About the Journal

Overview

Pertanika Journal of Social Sciences & Humanities (JSSH) is the official journal of Universiti Putra Malaysia published by UPM Press. It is an open-access online scientific journal which is free of charge. It publishes the scientific outputs. It neither accepts nor commissions third party content.

Recognized internationally as the leading peer-reviewed interdisciplinary journal devoted to the publication of original papers, it serves as a forum for practical approaches to improving quality in issues pertaining to social and behavioural sciences as well as the humanities.

JSSH is a **quarterly** (*March, June, September* and *December*) periodical that considers for publication original articles as per its scope. The journal publishes in **English** and it is open to authors around the world regardless of the nationality.

The Journal is available world-wide.

Aims and scope

Pertanika Journal of Social Sciences & Humanities aims to develop as a pioneer journal for the social sciences with a focus on emerging issues pertaining to the social and behavioural sciences as well as the humanities.

Areas relevant to the scope of the journal include Social Sciences—Accounting, anthropology, Archaeology and history, Architecture and habitat, Consumer and family economics, Economics, Education, Finance, Geography, Law, Management studies, Media and communication studies, Political sciences and public policy, Population studies, Psychology, Sociology, Technology management, Tourism; Humanities—Arts and culture, Dance, Historical and civilisation studies, Language and Linguistics, Literature, Music, Philosophy, Religious studies, Sports.

History

Pertanika was founded in 1978. A decision was made in 1992 to streamline Pertanika into three journals as Journal of Tropical Agricultural Science, Journal of Science & Technology, and **Journal of Social Sciences & Humanities** to meet the need for specialised journals in areas of study aligned with the interdisciplinary strengths of the university.

After almost 25 years, as an interdisciplinary Journal of Social Sciences & Humanities, the revamped journal focuses on research in social and behavioural sciences as well as the humanities, particularly in the Asia Pacific region.

Goal of *Pertanika*

Our goal is to bring the highest quality research to the widest possible audience.

Quality

We aim for excellence, sustained by a responsible and professional approach to journal publishing. Submissions are guaranteed to receive a decision within 14 weeks. The elapsed time from submission to publication for the articles averages 5-6 months.

Abstracting and indexing of *Pertanika*

Pertanika is almost 38 years old; this accumulated knowledge has resulted the journals being indexed in SCOPUS (Elsevier), Thomson (ISI) Emerging Sources Citation Index (ESCI), Web of Knowledge [BIOSIS & CAB Abstracts], EBSCO, DOAJ, ERA, AGRICOLA, Google Scholar, ISC, TIB, Journal Guide, Citefactor, Cabell's Directories and MyCite.

Future vision

We are continuously improving access to our journal archives, content, and research services. We have the drive to realise exciting new horizons that will benefit not only the academic community, but society itself.

Citing journal articles

The abbreviation for *Pertanika* Journal of Social Sciences & Humanities is *Pertanika J. Soc. Sci. Hum.*

Publication policy

Pertanika policy prohibits an author from submitting the same manuscript for concurrent consideration by two or more publications. It prohibits as well publication of any manuscript that has already been published either in whole or substantial part elsewhere. It also does not permit publication of manuscript that has been published in full in Proceedings.

Code of Ethics

The Pertanika Journals and Universiti Putra Malaysia takes seriously the responsibility of all of its journal publications to reflect the highest in publication ethics. Thus all journals and journal editors are expected to abide by the Journal's codes of ethics. Refer to Pertanika's **Code of Ethics** for full details, or visit the Journal's web link at http://www.pertanika.upm.edu.my/code_of_ethics.php

International Standard Serial Number (ISSN)

An ISSN is an 8-digit code used to identify periodicals such as journals of all kinds and on all media–print and electronic. All Pertanika journals have ISSN as well as an e-ISSN.

Journal of Social Sciences & Humanities: ISSN 0128-7702 *(Print)*; ISSN 2231-8534 *(Online)*.

Lag time

A decision on acceptance or rejection of a manuscript is reached in 3 to 4 months (average 14 weeks). The elapsed time from submission to publication for the articles averages 5-6 months.

Authorship

Authors are not permitted to add or remove any names from the authorship provided at the time of initial submission without the consent of the Journal's Chief Executive Editor.

Manuscript preparation

Refer to Pertanika's **Instructions to Authors** at the back of this journal.

Most scientific papers are prepared according to a format called IMRAD. The term represents the first letters of the words **I**ntroduction, **M**aterials and Methods, **R**esults, **A**nd, **D**iscussion. IMRAD is simply a more 'defined' version of the "IBC" [Introduction, Body, Conclusion] format used for all academic writing. IMRAD indicates a pattern or format rather than a complete list of headings or components of research papers; the missing parts of a paper are: *Title, Authors, Keywords, Abstract, Conclusions*, and *References*. Additionally, some papers include Acknowledgments and Appendices.

The *Introduction* explains the scope and objective of the study in the light of current knowledge on the subject; the *Materials and Methods* describes how the study was conducted; the *Results* section reports what was found in the study; and the *Discussion* section explains meaning and significance of the results and provides suggestions for future directions of research. The manuscript must be prepared according to the Journal's **Instructions to Authors**.

Editorial process

Authors are notified with an acknowledgement containing a *Manuscript ID* on receipt of a manuscript, and upon the editorial decision regarding publication.

Pertanika follows a **double-blind peer-review** process. Manuscripts deemed suitable for publication are usually sent to reviewers. Authors are encouraged to suggest names of at least three potential reviewers at the time of submission of their manuscript to Pertanika, but the editors will make the final choice. The editors are not, however, bound by these suggestions.

Notification of the editorial decision is usually provided within ten to fourteen weeks from the receipt of manuscript. Publication of solicited manuscripts is not guaranteed. In most cases, manuscripts are accepted conditionally, pending an author's revision of the material.

As articles are double-blind reviewed, material that might identify authorship of the paper should be placed only on page 2 as described in the first-4 page format in Pertanika's **Instructions to Authors** given at the back of this journal.

The Journal's peer-review

In the peer-review process, three referees independently evaluate the scientific quality of the submitted manuscripts.

Peer reviewers are experts chosen by journal editors to provide written assessment of the **strengths** and **weaknesses** of written research, with the aim of improving the reporting of research and identifying the most appropriate and highest quality material for the journal.

Operating and review process

What happens to a manuscript once it is submitted to *Pertanika*? Typically, there are seven steps to the editorial review process:

1. The Journal's chief executive editor and the editorial board examine the paper to determine whether it is appropriate for the journal and should be reviewed. If not appropriate, the manuscript is rejected outright and the author is informed.

2. The chief executive editor sends the article-identifying information having been removed, to three reviewers. Typically, one of these is from the Journal's editorial board. Others are specialists in the subject matter represented by the article. The chief executive editor asks them to complete the review in three weeks.

    Comments to authors are about the appropriateness and adequacy of the theoretical or conceptual framework, literature review, method, results and discussion, and conclusions. Reviewers often include suggestions for strengthening of the manuscript. Comments to the editor are in the nature of the significance of the work and its potential contribution to the literature.

3. The chief executive editor, in consultation with the editor-in-chief, examines the reviews and decides whether to reject the manuscript, invite the author(s) to revise and resubmit the manuscript, or seek additional reviews. Final acceptance or rejection rests with the Edito-in-Chief, who reserves the right to refuse any material for publication. In rare instances, the manuscript is accepted with almost no revision. Almost without exception, reviewers' comments (to the author) are forwarded to the author. If a revision is indicated, the editor provides guidelines for attending to the reviewers' suggestions and perhaps additional advice about revising the manuscript.

4. The authors decide whether and how to address the reviewers' comments and criticisms and the editor's concerns. The authors return a revised version of the paper to the chief executive editor along with specific information describing how they have answered' the concerns of the reviewers and the editor, usually in a tabular form. The author(s) may also submit a rebuttal if there is a need especially when the author disagrees with certain comments provided by reviewer(s).

5. The chief executive editor sends the revised paper out for re-review. Typically, at least one of the original reviewers will be asked to examine the article.

6. When the reviewers have completed their work, the chief executive editor in consultation with the editorial board and the editor-in-chief examine their comments and decide whether the paper is ready to be published, needs another round of revisions, or should be rejected.

7. If the decision is to accept, an acceptance letter is sent to all the author(s), the paper is sent to the Press. The article should appear in print in approximately three months.

The Publisher ensures that the paper adheres to the correct style (in-text citations, the reference list, and tables are typical areas of concern, clarity, and grammar). The authors are asked to respond to any minor queries by the Publisher. Following these corrections, page proofs are mailed to the corresponding authors for their final approval. At this point, **only essential changes are accepted**. Finally, the article appears in the pages of the Journal and is posted on-line.

Preface

We are pleased to present the Special Issue of Pertanika Journal of Social Science and Humanities featuring papers presented at the 2nd International Conference on Statistics in Science, Business and Engineering 2015 (ICSSBE2015). The ICSSBE2015 was held in Pullman Hotel, Putrajaya from 2-3 September 2015. The theme of the conference was '"Empowering Data Analytics with Mathematics, Statistics and Actuarial Science".

Statistics, Mathematics, Operations Research and Actuarial Science play important roles in providing solutions to technical and managerial problems. When applied correctly, they provide optimal solutions to complex problems, and hence, enhance the chances of making the right decisions. The ICSSBE2015 brings together mathematicians, statisticians, researchers and actuarial scientists onto a single platform in an effort to enhance development in these areas.

We are delighted that the conference attracted submissions from a diverse group of national and international researchers. We received 76 papers, 25 of which were accepted for publication in the Social Science discipline. A double-blind review procedure was used. The submissions were assigned to at least 3 independent reviewers (at least two international reviewers) in order to have a rigorous and convincing evaluation process. The reviewers provided very good feedback which helped the editors to decide on the final selection of papers for publication. In the end, 12 papers were selected for this Special Issue.

We would like to thank both the reviewers and the conference committee members for their time, ideas and effort in ensuring the success of ICSSBE2015. We also record our gratitude to Dr Nayan Kanwal, Chief Executive Editor, Pertanika and Erica Kwan Lee Yin of Universiti Putra Malaysia for their valuable advice and support at every stage to ensure the successful publication of this Special Issue.

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Yap Bee Wah *(Prof. Dr.)*
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Components of eLearning and Progression: Radical Innovation in Built Environment Teaching

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ABSTRACT

Bricks and mortar are common building materials and without them the building would fail to fulfil its purpose. Alternative building materials have become more acceptable and desirable for modern residents. The use of alternative materials in construction is analogous to eLearning as a radical innovation in the education process. In this paper, the design and effective delivery of eLearning in Built Environment programmes (distance learning) is examined. Its purpose is to enhance student progression while decreasing attrition. The basic design components of an eLearning environment are presented and evaluated through findings from a mixed-method study. We find that students who take up components of eLearning are more aligned with their progression goals than those who do not. An area for further study has been identified as the portability of content on mobile devices.

Keywords: Built environment, eLearning, radical innovation, progression, eLearning components

INTRODUCTION

Radical innovation in the educational arena is critical to the long-term sustainability of related institutions (McDermott & O'Connor, 2002). However, support for such radical developments are often stifled, pushed aside by lower risk conventional approaches (Dougherty & Hardy, 1996). This paper examines eLearning as a radical innovation, as revolutionary as Phillips' introduction of distance learning in the 1720s.

On March 20, 1728 when Caleb Phillips from Boston advertised in the local news that he would mail weekly shorthand

lessons to students in the countryside, no one realised that it would be start of the distance education revolution. It would take another 275 years or so before distance education would further evolve, this time from real to virtual. Starting slowly, it was not until the late 1970s that interest in these specific aspects of education started gaining momentum (Holmberg, 1995; Bower & Hardy, 2004). Understanding why students chose alternative options to didactic teaching modes became very relevant to higher education providers trying to maximise student success, provide a beneficial student experience, and especially, to understand why they stay and pass, or leave and fail (Bean, 1990; Tinto, 1995; 2005). The benefit to institutions is also reflected in their own success, prestige and funding. Technology, flexibility and accessibility have become increasingly important, and it is evident that educators and institutions need to keep abreast of technology and that new knowledge and abilities within the institution are required (O'Neill, Singh, & O'Donoghue, 2004; Tyler-Smith, 2006; Kukulska-Hulme, 2009).

Technological changes inevitably produce changes in other components of education (Ally & Samaka, 2013). Exchanging face-to-face interaction for eLearning not only allows flexibility for individuals but also widens the market for higher education. ELearning allows different utilisation of some basic components such as time, cost and space. It provides alternative utilisation of time previously considered "dead time" e.g. time spent on a train while commuting to work. ELearning also utilises different components in the architecture of the programme, such as podcasts and video conferencing tools, to satisfy the requirements of an effective teaching programme. Some basic components are used differently while others are themselves different; together, these constitute the radical innovation that eLearning provides to ensure the suitability of the programme construction for industry and society.

Not all disciplines are able to incorporate all new components of eLearning. Some disciplines require students to complete face-to-face practicums or attend residential schools to satisfy academic learning outcomes and professional accreditation requirements. Aligning the cohort, subject content, technology and delivery is vital in order to establish a successful eLearning programme (González, 2010). Understanding what students want is important in facilitating an eLearning market penetration. Subject content and resource materials provide support to an isolated learner (Sarah, Carol, Tony, & Adam, 2007; Croft, Dalton, & Grant, 2010). Equally important is to determine how student progression is affected by utilising eLearning affordances for radical innovation in Built Environment (BE) teaching.

Traditionally, student progression has been assessed by measuring academic attainment, defined as the achievement of the minimum pass rate specified by the

academic institution, attainment of the minimum number of units of credit for a defined period and in some cases, passing any compulsory barrier units of study, field or clinical work or practicum (Robinson, 2004). Progression rate is defined as the percentage of effective full time student load (EFTSL) passed compared with the EFTSL assessed (McInnis, Hartley, Polesel, & Teese, 2000). Universities struggle, and have been struggling to arrest student attrition for the last 40 years (Godfrey, Aubrey, & King, 2011; Willcoxson, Cotter, & Joy, 2011; Pienaar, O'Brien, & Dekkers, 2012). With the increase of eLearning in universities, the problem is more complex. In 2010, 81% of the almost 1 million students were studying face-to-face, 12% were engaged in distance education with the remaining 7% engaging in a blended model (ABS, 2012). At Central Queensland University (CQU), 57% of students were enrolled in distance education in 2014. With the shift in the student cohort towards distance education, attention has to be given to maintaining acceptable levels of student retention while satisfying industry expectations (Love, Haynes, & Irani, 2001; Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011).

All students in the BE programme at CQU are enrolled in the distance education mode. The BE programme here and in most of the 29 other Australian universities which offer the same programme have a high attrition rate (over 50% in the first year at CQU). As a consequence, many institutions have incorporated

mechanisms to curb attrition, including higher tertiary entry requirements, having bridging subjects, and subjects designed specifically to alleviate the feeling of disconnect particularly experienced by distance education students (Ariadurai & Manohanthan, 2009; Pienaar et al., 2012).

The BE programme brings together a variety of established applied disciplines and professions including engineering, design, town planning, building surveying and legislation, quantity surveying and construction management (Frank, 2005; Zillante, 2007). Traditionally, research in the Built Environment discipline, like other applied science disciplines, was problem-focused with pragmatism as its underlying knowledge paradigm (du Toit & Mouton, 2013).

This paper discusses the design of eLearning subjects in the BE discipline, their utility and perceived impact on the progression by students and their career. In so doing, it shows the effectiveness of the radical innovation of eLearning in the teaching of the Built Environment programme.

THE BUILT ENVIRONMENT (BE) AT CQUNI

Five academic programmes across three disciplines make up the BE suite of degrees at CQU. Both bachelor and associate degrees for Building Design and Building Surveying and Certification and a bachelor for Construction Management are offered here. All programmes are delivered solely in distance education

mode and are fully accredited by three professional organisations i.e. Australian Institute of Building, Australian Institute of Building Surveying and the Building Designers Association of Australia. The BE programme at CQU has about 550 active students.

Commencing in the late 1990s, the programmes were designed for distance education with major inputs from industry partners and employers. Students were provided with hard copy reference materials for study within a given time frame of one term. Lecturers were available to help students though telephone or email and students relied heavily on employer support for study progression. Students were required to complete between 100 and 120 days of industry employment before graduating. Assessments were submitted via the postal system, assessed by the lecturer and returned to students, again by post. This was a slow, costly and troublesome method as many assessments never arrived (or were never sent) which resulted in intensive and frustrating rework for both students and academics.

ELEARNING IN BE – THE RADICAL INNOVATION

With the introduction of the learning management system (LMS) at CQU in the early 2000s, the programmes were presented in an electronic format, initially to Blackboard, and then to Moodle in 2010. Moodle is a free open-source LMS which can be customised to produce modular web-based subjects. It is used in many Australian universities and overseas. Each subject in the programme has an individual Moodle presence (site) and all programme materials are distributed through the Moodle LMS. By 2012, all resource materials, contacts and student engagement activities were centralised on Moodle where students could access and download reference materials. Students now have to print their own resource materials which initially created a set back to the new initiative of onscreen reading. From 2012, subjects had to be fully online with assessment submissions, marking, and forum activities as well as downloading resource material. Since the introduction of Moodle, there have been five fundamental upgrades of the system and the University is currently running Moodle release 2.7. The LMS provides the foundation, the base slab, for the construction of an alternative solution to BE education.

The radical innovation introduced new components into the architecture of the Moodle LMS site that were better suited to the particular cohort of students. With 95% of students employed and devoid of free time for face-to-face activities, it became necessary to expand options to remove isolation from the cohort. Asynchronous podcasts were introduced as a pilot programme for the university and expanded to include synchronous webinar sessions. Initially the BE programme at Central Queensland University (BE@CQUni) utilised WebEx as a webinar platform, but in 2012, this was replaced by Blackboard Collaborate (BBCollaborate)

(integrated into Moodle). The decision to introduce BBCollaborate university-wide was given impetus by the identification of key features required by the BE@CQUni team for online delivery. Students can access online recordings at any time and have reported that "no lecturer can be as patient as a recording".

The BE programme developed a simple layout that is user friendly and accessible, now adopted university wide. The simple design limits cognitive load for students as all Moodle websites have a similar look and feel.

As can be seen from Figure 1, all BE@CQUni Moodle LMS sites would include four main sections.

Figure 1. BE@CQUni Moodle LMS Design

Subject Navigation and Information – Section 1

Navigation is located at the left of the interface. All subject activities and assessments will appear in the navigation pane (Fig. 2). The three most important pieces of preterm information are displayed first, namely the subject profile, subject communication methods and assessment

tasks. Students can also access their assignment tasks from here which are sorted chronologically by due date. Students can also use the various forums such as Q & A to interact with staff or General Discussion for chats not requiring lecturer input. The News Forum is used by lecturers to distribute subject wide information to all students enrolled in that subject.

Figure 2. Navigating Moodle

Scaffolding System –Section 2

Scaffolding is the term widely used to describe effective learning support (Vygotsky, 1997). The support system (Fig. 3) is located at the left of the interface, directly below the assessment tasks. A list of varied support systems including IT help, library help and student support centre is provided. In addition to the scaffolding system, the lecturers should also clearly state when they will be available for assistance.

Figure 3. Scaffolding

Collapsed Topics – Section 3

The collapsed topics are located in the middle of the interface and a sample design

is shown in Figure 4. Only core elements of each topic, such as textbook, additional readings and workbook, are presented in the collapsed topic of each week. This is to ensure that the core elements are seamlessly joined thus avoiding any extraneous load. To further reduce student confusion, in 2012 the BE@CQUni concluded that all subjects should be uniform in design. By ensuring the layout of each LMS site is the same throughout all subjects of the program, students know where to find the relevant information quickly and easily. Ease of use, logic and common-sense are all factors that dictate the current layout of the LMS. Like a modular building, the consistency of the Moodle layout means that each subject has a prefabricated design so that students can easily find their way from one (learning) space to another.
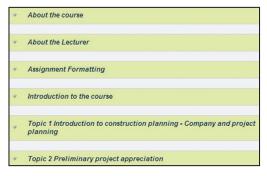
Figure 4. Collapsed topics

Interaction with Other Students – Section 4

The online users can be seen at the right of the interface. The lecturer will not always be available to answer questions or clarify ambiguities. Showing the online

users (Fig. 5) can enhance the interaction among students by sharing ideas and answering questions. This facility also supports various other activities such as the Collaborate sessions that the subject might require students to complete or participate. Enhancing the virtual campus environment aims to reduce the feeling of "remoteness" for distance education students.

As of term 1 2012, all BE@ CQUni subjects also have an individual BBCollaborate "Tea Room" (Fig. 5). The tea room allows students to interact with each other, independent of the lecturer, and control the online webinar meeting room. Using this facility, students report that they can easily facilitate discussions and seek clarifications in the absence of the lecturer.

Figure 5. Student interaction

STUDY OVERVIEW AND DISCUSSION

Evaluation of these design elements in terms of their utility to foster student progression was investigated as part of a larger sequential mixed methods study (Abowitz & Toole, 2010; du Toit & Mouton, 2013). This approach consisted of an archival analysis of student progression, followed by an online survey with descriptive trend data analysis of factors impacting student progression. The findings identified student demographic and subject performance data as well as their use of the various components of the Moodle LMS site.

In stage one, the study evaluated student and enrolment data spanning a period of 10 years for the BE discipline at CQU. Data was based on 1,547 individual student enrolment and performance records across the three disciplines and five programmes. Data by programme were extracted from the student administration system before being analysed using the Statistical Package for the Social Sciences (SPSS version 20) software. Data included 74 variables covering enrolment and demographic information as well as individual subject performance. The analysis was aimed at determining trends in performance and to identify factors influencing student progression. Female students represented 22% of the population. Students under age 24 accounted for 40% of the total student population registered for the BE course while those between 25 and 44 years-old accounted for 50%.

In stage two, an online survey was developed based on student enrolment data and performance data analysis as well as a detailed literature review. The survey targeted students in any CQU Built Environment discipline between April and May 2013 as well those enrolled during the preceding six months, but not necessarily active in the current term. The survey posed 31 questions with 142 answers. The majority of questions (28) were developed with a seven point Likert scale response with the remainder for qualitative text input. The survey was tested and improved using focus groups before it was finalised. A total of 295 students completed the survey resulting in a response rate of 22%. Responses were coded before analysis using SPSS 20. Trends were identified and cross-correlated with previous results to identify factors impacting student progression. This constituted a reasonably representative sample of the population with female students representing 24% of the sample, students under 24, 52% and those between 25 and 44 years old, 40%.

Progression has been considered from the broader individual and societal perspectives of the students' study, qualification, career and their professional organisations. The different components of the LMS constitute the alternative solution or radical innovation in BE teaching. They are now examined briefly in terms of their contribution to students' study, qualification, career and professional progression.

Internet and Connectivity

Reliable and fast internet and broadband connectivity are essential in assessing all the components of eLearning. If the LMS is the slab, then this is the power. It is not surprising then that this rated highly amongst all students across all types of progression. Those students who had better connectivity and utilised electronic communications more regularly were better aligned with their progression goals.

Online Resources

Online resources were not accessed frequently. The percentage of students rarely or never accessing online resources for the progression types were: subject progression 22%; qualification progression 39%; career progression 17%; and professional progression 77%. Of the students accessing resources in excess of five times per day, 31% did so for subject progression, 27% for career progression, 30% for qualification progression but only 8% for professional progression.

Email

Considering that email is one of the primary means of communication from the University, the students' level of access was disappointing. The percentage of students rarely or never accessing email for the progression types were: subject progression 53%; qualification progression 58%; career progression 40%; and professional progression 84%. Email was used more than five times per day by

18% of students for subject progression, 16% for qualification progression, 31% for career progression and 7% for professional progression. Students that utilised emails the most were those who were most on target in all progression types.

Forums, Blogs and Wikis

Forums, blogs and wikis allow students to communicate with each other and with the lecturer and support staff. Important notices are posted in the forums. A large proportion (78%) of the students did not make extensive use of online forums, educational blogs or wiki spaces for subject progression (never or less than once a week). This was true for all other aspects of progression, qualification (81%), career (89%) and professional progression (93%). Students who accessed these online study tools regularly (several times per day) reported a higher alignment with all progression goals. However, the relatively low usage may also be due to the fact that while forums have become mainstream, this is not the case with blogs and wikis.

Audio-Visual Aids and Podcasts

Audio-visual aids and podcasts are believed to reduce cognitive load and provide a more interactive environment, thereby increasing student engagement (DeTure, 2004; Jones, 2010). Only 3% of students reported that they accessed online audio-visual resources or podcasts more than five times per day for subject progression, with 83% stating that they accessed them less than once a week. For qualification progression, only 2% of students reported that they accessed online audio visual aids and podcasts more than five times per day while 98% indicated that they accessed them less than once a week. The percentage of students accessing these more than five times per day for career progression was 3% with 91% connecting less than once a week. Results were similar for students accessing for professional progression; 95% of students never or rarely utilised audio-visual or other podcasts. Students who utilised audio visual aids and other podcasts more than once a day were much more on target with their subject progression targets than those who did not.

Teamwork and Networking

Teamwork is considered an important outcome of any degree. Aspects of teamwork are easily under-emphasised and difficult to enhance in a distance education environment. Less than half (47% and 48% respectively) of the participant students, rarely or only 'once in a while' worked in a team as part of their subject or qualification progression. Students appeared to view teamwork as more important for their career progression with 72% of students utilising teamwork often. On the other hand, it was not considered essential for professional progression and 61% of students rarely or never worked in teams for this purpose.

Students engaged in face-to-face or blended study modes did not have the same level of regular networking as did distance students, the majority of

whom were employed. Distance students, though, reported networking with work and professional colleagues as less useful compared with students studying in other modes. This may be that employed distance students take this activity for granted.

Skype and Video Conferencing Tools

Given that most BE subjects at CQU offer video conference lectures regularly, it is surprising that 85% of students did not use Skype or other face-to-face virtual meeting tools for their subject progression. The 15% of students that utilised Skype or other virtual tools for their subject progression reported a higher level of alignment with subject progression goals than other students. Similarly, these tools were not utilised for qualification progression with 91% of students stating they did not use or rarely used Skype or other face-to-face virtual meeting for their qualification progression. Students who used online virtual meeting and communication tools were more on target with their qualification progression goals. Career and professional progressions were similar with 92% and 97% of students respectively stating they rarely used Skype (or other face-to-face virtual meeting rooms).

Mobile Devices

The survey did not ask specifically ask about mobile devices, but it is evident from student fora and feedback that this is an emerging area of importance. Powerful personal mobile phones are now almost

ubiquitous. Much of the development of the LMS and its components has been predicated on the use of PCs and/or laptops rather than small hand-held learning devices. Mobile devices allow nifty 'snack' use of dead time rather than the indigestible large chunks of video lectures or online resources. In the same way as flight bookings and check-in have changed, so eLearning systems will need to continue to adapt to changing technology, the cohort and the needs of industry. Whether this mobile revolution will constitute a radical innovation remains to be seen and will be a subject of future research.

CONCLUSION

Students who had access to better internet connectivity and utilised electronic communication more regularly were better aligned with their professional progression goals compared with those who did not have regular access or good connectivity.

The study concludes, as did Carroll, Ng and Birch (2009), that there is not a singular factor that influences retention and progression, but that these factors have varied impact depending on the combination of the factors.

This study, like previous studies, highlights that there is not a single structure for an effective construction of a successful eLearning environment (Carroll et al., 2009; Godfrey et al., 2011; Ahmed, Kloot, & Collier-Reed, 2015). From the outset, it is key to have a firm understanding of the discipline area and the requirements it has for its graduates. Detailed knowledge of

industry requirements and circumstances will have further impact if they can be successfully converted from or into an eLearning environment. The cohort adds further complexity and traditional students are more aligned with face-to-face delivery while mature students are better suited to the eLearning environment. Computer literacy and competency appear now to be a thing of the past and mature aged students in this study were more focused on completing their programmes and achieving their goals than their younger counterparts. This familiarity of students with online technology implies that the alternative solution in some respects is being normalised.

However, in order to manage radical innovation, institutions themselves need to change and to create 'truly new abilities and knowledge within the firm' (McDermott & O'Connor, 2002, p. 429). To move from an incrementalist to an innovative culture, three things are required: technical specialists, innovation champions and a coordinated process to link the outcome and the organisational structure (Ettlie, Bridges, & O'keefe, 1984). Staff resistance can become the biggest stumbling block for an online environment. An institutional strategy is therefore, required to develop technical specialists and to link the structures and processes to the desired outcome, for example, by staff development or transfers.

This paper has presented the development of eLearning in the Built Environment discipline as a radical innovation. In this innovation, basic components, such as time and space, were used differently, and alternative solutions to traditional lectures and learning materials were introduced including podcasts and video-conferencing. This radical innovation required a foundation of an effective LMS powered by internet connectivity. Students who used the components of the system more frequently were generally more aligned with their progression goals. At CQU, the BE team has been the innovation champion but there is more work to be done at the institutional level to align staff, structures and processes to the new paradigm. In general terms, it appears that take-up of the components of the eLearning system assists individual student progression and enables innovative institutions to succeed and thrive.

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Influence of Extrinsic Value on Customer Participation in Value Co-Creation Behaviour: Empirical Investigation using SEM Approach

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ABSTRACT

The aim of this empirical research is to investigate the influence of extrinsic experiential value on customer participation in value co-creation behaviour in hypermarkets. Data were collected from 800 customers of four top hypermarkets in Malaysia. Structural Equation Modeling (SEM), an analytical technique, was used to analyse the data. Findings indicate that extrinsic experiential value has a positive impact on customer information seeking behaviour, information sharing behaviour, and personal interaction behaviour. The study concludes that in order to develop customer participation in value co-creation behaviour, hypermarkets should provide high extrinsic experiential value in terms of service excellence and high returns on investment. This will influence customer behaviour and engage them to co-create value which is not only beneficial for customers but also for the hypermarkets to gain competitive advantage.

Keywords: Value co-creation, service-dominant logic, experiential value, retailing, Malaysia

INTRODUCTION

Research on value co-creation has remained an interesting topic of discussion in the last decade. Various studies have discussed value creation and value co-creation; however, most of them are conceptual in nature (Grönroos & Ravald, 2009; Grönroos, 2011; Grönroos & Voima, 2013) while empirical studies are limited (Restuccia, Montréal, & Ouellet, 2009; Albinsson, Perera, & Sautter, 2011). The conceptual studies elaborated on the role of customers and the firm in co-creation in various perspectives. The Service-Dominant Logic considers the customer as a value co-creator (Vargo

& Lusch, 2008) while the service logic (SL) considers the role of customers in value creation differently. According to SL, the customers are always value creators and create value as value-in-use. When customers begin interaction with firms and involve in dialogue, they co-create value. Without interaction and dialogue, co-creation is not possible (Grönroos, 2008, 2011, 2012; Grönroos & Voima, 2013).

The evolution of SL gives an empirical logic for exploring value co-creation. Consequently, various empirical studies have investigated the role of the firm and the customer in value co-creation and resulting outcomes (Dong, Evans, & Zou, 2008; Jaakkola & Alexander, 2014). Nonetheless, studies exploring the factors that contribute to customer participation in value co-creation behaviour are still limited. This is important to investigate because firms can only focus on the factors that motivate the customers to engage in co-creation activities. The decision of participating in value co-creation is made solely by the customers who are not in control of the firms. Thus, it is imperative to know what actually motivates customers to participate in value co-creation.

In modern retailing, such as hypermarkets, customers are not only interested in utilitarian benefits but also in hedonic benefits. The utilitarian and hedonic benefits provided by the hypermarkets give customers extrinsic motivation for consumption through active and reactive value sources (Holbrook, 1994). Therefore, their behaviour is usually influenced by the benefits they get in the form of extrinsic values (Mathwick, Malhotra, & Rigdon, 2001).

Since co-creation takes place through direction interaction where customers and firms involve in dialogue (Grönroos & Voima, 2013), extrinsic motivation to the customers to start interacting with the firm is necessary. In this context, customer returns on investment and service excellence are important considerations because these are extrinsic experiential values which offer both active and reactive value to the customers. Thus, the extrinsic experiential values are expected to be significant predictors of customer behaviour towards participation in value co-creation activities as the extrinsic cues motivate customers to go beyond shopping and involve in other activities (Shamim & Ghazali, 2014). The objective of this research, therefore, is to propose extrinsic experiential value as an important factor behind customer participation behaviour in value co-creation. This is an empirical research which investigates the influence of extrinsic experiential value in terms of service excellence (reactive) and customer return on investment (active) on three dimensions of customer participation in value co-creation behaviour, namely information seeking behaviour, information sharing behaviour, and personal interaction behaviour.

LITERATURE REVIEW

Customer Participation Behaviour in Value Co-Creation

Since customers are considered as one of the most important stakeholders in value

co-creation, their participation behaviour is essential for value co-creation (Yi & Gong, 2013; Shamim & Ghazali, 2015b). This behaviour is achieved when customers have information seeking, information sharing and personal interaction with the firm. Information seeking refers to customers searching for information through direct and indirect resource channels; these include interaction with service providers, environment, seeking information from brands displayed in the hypermarkets, and other resources provided by the hypermarkets (Yi & Gong, 2013; Shamim & Ghazali, 2015a; Shamim, Ghazali, & Albinsson, 2016). Information sharing behaviour is when customers are willing and open to sharing information required for co-creation during their interaction with service providers (Shamim & Ghazali, 2015a). They are willing to share any kind of information with service providers and the other customers. Participation behaviour is manifested in personal interaction with service providers (Yi & Gong, 2013; Shamim et al., 2016). It

is necessary for customers to be motivated and interested in participating in value co-creation. Customer participation behaviour has four dimensions, namely information seeking behaviour, information sharing behaviour, personal interaction and responsive behaviour (Yi & Gong, 2013; Shamim et al., 2016). Hence, customer participation behaviour is reflected in three dimensions, namely information seeking, information sharing and personal interaction.

Experiential Value Theory

In retailing, experiential value, namely customers' perception about an object based on their direct interactions which provide them relativistic preferences to get extrinsic and intrinsic benefits, is an extensively researched topic (Holbrook & Corfman, 1985; Mathwick et al., 2001). The experiential value concept is well explained by dividing it into four quadrants (Holbrook, 1994; Mathwick et al., 2001), as depicted in Figure 1.

	Active Value	Reactive Value
Intrinsic Value	Playfulness	Aesthetics
Extrinsic Value	Consumer Return on Investment (CROI)	Service Excellence
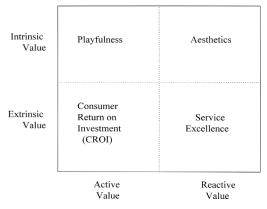
Figure 1. Experiential value topologies

Active value is achieved by increasing relationship between customer and marketing entities or businesses (Yuan & Wu, 2008) where customers try to fulfil their functional or affective needs by using resources provided by shopping malls (Kim, 2002; Keng, Huang, Zheng, & Hsu, 2007). On the other hand, *reactive value* is achieved from customer evaluations, responses to entities and understanding of services or products they want to buy or experience (Yuan & Wu, 2008). It is gained in a situation when customers appreciate physical shopping environment or respond positively to service counter employees (Kim, 2002; Keng et al., 2007). Similarly, *extrinsic value* is achieved by satisfying utilitarian needs such as saving money whereas *intrinsic value* is achieved through enjoyable shopping trips (Babin, Darden, & Griffin, 1994; Keng et al., 2007; Shamim, Ghazali, & Abdul Jamak, 2015).

The extrinsic value comprises two dimensions, namely service excellence and customers return, on investment (Mathwick et al., 2001). Service excellence is the reactive response of customers as a means to a self-oriented end (Holbrook, 1994; Mathwick et al., 2001). In other words, service excellence is customer appreciation for good services provided by the hypermarkets. If service excellence as a reactive response to extrinsic value is high, customers' motivation to involve with the service environment and service counter employees would be high (Shamim & Ghazali, 2014). Likewise, consumer return

on investment is the customer expectation to gain advantage out of his or her shopping visits in terms of economic gain, emotional excitement, time utilisation and psychological satisfaction (Mathwick et al., 2001).

In the context of hypermarkets, customers are more interested in getting hedonic benefits in addition to utilitarian benefits. Hence, they participate in other activities, engaging in resources provided by the hypermarkets. Thus, this paper only investigates extrinsic value and proposes that a high level of extrinsic value significantly develops customer behaviour towards participation in value co-creation activities (Shamim & Ghazali, 2014). Hence, the following hypotheses are formulated:

H1: Extrinsic value positively influences customer information seeking behaviour

H2: Extrinsic value positively influences customer information sharing behaviour

H3: Extrinsic value positively influences customer personal interaction behaviour

METHODOLOGY

Measurement Instrument

A 5-point Likert rating scale was used in this study ((1) equals strongly disagree and (5) equals strongly agree (5)). The questionnaire for measuring extrinsic

value was adapted from Mathwick et al. (2001) and customer participation behavior from Yi and Gong (2013).

Data Collection

A pilot study was conducted on 200 samples. An exploratory factor analysis (EFA) was performed to confirm factor structure and reliability of the items. Principle component analysis using Promax rotation was used to access the factor structure. The original scale of customer participation behaviour consists of 16 items loaded on four dimensions. Based on the EFA results, five items were deleted due to low factor loading resulting in three dimensions, namely information seeking, information sharing and personal interaction. Reliability was tested using Cronbach's Alpha value which showed the value of information seeking behaviour is 0.779, information sharing behaviour is 0.839, and personal interaction is 0.858. Similarly, the original scale of extrinsic value consists of seven items. Based on the EFA results, two items of customers return on investment were deleted due to low factor loading. This resulted in five items for extrinsic value. The Cronbach's Alpha value customer return on investment is 0.805 and service excellence is 0.765.

Following this, a field study was conducted involving 800 customers of hypermarkets located in five states of Malaysia, namely Perak, Penang, Selangor, Malacca, and Johor. Using mall intercept survey techniques, four hypermarkets from each state and 40 respondents from each hypermarket were selected randomly (Sudman, 1980). Data was collected in the morning and evening; 43.6% of the respondents were males and 56.4% females. Data were screened to detect missing values, incomplete responses, and outliers and the resulting final 516 responses were used for analysis.

DATA ANALYSIS

Measurement Model

Data were analysed using Structural Equation Modeling technique in AMOS 21.0 software. A two-step approach was employed for structural equation modeling (Anderson & Gerbing, 1988). In the first step, measurement model was estimated for the confirmation factor analysis (CFA) to check the model fit and validity. Findings show the factor loadings as significant (see Fig. 2). The Chi-Square / df is 3.402 < 5 meet the criteria recommended by Marsh and Hocevar (Marsh & Hocevar, 1985). The GFI is 0.926 > 0.90 (Joreskog & Sorbom, 1984), CFI is 0.935 (Bentler, 1990), TLI is 0.916 (Bentler & Bonett, 1980), and RMSEA (root mean square error of approximation) is 0.068 (Browne, Cudeck, & Bollen, 1993). These results meet all the recommended criteria for a good model fit (Hair, Black, Babin, & Anderson, 2010; Hair et al., 2010; Babin et al., 2010).
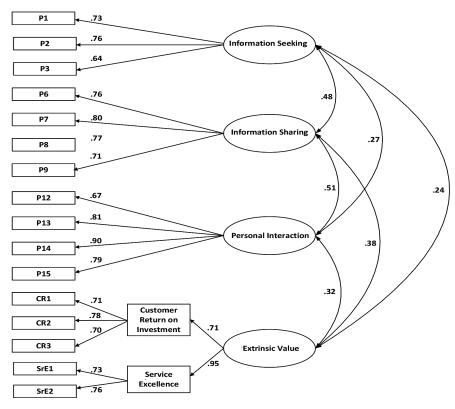
Figure 2. Measurement Model

Data were also tested for construct validity. A variable has convergent validity if Average Variance Extracted (AVE) is greater than 0.50 (Hair et al., 2010). As shown in Table 1, the AVE for all the variables is greater than 0.50 suggesting convergent validity. The discriminant validity was assessed by calculating the square root of AVE and compared with inter-construct correlations (Hair et al., 2010). As shown in Table 2, the square root of average variance extracted from all variables is greater than inter-construct correlation confirming the discriminant validity. Moreover, composite reliability for all variables is greater than 0.70 confirming reliability of the items (see Table 1).

Data Normality

For structural equation modeling, it is necessary for data to be normally distributed (Hair et al., 2010) requiring data normality to be checked. All values of Skewness and Kurtosis were below 1 confirming the univariate normality of the data distributed. However, multivariate kurtosis value for the data was 65.99 indicating multivariate normality concerns. To rectify the multivariate normality concern, the bootstrapping technique was used where bootstrap standard error was calculated and replaced with regression standard error. The subsequent t-value and p-value were calculated based on the bootstrap standard error.

Structural Model

The structural model was created to test the proposed hypothesis as shown in path analysis diagram in Figure 3. The obtained CFA model is a perfect fit as the value of all estimated measures GFA, AGFI, CFI, TLI and RMSEA is greater than the threshold level. The percentage of variance explained (R^2) for information seeking, information sharing and personal interaction is 0.27, 0.54 and 0.35 respectively indicating that the model has good explanatory power (Hair et al., 2010). The standard regression weights are presented in Table 2. As shown, the β value for the impact of extrinsic value on information seeking behaviour is 0.685 with 0.257 standard error. The t-statistics is 2.665 and p-value is 0.004 < 0.05 suggesting that the extrinsic value has a significant and positive impact on information seeking behaviour. Hence, Hypothesis H_1 is supported. The β estimate for the relationship of extrinsic value and information sharing behaviour is 1.248 with 0.427 standard error, and t-statistics is 2.923.895 with p-value 0.002 < 0.05. This suggests that extrinsic value has significant and positive impact on information sharing behaviour, supporting Hypothesis H_2. Finally, the β estimate for the relationship between extrinsic value and personal interaction behaviour is 0.846 with 0.239 standard error, and t statistics is 3.540 (p < 0.05) suggesting that extrinsic value has significant and positive impact on personal interaction behaviour.

Table 1

Factor Loadings, Composite Reliability, and AVEs

Code Items		Factor Loadings	CR	AVE
Extrinsic Value (Service Excellence, Customers Return on Investment)				
SrE1	When I think of this hypermarket, I think of excellence.	0.729		
SrE2	I think of this hypermarket as an expert in the merchandise it offers.	0.761		
CR1	Shopping at this hypermarket is an efficient way to manage my time.	0.719	0.823	0.704
CR2	Shopping at this hypermarket makes my life easier.	0.772		
CR3	Shopping at this hypermarket fits with my schedule.	0.699		
Information Seeking				
P1	I have asked others for information on what this hypermarket offers.	0.726		
P2	I have searched for information on where this hypermarket is located.	0.764	0.752	0.505
P3	I have paid attention to how others behave to use this hypermarket service well.	0.635		
Information Sharing				
P6	I provided the necessary information so that the employee could perform his or her duties.	0.759		
P7	I answered all the employee's service-related questions.	0.798	0.846	0.578
P8	I performed all the tasks that were required.	0.771		
P9	I adequately completed all the expected behaviour.	0.711		
Personal Interaction				
P12	I was friendly to the employee.	0.668		
P13	I was kind to the employee.	0.809	0.874	0.637
P14	I was polite to the employee.	0.902		
P15	I was courteous to the employee.	0.795		

Table 2
Validity Matrix

Variables	Personal Interaction	Information Sharing	Information Seeking	Extrinsic Value
Personal Interaction	0.798			
Information Sharing	0.506	0.760		
Information seeking	0.271	0.477	0.710	
Extrinsic Value	0.320	0.375	0.244	0.839
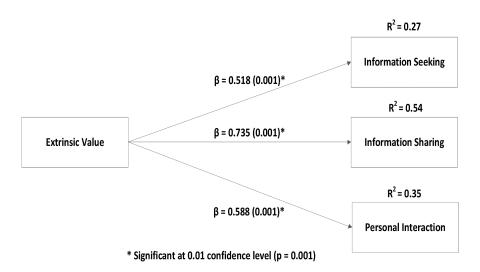
Figure 3. Theoretical Model

Table 3
Regression Estimates

Hypothesis	Independent Variable	Path	Dependent Variables	Estimate	S.E.	t	p	Remarks
H_1	Extrinsic Value	--->	Information Sharing	1.248	0.427	2.923	0.002	Supported
H_2	Extrinsic Value	--->	Personal Interaction	0.846	0.239	3.540	0.000	Supported
H_3	Extrinsic Value	--->	Information Seeking	0.685	0.257	2.665	0.004	Supported

CONCLUSION AND IMPLICATIONS

A hypermarket is a new, modern and a rapidly growing retailing concept that sells a wide range of household items under one roof. It occupies an area of between 2,500 square meters and over 8,000 square meters and has a large car park (Hassan, Bakar Sade, & Sabbir Rahman, 2013). Malaysia has taken considerable steps to boost its retail sector by establishing a number of hypermarkets in almost every state. Many international players such as TESCO, Carrefour, Giant and AEON have a presence in the Malaysian market. On

the one hand, these retailers help boost the wholesale and retail sector but on the other, they pose a tough competition for the local hypermarkets as well as small-scale retailers. Customers prefer to shop in the hypermarkets instead of local small-scale retailers because they get more extrinsic value from the former compared with the latter (Holbrook, 1994).

This study was conducted in top four hypermarkets in Malaysia to identify how the extrinsic value offered by the latter lure customers to engage in value co-creation activities. The aim was to investigate whether or not the extrinsic value has a significant role in developing customer participation in value co-creation behaviour. Customer participation in value co-creation behaviour is measured by three dimensions, namely information seeking behaviour, information sharing behaviour and personal interaction. Three hypotheses were formulated based on these dimensions. The extrinsic value as a second order construct comprises two dimensions, namely service excellence and customers return on investment which were regressed on customers' information seeking behaviour, information sharing behaviour, and personal interaction. The results suggest that extrinsic value has a positive impact on customer information seeking behaviour, information sharing behavior, and personal interaction behaviour. Among these three variables, the highest rate of change caused by the extrinsic value is found in information sharing behaviour ($R^2 = 0.54$) followed by personal interaction

($R^2 = 0.35$) and then information seeking behaviour ($R^2 = 0.27$). Value co-creation is a phenomenon which needs action by various stakeholders and led by customers to co-create platform for interaction and dialogue (Grönroos, 2008). Hence, these findings are relevant, meeting the basic premise for value co-creation process. Since service excellence is a reactive response to extrinsic value which is generated based on the service providers action in terms of providing excellent service, it stimulates customers' motivation level to go beyond shopping and involve in value co-creation. This shows that service providers' action is necessary for involving customers in value co-creation. On the other hand,, customer return on investment is the active source of extrinsic value where they expect to gain advantage out of their shopping trips in terms of financial gains, quality products, time save and psychological satisfaction. Customers experiencing higher gains show positive behaviour towards involvement in co-creation of value with the hypermarkets. This is advantageous for the customers as well as for the hypermarkets to boost future relationships. Hence, it is argued that for developing customers' participation in value co-creation behaviour, hypermarkets must need to focus on developing extrinsic experiential value by providing good services and high returns to customers.

Value is created by customers (Grönroos & Voima, 2013) where hypermarkets' facilitation help them in

creating value. Though the basic concept of hypermarket retailing is self-service, for co-creation of value, they need to assist their customers during delivery. For instance, some customers may take a long time to locate a product due to lack of information. Service providers by helping to facilitate sales at hypermarkets in the form of service delivery assist customers in getting a high return on their investment as the latter saves cost, time and energy. This will motivate customers to engage with the hypermarkets to co-create value. Service providers, especially at luxury stores, grocery stores, cosmetics, durable goods stores and other local shops operating within the hypermarket premises, need to enhance personal interaction with customers to ensure their shopping experience is pleasant and enjoyable. These kinds of strategies result in a co-creation environment and create more value for customers and the service providers.

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The Mediating Role of Customer Satisfaction in Customer Retention Model: A Case of Local Automobile Brands in Malaysia

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ABSTRACT

The automobile industry in Malaysia is facing increasing competition from foreign makes. Local automobile manufacturers, namely Perodua and Proton, are thus losing their market share. With such rapid decline in sales, it is important to ascertain the needs of customers in determining the predictors of repurchase intention of vehicles. This research seeks to examine the mediating role of customer satisfaction and to investigate the relationship of perceived service quality, product quality, price fairness, satisfaction, and repurchase intention. Multistage cluster sampling method was employed first in the Klang Valley before extending to a few selected authorized service centres. 200 samples were collected and data was analysed using SMART PLS 2.0 to build and assess the structural equation model of the relationships between the constructs. The results show that perceived service quality has no significant relationship with repurchase intention. However, perceived product quality, perceived price fairness and customer satisfaction are important factors that influence customers' repurchase intention. Customer satisfaction also mediates the relationship between perceived product quality and perceived price fairness towards repurchase intention.

Keywords: Automobiles, customer satisfaction, repurchase intention, service quality, product quality, price fairness, loyalty, Malaysia

INTRODUCTION

The automobile industry is an important driving force of economic growth, 2.6 new vehicles sold every second (LeBeau, 2014). A total of 666,674 units of vehicles were sold in Malaysia in year 2015, hitting a record high according to Malaysian

Automotive Association, 2016. In spite of this growth sales of Proton and Perodua, the 2 local producers, have been declined from 2011 to 2015 (Tan, 2015). The implementation of the ASEAN Free Trade Area (AFTA) and lower import duty on cars from Australia and Japan in 2016 will further increase the competitiveness for these local brands (Choong, 2013). Furthermore, recent surveys reported both local automobile manufacturers received scores which are lower than the industry average in terms of pre-sales satisfaction and after-sales satisfaction, indicating that the standard of services does not meet customers' expectations and is more inferior to international automobile manufacturers (Tan, 2013).

Albeit the dominance of local automobile manufacturers over a decade, unsatisfactory product quality of local automobiles has been a key reason for negative brand image, resulting in low trust and shrinkage in confidence level toward local brands amongst consumers (Ing, Phing, Peng, Ho, & Ong, 2012; New Straits Times, 2014). Thus, to remain as competitive contenders in the automobile market, local automobile manufacturers need to re-examine their marketing strategy. Coupled with both external forces and internal issues, it is crucial to examine the critical factors that influence existing customers' repurchasing decision of local automobiles. These repurchase intentions have a pertinent impact on the auto industry as a whole, as much of the revenue generated by the auto industry comes not only from the sales of actual cars but also from the continual service to customers. It is therefore important to ensure customer's confidence in the automobile industry to avoid the risk of losing out to foreign competitors. As such, the purpose of this research is to investigate the antecedents of consumers repurchase intention within the automobile industry.

LITERATURE REVIEW

Repurchase Intention

Repurchase intention is an individual's decision regarding revisiting a designated service or repurchasing a product from the same company (Hellier, Geursen, Carr, & Rickard, 2003). Retention of loyal customers has been shown to be more important that acquiring new ones in recent years with more emphasis placed on customer relationship (Gallo, 2014). In fact, research found that successfully increasing customer retention rates by 5% can lead to raising profit by 25% to 95% (Gallo, 2014). The key to developing loyalty and keeping customers hinges on organizations' capability to deliver superior customer value and the commitment to maintain the loyal relationship (Varga, Dlacic, & Vujicic, 2014). Therefore, to increase customers' intention to purchase, companies should evoke the commitment and positive beliefs about the product (Varga et al., 2014; Oh & Jeong, 2015). It is critical for automobile companies to recognize the importance of understanding consumers' repurchase intention because it

aids companies to better formulate business strategy (Morwitz, Steckel, & Gupta, 2007). Hence, this research seeks to investigate consumers' attitudes towards perceived service quality, perceived product quality and perceived price fairness, as well as the mediating role of customer satisfaction.

Perceived Quality

Quality can be viewed as objective quality and perceived quality (Mitra & Golder, 2006). Objective quality includes the technical, measurable, and quantifiable nature of the product or service, processes and quality control. A car's objective quality attributes are the horse power of the engine, materials used, size, safety features and others. Consumers buy based on prior experience, existing knowledge, overall product quality, durability, reliability, safety, technology, and functions (Mitra & Golder, 2006; Hidrue, Parsons, Kempton, & Gardner, 2011). Perceived quality however refers to the overall subjective judgment of the product quality (Zeithaml, 1988) which is an overall assessment that involves attitude (Bei & Chiao, 2001) and a higher-level of abstraction, rather than a specific attribute of a product.

Perceived Service Quality

Firms that provide a high level of service quality tend to generate greater profits compared to firms that provide low level of service quality (Bhat, 2005). Excellent service quality reduces cognitive dissonance and enhances their belief in choosing a right brand (Solomon, 2013). In the context of the automobile industry, a customer will encounter two distinctive types of customer service experiences, which are salespersons' service quality (pre-purchase) and service-centres' service quality (post-purchase). Salespersons are responsible for selling the firms' product/ brand to the customers while car service centres provide a series of maintenance procedures which are performed periodically (KT Motors, 2013).

The role of salespersons is essential in building customer satisfaction and brand loyalty (Darian, Wiman, & Tucci, 2005). However, the relationship between salespersons' service quality and customer satisfaction has only been tested rarely for the automobile industry (Yu, Wu, Chiao, & Tai, 2005; Yieh, Chiao, & Chiu, 2007; Wong et al., 2011; Yee & Ng, 2011). According to Vigripat and Chan (2007), it was found that there is no direct relationship between service-centres' service quality and repurchase intention albeit Wong et al. (2011) found there is an indirect relationship between service-centres service quality and repurchase intention. The inconsistency of these findings postulates the following hypotheses below:

H1: Perceived service-centres service quality is positively related to repurchase intention.

H2: Perceived salespersons' service quality is positively related repurchase intention.

Perceived Product Quality

Product quality is defined as the difference in quality amount to difference in the quantity in the desired ingredient or attributes (Abbott, 1955). Both product and service quality play a significant role in consumers' decision-making process (Kim & Na, 2015). Product quality is important when customers are purchasing high-involvement products (Solomon, 2013). Instead of trying to improve every attribute of a product, companies should place greater emphasis on the right attributes which will illuminate a better unique selling point and a valid justification of setting a premium price (Garvin, 1984). Often the final decision made by suppliers or customers is very much based on the product quality (Chumpitaz & Paparoidamis, 2004). When buying an automobile, the significance of product characteristics such as design, colours, functional needs and utilitarian needs varies (Haubl, 1996). Previous research found that perceived product quality has a significant positive relationship with purchase intention (Brucks, Zeithaml, & Naylor, 2000; Asshidin, Abidin, & Borhan. 2016). In addition, a study by Wong et al. (2011) indicated that there is indirect effect between perceived product quality and repurchase intention. Based on the evidence from previous studies stated, the following hypothesis is postulated:

H3: Perceived product quality is positively related to repurchase intention

Perceived Price Fairness

The concept of perceived price fairness has been an area of research that has gained considerable attention in the marketing literature (Xia, Monroe, & Cox, 2004). Perceived price fairness is defined as the consumers' assessment and associated emotions of the difference (or lack of difference) between a seller's price and the price of its competitor (Xia et al., 2004). This worthiness of the product is usually based on their perception of the cost of producing the product or delivering the service. As services are often immeasurable, the perceived price fairness will be judged based on "normatively acceptable" price (Thaler, 1985).

When customers perceive unfair pricing, this situation will evoke their price-consciousness in order to avoid being cheated (Sinha & Batra, 1999; Xia et al., 2004). In addition to that, unfair pricing might lead to customer complaints and subjugation of refunds from the sellers (Xia et al., 2004). In a worst-case scenario, customers might protest against unreasonable pricing and boycott the organization (Kahneman, Knetsch, & Thaler, 1986). Past studies indicated that overpriced products or services reduce customers' repurchase intention (Lichtenstein, Ridgway, & Netemeyer, 1993), indicating there is a negative relationship between perceived price fairness and repurchase intention (Bell, Biyalogorsky, & Cormon, 1997; Wu, Liao, Chen, & Hsu, 2011; Haddad, Hallak, &

Assaker, 2015). As such, we postulate the following hypothesis:

H4: Perceived price fairness is positively related to repurchase intention.

Customer Satisfaction

The feeling of disappointment or pleasure as a result of the performance of the product or service should match the buyer's expectation (Oliver, 1999; Kotler & Armstrong, 2008) indicating customer satisfaction. Customer satisfaction is an important precursor of future purchase intention (Mittal & Kamakura, 2001) and is achieved when the expected standard of quality is met or surpassed. In most cases, high (Low) level of customer satisfaction leads to high (low) level of repurchasing intention (Hellier et al., 2003; Fang, Chiu, & Wang, 2011). Failure to carefully take into account customers' satisfaction can lead to brand switching behaviour or discontinuation of future purchase (Durvasula, Lysonski, Mehta, & Tang, 2004) as customer satisfaction and repurchase intention are interrelated (Dawes, Dowling, & Patterson, 1993; Oliver, 1999; Durvasula et al., 2004). Hence, the following hypothesis is postulated:

H5: Customer satisfaction is positively related to repurchase intention.

The Mediating Role of Customer Satisfaction

Service quality affects customer satisfaction (Bei & Chiao, 2001) and mediates between

perceived quality, brand loyalty and behaviour intention. (Mosahab, Mahamad, & Ramayah, 2010; Osman & Sentosa, 2013). This indirect influence is also evident between perceived product quality and purchase intentions (Sweeney, Soutar, & Johnson, 1999; Llusar, Zornoza, & Tena, 2001). While perceived price fairness is important for customer satisfaction, there is insufficient research on the mediating effect of customer satisfaction between perceived price fairness and repurchase intention especially in the automobile industry in Malaysia. As such, we postulate the following hypotheses:

H6: Customer satisfaction mediates the relationship between perceived service-centres' service quality and repurchase intention.

H7: Customer satisfaction mediates the relationship between perceived salespersons' service quality and repurchase intention.

H8: Customer satisfaction mediates the relationship between perceived product quality and repurchase intention.

H9: Customer satisfaction mediates the relationship between perceived price fairness and repurchase intention.

METHODOLOGY

Data Collection

Prior to the actual data collection, the questionnaire was tested on 5 respondents

to obtain feedback and comments to test respondent understanding of questions from which further improvements can be made. Minor adjustments on the sentence structures and formatting were made. Furthermore, a pilot test of 30 respondents was conducted to verify the reliability of each construct. Instruments were adapted from the following sources: - Repurchase Intention (RP) (Lin, Chen, Chiu, & Lee 2011); Customer Satisfaction (CS) (Zeithaml, Berry, & Parasuraman, 1996); Perceived Service-Centres' Service Quality (SQa) (Yieh et al., 2007); Perceived Salespersons' Service Quality (SQb) (Kennedy, Ferrell, & LeClair, 2001); Perceived Product Quality (PPQ) (Kennedy et al., 2001; Vantamay, 2007); and Perceived Price Fairness (PPF) (Andreas, Lan, Kent, & Frank, 2007). From the reliability test, only one item was deleted in SQb. Cronbach's Alpha value of each construct is above than acceptable value of 0.7 (Nunnally & Bernstein, 1994).

Multistage cluster sampling method was used in the study, with the first cluster sampling area in the Klang Valley and the second cluster sampling area confined to a few authorised service centres within the Klang Valley. A total of 250 questionnaires were distributed to local automobile users at various time intervals for a month. Only 200 questionnaires were usable due to missing data and outliers. The final data set consists of 100 data for each brand (Proton and Perodua) to avoid biasness.

DATA ANALYSIS

Partial Least Square (PLS) based Structural Equation Modelling (SEM) was employed due to the software's lower restrictions on data distribution, sample size, and measurement scales (Urbach & Ahlemann, 2010). PLS maximizes the explained variance of the endogenous variables compared to covariance-based SEM which focuses on best fit for the research model (Gefen, Straub, & Boudreau, 2000). Bootstrapping method (1000 resamples) was used to determine the significance levels of the loadings, weights, and path coefficients.

Common method variance was checked using the Harman one-factor test and results of the factor analysis showed that the total variance explained by a single factor is 40.78%, which is lower than the suggested value of 50% by Podsakoff, MacKenzie, Lee and Podsakoff (2003). Hence, we can conclude common method variance is not a major issue for this research.

Assessment of Measurement Model

Discriminant validity is achieved when the square root of the (Average Variance Extracted) AVE is greater than the correlation with other constructs (Hair, Hult, Tomas, Ringle, & Sarstedt, 2017). The loadings of all reflective indicators are above 0.70 except SQa1, SQa2, PQ3 thus were deleted. The values of composite reliability for all reflective constructs are above 0.70 (Hair et al., 2017) and the AVE for each construct is above 0.50 (Fornell & Larcker, 1981) suggests convergent validity shown in Table I.

Table 1
The Summary of Measurement Model

Constructs	Items	Loadings	CR[a]	AVE[b]
SQa	SQa3	0.73	0.91	0.58
	SQa4	0.72		
	SQa5	0.75		
	SQa6	0.75		
	SQa7	0.73		
	SQa8	0.85		
	SQa9	0.80		
SQb	SQb1	0.83	0.95	0.69
	SQb2	0.83		
	SQb3	0.81		
	SQb4	0.84		
	SQb5	0.79		
	SQb6	0.86		
	SQb7	0.85		
	SQb8	0.81		
PPQ	PQ1	0.87	0.94	0.81
	PQ2	0.92		
	PQ4	0.92		
	PQ5	0.88		
PPF	PF1	0.90	0.93	0.73
	PF2	0.73		
	PF3	0.91		
	PF4	0.92		
	PF5	0.80		
CS	CS1	0.92	0.96	0.84
	CS2	0.90		
	CS3	0.93		
	CS4	0.93		
	CS5	0.91		
RP	RP1	0.93	0.95	0.78
	RP2	0.93		
	RP3	0.72		
	RP4	0.90		
	RP5	0.92		

a Composite Reliability (CR) = (square of the summation of the factor loadings)/ {(square of the summation of the factor loadings) + (square of the summation of the error variances)}.

b Average Variance Extracted (AVE) = (summation of the square of the factor loadings)/ {(summation of the square of the factor loadings) + (summation of the error variances)}

Table 2
Discriminant Validity

	CS	PPF	PPQ	SQa	SQb	RP
CS	**0.91761**					
PFF	0.604367	**0.85405**				
PPQ	0.812914	0.538321	**0.89974**			
SQa	0.415367	0.381441	0.459788	**0.82911**		
SQb	0.479574	0.392603	0.503498	0.632378	**0.76318**	
RP	0.739968	0.615301	0.680859	0.346191	0.398086	**0.8831**

Assessment of Structural Model

To assess the structural model, a nonparametric bootstrapping procedure (1000 resamples) was employed to generate standard errors and t-statistics to evaluate the statistical significance of the path coefficients shown in Table II. The results revealed that H1 and H2 are not supported, but H2, H3 and H4 are supported. Mediation effect happens when the presence of the mediating variable strengthens the link between independent and dependent variables (Kumar, Talib, & Ramayah, 2013). Tests on the mediation hypotheses (H6, H7, H8, H9) removed direct effect path to obtain the indirect paths and the corresponding standard deviation to calculate t-statistics (Preacher & Hayes, 2008) where results are shown in Table III. The R^2 value for repurchase intention in the model is 60.6%.

Table 3
Hypothesis Testing for Direct Effects

Hypothesis	t- value	Standard Error	(95%) Lower Limit and Upper Limit	Decision
H1: SQa→ RP	0.121	0.069	[-0.128, 0.142]	Not Supported
H2: SQb→ RP	0.322	0.059	[-0.143 0.089]	Not Supported
H3: PPQ → RP	2.370**	0.085	[0.039, 0.373]	Supported
H4: PPF→ RP	3.267**	0.074	[0.109, 0.399]	Supported
H5: CS → RP	4.629**	0.091	[0.249, 0.605]	Supported

*p<0.05; **p<0.01

Table 4
Hypothesis Testing for Mediation

Hypothesis	Indirect Effect a*b (Constraint Model)	t- Value	Std Error	(95%) Lower Limit and Upper Limit	Decision
H6: (CS) mediates (SQa) and (RP)	(SQa-> CS) 0.067 * (CS-> RP) 0.740 = 0.04958	0.857	0.057	[-0.062, 0.161]	Not Supported
H7: (CS) mediates (SQb) and (RP)	(SQb-> CS) -0.023 * (CS-> RP) 0.740 = -0.01702	-0.026	0.063	[-0.141, 0.106]	Not Supported
H8: (CS) mediates (PPQ) and (RP)	(PPQ-> CS) 0.667 * (CS-> RP) 0.740 = 0.49358	9.383**	0.052	[0.392, 0.566]	Supported
H9: (CS) mediates (PPF) and (RP)	(PPF-> CS) 0.229 * (CS-> RP) 0.740=0. 16946	2.555**	0.066	[0.040, 0.299]	Supported

$*p<0.05$; $**p<0.01$

DISCUSSION, IMPLICATIONS AND CONCLUSION

From the result, service-centres' service quality does not have a significant positive relationship on customers' repurchase intention (H1 not supported) and are consistent with Vigripat and Chan's (2007) findings. The insignificant relationship can be attributed to the invariant level of service quality provided by both local and international service centres which leads to the diminishing importance and appreciation of service quality. When service quality reaches a threshold, it adds no additional value to customers (Anderson & Sullivan, 1993). Furthermore, later stages of car ownership life cycle customers tend to have higher expectations of service-centres' service quality (Kennedy et al., 2001). Based on the findings, it is suggested local automobile manufacturers maintain the current level of service-

centres' service quality. Investing excessive capital in improving service-centres' service quality will not increase customers' repurchase intention. However, the result does not indicate that service-centres' service quality is not important because it may affect the perceived brand image and subsequently influence repurchase intention. Future researchers may want to look into the relationship between service-centres service quality and brand image.

The results also indicate that perceived salespersons' service quality does not affect repurchase intention (H2 not supported). This could be attributed to the fact that existing consumers have a high level of product knowledge and therefore may perceive salespersons' assistance as salesmanship rather than providing factual information or knowledge (Kennedy et al., 2001). In light of this, salespersons would then have to be extra vigilant and

sensitive to the types of customers they are serving, adjusting to the most effective approach to attend to discerning customers. Although salespersons' service quality do not have substantial influence on existing customers' repurchase intention, local automobile manufacturers still need give a proper training to the salespersons so that they possess necessary product knowledge and interpersonal skills to establish trust and rapport with interested customers (Panda, 2013).

This study shows that perceived product quality has a significant positive relationship with repurchase intention (H3 supported). Higher perceived product quality often associates with higher perceived value, resulting in repurchasing intention in the future (Toivonen, 2012). High quality cars not only help save money in the long run with less expenditure on maintenance but also provide a sense of safety and brand trust for car users. Given that local automobiles are often associated with poor product quality, these local automobile organizations would then have to be innovative with their product offerings and coupled with the right marketing strategy to keep negative perception on product quality of local automobiles at bay.

The result of this study shows that perceived price fairness has a significant positive relationship with repurchase intention (H4 supported). Low level of perceived price unfairness intensifies the perceptions of monetary sacrifice (Sinha & Batra 1999). Local automobile manufacturers mainly produce affordable cars, aiming at the lower-end buyers. While this makes pricing strategy crucial, producers could produce cars with new designs, extra features, advanced engine technology or other valuable features which can help to increase the perceived value of the cars. The result of H5 shows that customer satisfaction has a significant positive relationship with repurchase intention (H5 supported).

This research shows that the customer satisfaction does not mediate the relationship between perceived service-centres' service quality and repurchase intention (H6 not supported) and the relationship between perceived salespersons' service quality and repurchase intention (H7 not supported). Customers view outstanding service quality as an enhancement or an ancillary benefit rather than a necessity. Hence, superior service quality is no longer effective enough to retain customers. The support of H8 shows that customer satisfaction mediates the relationship between perceived product quality and the repurchase intention (H8 supported). The durability of a car depends on how well the car is maintained. Service centres must ensure that automobiles are given the best in the long run, customers, who experience least problems with their vehicles might feel that cars are more durable which will indirectly increase customer satisfaction, ultimately resulting in likelihood repurchase intention. Lastly, the support for H9 indicates that high level of customer satisfaction might reduce the impact of negative price fairness perception thus leading to repurchase intention.

Satisfied customers are less likely to trigger fairness perception which might ultimately lead to precipitous price comparison (Xia et al., 2004).

LIMITATIONS AND FUTURE RECOMMENDATIONS

The limitations of this research are: 1) the sampling areas mainly come from the Klang Valley. 2) this research combines the data of both Proton and Perodua. Future researchers might consider testing the issue of heterogeneity between two groups of data. 3) there is a need to include more variables into the model.

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Video Enhanced Multiple Choice Questions – Personalising eLearning

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ABSTRACT

Instructional videos have been successfully used to teach mathematical concepts to distance students. These videos allow the students to see and hear their lecturer with an added advantage of being able to stop and rewind or replay until the concept is understood. While videos facilitate student understanding, formative assessment provides both lecturer and student with an indication of the latter's mastery of a mathematical concept.

Formative assessment with handwritten feedback is viewed as preferential because changing university culture means few academics have the time to provide comprehensive handwritten feedback to large numbers of students for every concept. Further, for this feedback to be useful it needs to be delivered to the student in a timely manner. The ability to provide instant feedback is one of the major advantages of online quizzes using multiple choice questions (MCQs).

There are mixed attitudes towards MCQs within academia. For each attribute of MCQs, research can be found to both support and condemn it. Feedback from MCQs is undoubtedly fast but is it effective? Using video enhanced feedback for online quizzes may provide the best of both worlds.

Keywords: Mathematics education, assessment, feedback, Multiple Choice Questions, assessment technology

INTRODUCTION

Universities around the world have undergone changes in their identities and roles; education has become an internationalised, global commodity, with reduced government funding and increased emphasis on market driven university funding (Parker, 2011). The 2015-2016

Australian Federal Budget (Australian Government, 2015) facilitates further commercialisation of Australian universities by removing the cap on student fees and decreasing the government's contribution for government supported students.

The Australian Government is encouraging universities to increase their enrolments and admit greater numbers of non-traditional students (Gillard, 2009). As a result, Australian universities have relaxed their entry requirements, reducing the necessity for high school students to complete traditional science subjects (Lyons & Quinn, 2010). The Australian Academy of Science identifies these changes as 'one of the key contributors to declines in mathematics enrolments at the senior high school level' (Lyons & Quinn, 2010, p. 109). Students are completing high school unprepared for their tertiary studies, increasing the burden on universities to provide bridging and remedial courses (Falkiner, 2012) or provide extra academic assistance.

This goes against the perception that a university's 'purpose is not to transfer knowledge but to create environments and experiences that bring students to discover and construct knowledge for themselves, to make students members of communities of learners that make discoveries and solve problems' (Barr & Tagg, 1995, p. 13). When students enter undergraduate programmes without the assumed knowledge, learning is affected. Given that learning is 'a planned process to modify attitude, knowledge or skill behavior through learning experience to achieve performance in an activity or range of activities' (Hargreaves & Jarvis, 1998, p. 53) it is important that students can identify gaps in their assumed knowledge to plan this process for themselves. Diagnostic tests and formative assessment can alert students to gaps in their mathematical knowledge or comprehension.

Multiple Choice Questions (MCQs) are able to provide quick feedback to students, though this is often limited to an indication of the answer being correct or not. Combining MCQs and proven forms of feedback can provide students with quality feedback immediately.

LITERATURE REVIEW

Assessment and Feedback

Assessment and feedback are vital components of learning and teaching - it could be stated that assessment is the corner stone of education. It prepares the student for the next task and creates confidence that tasks are achievable (Boud, 2000). Assessment should not be so difficult that the student becomes discouraged but should still maintain a certain amount of complexity (Boud, 2000) while testing acquired knowledge.

Formative assessment is any assessment that is used to acquire information for the purpose of adjusting learning and teaching (Killen, 2005). This form of assessment provides students with a chance to reflect on feedback with the knowledge that it will improve their chance of achieving a better grade (Tait, 2005).

Distance students and their lecturers gain valuable insight into the former's level of understanding, highlighting any need for assistance. 'The importance of feedback provided through formative assessment is not only an important part of the learning process but is also reciprocal' (Dekkers, Adams, & Elliott, 2011, p. 4). Formative assessment has the ability to improve students' confidence and their ability to learn (Boud, 2000) by giving them feedback and the opportunity to improve. It is well accepted that formative assessment and the associated feedback, guides the learning process, provides students with feedback vital for assurance or correction and encourages self-directed learning (Rolfe & McPherson, 1995; Rushton, 2005; Fletcher & Shaw, 2012).

Self-assessment is the means by which the student or the learner determines, through their own means, whether or not they have grasped the concept or the task being learnt. It is an important part of becoming a successful student. Students who are capable self-assessors experience favourable learning and internal motivation (Athanasou & Lamprianou, 2002). The acquisition of self-assessment skills not only improves learning in a particular subject but also establishes the foundation for lifelong learning (McDonald & Boud, 2003).

A study examining students seeking mathematics assistance found 52% (23/44) did so because they recognised their failure to comprehend a concept, topic or problem in a lecture, tutorial or in their textbook (Adams, Hayes, Dekkers, Elliott, & Atherton, 2012, p. 28). Accurate self-assessment is especially crucial in higher education, though several factors limit the student's ability to accurately self-assess (Dunning, Heath, & Suls, 2004). These factors are:

- Information deficits — the lack of knowledge or expertise to accurately assess competence.

- Unknown errors of omission — the inability to recognise knowledge gaps.

- Information neglect — the failure to take into account information that is at hand.

Students that are not effective self-assessors face impediments in learning and performing well on other assessments which also hinder their ability to cope with change (Boud, 2000, 2007). Formative assessment in the form of diagnostic tests may be one way to assist students to self-assess and determine any knowledge gaps that they may have.

The gaps between students' present knowledge and required knowledge can be lessened or closed through formative assessments (Boston, 2002). For formative assessment to be effective, a minimal turn-around time is required to correct students' fundamental errors prior to them commencing subsequent topics, which are built on mathematical knowledge. Timely feedback is important in the student's learning process (Irons, 2007) as it can strengthen correct understanding and encourage long-term recollection (Smith & Kimball, 2010) as well as correct errors.

Students are motivated by detailed feedback but are less satisfied when the feedback is generic (Malau-Aduli, Assenheimer, Choi-Lundberg, & Zimitat, 2013). Quality of the feedback is central to learning (Sadler, 1998). Quality, timely feedback is required to assist self-directed learning (Pilling-Cormick, 1997) and it has been suggested that regardless of the sophistication of the feedback system associated with the use of technology, it is unable to provide the personalized feedback required by students (Siozos, Palaigeorgiou, Triantafyllakos, & Despotakis, 2009). It is important then that the use of technology in education benefits both student and lecturer.

Technology in Education

Technology is now increasingly used to make higher education accessible to students (Shea, Pickett, & Li, 2005). It is changing the way students learn and study as well as the way they interact with educational institutions. In fact, students now expect that electronic materials will be available for their subjects via the internet (Golden & Lee, 2007). 'One vision of the future of universities is that virtualization and remote working technologies will enable us to study at any university in the world, from home' (MacKeogh & Fox, 2009, p. 147). Distance study is moving into the mainstream of higher education, with increases in technological development causing rapid expansion during the past decade (Harry, John, & Keegan, 2013).

The use of Information communication technologies (ICTs) has increased across every facet of our lives. This has resulted in universities adopting online learning environments as a means of delivering subjects (Fleming, 2010). 'Improving the quality of learning is no light undertaking and does not happen just because teaching goes online. A high-quality learning system with real potential for improving student performance would entail a quite substantial investment - human, intellectual, financial…' (Skilbeck, 2001, p. 62). This will require 'lecturers to provide the interface between the 'educational technology' of the learning and teaching environment and the 'technological literacy' demands of society' (Dekkers, Howard, Adams, & Martin, 2013, p. 165).

Even though integrating technology into a mathematics classroom results in improved attitude and increased engagement with the mathematics, these positive effects are dependent on how well the technology is used (Ozel, Yetkiner, & Capraro, 2008). Within the Australian context this is hindered by the fact that mathematics teachers have little experience with computer-based learning design (Geiger, Forgasz, Tan, Calder, & Hill, 2012). Despite being taught their subject matter through the use of technology, many pre-service teachers have not learnt to teach with technology and therefore few teachers feel comfortable including technology in their teaching (Niess, 2005).

Mobile learning utilises personal and portable technologies for effective education (Roschelle & Sharples, 2010). These technologies are termed ubiquitous

technologies. They have facilitated the breaking down of the boundaries in higher education and enabled eLearning regardless of location. Technologies that provide access to asynchronous learning have fostered anywhere, anytime learning (Kumar, 2014). It is a concept that predates the use of ubiquitous technologies (Nyquist, Arbolino, & Hawes, 1977).

The use of ubiquitous technologies is encouraged by the use of eLearning systems at the university level. Universities now place all of their learning materials, assessment and support facilities on a Learning Management System (LMS) such as Moodle. The LMS provides students with activities, readings, videos, recorded lecture videos and accompanying PowerPoint® slides.

The Tablet PC enables PowerPoint®, and other programs to be used in a more interactive way; 'digital inking' enables the user to write on the computer using a digitiser pen. No attempt is made by the computer to convert the writing into text (*Figure 1*). Combining this ability with Camtasia®, allows videos to be created that not only convey the mathematics concepts and ideas but also the mental processes involved in problem solving (Adams, Elliott, & Dekkers, 2010). It is important that students be able to mentally plan a sequence of tactical decisions when forming a strategy for solving equations (Robson, Abell, & Boustead, 2009). These videos enable students to experience the teaching of mathematics as if they were in a classroom.
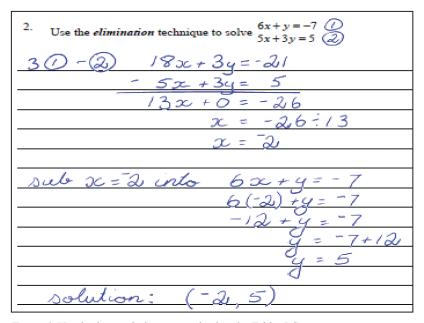
Figure 1. Handwritten solutions created using the Tablet PC

Videos provide more effective learning and reduced cognitive overload if they are limited to a maximum of 7 minutes (Miller, 1994; Adams et al., 2010). To avoid passive viewing and engage the students, each video should first present the topic, demonstrate through examples and then provide an activity for the student. The ability to provide digital handwritten feedback and solutions makes the Tablet PC an exceptional tool for providing feedback on assessments.

Technology and Assessment and Feedback

Technology has been utilised in many ways for formative assessment and feedback. It has the ability to remove various limitations that formerly rendered high-quality formative assessment difficult or impractical (Brown, Hinze, & Pellegrino, 2008). Online formative assessments can provide teachers and students with significant educational experiences via a pedagogical strategy to change the assessment culture so that diverse learning needs and equitable education are supported (Gikandi, Morrow, & Davis, 2011).

The possibility of incorporating multimedia feedback into assessments seems only to be limited by the imagination. Smartphone scanner apps allow students to scan their work and share it with the lecturer using Dropbox, providing the lecturer with instant feedback on the students' understanding of the class content in real time (Herr & Tippens, 2013). Providing students with audio feedback was found to increase content retention, increase students' satisfaction through personalization and reduce marking time (Orlando, 2013). Electronic marking has also been conducted using a Tablet PC to annotate student assessment. Once annotated, the assessment is saved as a Word or PDF document which can be viewed on any LMS by the student (French, 2007). The Tablet PC allows personalized handwritten feedback for mathematics to be provided electronically to all students (Hayes & Adams, 2009). Handwritten feedback is preferable to computer generated marking and comments as it is more authentic and provides guidance for a solution. (Harrison, Pidcock, & Ward, 2009). Handwritten solutions have been found to be more beneficial to student comprehension than typed solutions (Jordan, Loch, Lowe, Mestel, & Wilkins, 2012), and instructional videos even more so (McNamara & Barnett, 2012).

Multiple Choice Questions

Multiple Choice Questions (MCQs) have been used in assessment since 1914 when they were designed by Frederick J. Kelly of the University of Kansas (Mathews, 2006). The MCQs are quick to mark and relatively easy to setup, though writing good MCQs is not so easy. It is important that assessment be both reliable and valid, as these attributes will provide consistent results across comparable cohorts. Both MCQs and true-false questions are considered to be highly reliable when they contain a sufficient number of valid

questions (Palmer & Devitt, 2007). Good MCQs are difficult to write and have been found to be time consuming to construct correctly. When conducted online they are difficult to authenticate (McNamara & Barnett, 2012). The MCQs often contain item-writing flaws attributed to the lack of training provided to educators (Tarrant & Ware, 2008). One such flaw is cueing (Fenderson, Damjanov, Robeson, Veloski, & Rubin, 1997).

Two types of cueing are recognised: positive cueing (correct answer directed cue) and negative cueing (incorrect answer directed cue) (Schuwirth, van der Vleuten, & Donkers, 1996). Positive cueing is more evident in difficult items, with easy items more often displaying negative cueing. Recognising cuing is just one of the methodologies adopted by students in their attempt to game play MCQ examinations (McNamara & Barnett, 2012). Despite this game play, it has been found that student feel disempowered by MCQs and would prefer to answer the questions in their own words (Paxton, 2000). Some students find the language used in MCQs confusing and have difficulties distinguishing between answers that are quite similar in meaning (Paxton, 2000). Item-writing flaws tend to benefit borderline students but disadvantage others (Tarrant & Ware, 2008).

The increasing popularity of MCQs in higher education may be due to 'growing numbers of students, reduced resources, modularization and the increased availability of computer networks' (Nicol, 2007, p. 53). This increase in popularity is further facilitated by the growth in ubiquitous technologies and the corporatisation of universities. The fact that MCQs are comparatively less time consuming 'to set, to answer, to correct, to provide feedback and to administer' contributes to their acceptance (Chan, Tam, & Li, 2011). Marking is usually completed electronically, making MCQ tests and examinations preferable for subjects with large cohorts. The problem with many MCQs is that the only feedback they provide to students is the correct answer. This provides minimal assistance in helping students to learn from their mistakes. Additionally, single attempt MCQs provide no opportunity for students to verify if they have overcome their misunderstanding and mastered the concept. Single or short answer on-line quizzes also experience similar problems. The MCQs have the advantage of being easily incorporated into e-Learning platforms.

The LMS enables various forms of media and multimedia to be incorporated into an online quiz. Providing video solutions to MCQs engages students' senses and enables them to more easily comprehend the concept. It is envisaged that this will also remove the 'multiple-guess' problem associated with MCQs as students will have the opportunity to watch a video explaining the mathematical concept, through a similar example, when an incorrect answer is selected. Just watching a video is not sufficient for learning mathematics. It is important that the feedback loop is completed and

students require the opportunity to practice. This can be achieved by enabling the student to attempt a similar question after watching the video. The student is then able to reattempt questions to affirm their understanding.

Equally important as completing the feedback loop is ensuring that the feedback facilitates this completion. Merely indicating that an answer is correct is not very helpful as it is unable to provide the feedback that is valuable for learning (Paxton, 2000). Discovering what is known and unknown directs learning. While suitable feedback on performance is beneficial for learning, discovering what is unknown and being provided with the resources to learn can lead to increased confidence.

High levels of self-confidence and self-efficacy lead to greater success in undergraduate mathematics and mathematics assessment (Goodwin, Ostrom, & Scott, 2009). These findings are more significant for women than for men. Traditionally, males performed better than females on multiple choice tests, though this gap is closing (Liu & Wilson, 2009). This may be due to better test preparation and an increased willingness by females to guess where they would have left a question blank. Gender biases in multiple choice questions may lay in what is tested rather than how it is tested (Goodwin et al., 2009). Performance in MCQs is also related to the marking schemes adopted.

Researchers and educators are undecided on the most appropriate method for applying marks for MCQs. The simplest marking form rewards correct answers only. Some marking schemes attempt to compensate for guessing (Scharf & Baldwin, 2007). Negative marking for incorrect answers is mainly adopted to discourage guessing (Burton, 2005), but all students are negatively affected by negative marking (Bond et al., 2013). To overcome this, a method of applying confidence measurements to each MCQ answer was developed (Farrell & Leung, 2004) and also for the same reason, Elimination testing, claimed to discriminate between all possible knowledge levels (Bond et al., 2013). Regardless of these attempts, discouraging guessing is difficult and using MCQs for formative assessment seems the most appropriate.

When MCQs are used for formative assessment and delivered online, students are able to practise, receive feedback and reflect on their learning (Wei & Johnes, 2005).

The Project and Preliminary Results

This research builds on previous research investigating the use of videos to teach mathematics to students and the resulting changes in students' confidence levels (Adams et al., 2010; Adams, Elliott, & Dekkers, 2011; Adams & Elliott, 2013; Adams, Hayes, Dekkers, & Johnston, 2013; Adams, Dekkers, & Elliott, 2012, 2014; Adams & Porter, 2014). These initial results were formulated with very basic statistical applications and further investigation is required.

This projects investigates optimising the feedback provided by MCQs and the learning capacity through the incorporation of video feedback for incorrect answers. Upon selecting an incorrect answer (*Figure 2*) the student may choose to watch a video on a similar question or download a related module (text chapter). The use of a similar question for the video was to improve students' application and transference skills.
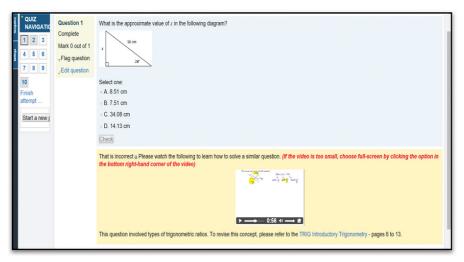
Figure 2. Incorrect answer with video

The initial pilot of the video enhanced multiple choice questions (VEMCQs) project commenced in term 2, 2014, and was a first-year introductory undergraduate subject. The subject included some very basic mathematics for Built Environment students. There were initially 35 students enrolled in the subject. Eleven students dropped the subject before census date (last day to withdraw without academic or financial penalty) and a further two students withdrew after this date; these two students did not attempt the VEMCQ test. Three of the students withdrawing before census attempted the VEMCQ test, one of these students withdrew from the subject on the same day the test was completed.

There was a total of 18 students who attempted the test (not all attempts were completed); 6 of these students attempted the test multiple times. All of the students attempting the test more than once improved on subsequence attempts. The first attempt could not be used to predict the final test score as it was unknown what action students took as a result of attempting the test. The small number of students that did complete the survey provided minimal insight into some actions taken (*Figure 3*).

> *I did not finish the test as I wasn't doing too well and commenced some study through the ALC but did not re-commence the test as I got caught up studying for other topic quizzes/assignments.*
>
> *It's the first time I have encountered so much help. It is truly amazing.*

Figure 3. Student comments

The survey consisted of seven questions comprising multiple choice questions, scaled questions and open-ended responses. Only 5 students completed the survey and they believed that the inclusion of the VEMCQ test into the subject assisted them with their understanding of the assumed knowledge content and all would like to see similar types of tests, with video support, incorporated into their other subjects. Figure 3 shows the students' comments. It can be seen from the first comment that at least one student used the test to highlight the gaps in his or her knowledge and seek assistance (the ALC provides individual mathematics assistance).

Though the number of students in the pilot study was small, valuable insight into the setting up and implementation of the project was gained. The study will be repeated in subjects with larger cohorts and the knowledge gained from the pilot will be used to improve subsequent implementations.

CONCLUSION

Building on research investigating the use of videos to teach mathematics to distance students and register changes in their confidence levels, this project combines this with the ability of MCQs to give immediate feedback. Videos have been found to be a convenient and worthwhile way to teach mathematics to distance students. It was found that scaffolding mathematics subject with both instructional videos and personalised feedback increased student confidence and reduced their fear of mathematics.

Providing students with MCQ diagnostic testing prior to the commencement of a subject can assist students in discovering any gaps they may have in their assumed knowledge. While conceptually the use of video feedback for MCQs should assist students to highlight and fill assumed knowledge gaps, data collected have not been able to provide insight into its effects. The pilot has however, highlighted the need to improve the survey instrument and increase participant numbers to provide insight into student experience.

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Relationship of Inquiry-based Instruction on Active Learning in Higher Education

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ABSTRACT

Inquiry-based instruction is a student-centred approach that can enhance students' confidence, understanding, and academic performance in learning. This study seeks empirical evidence on the effect of Inquiry-Based Instruction on Active Learning and involves a sample of 147 undergraduate students in an institution of higher learning in Malaysia. Confirmatory Factor Analysis confirmed the second-order factor model of Inquiry-Based Instruction which consists of three latent constructs. On the other hand, the Active Learning construct was also represented as a second-order factor model with three latent constructs (Learning Obligation, Learning Effort and Learning Collaboration). Overall, Structural Equation Modeling results provided statistical evidence that Inquiry-Based Instruction has a strong, positive and significant effect on Active Learning in higher education.

Keywords: Inquiry-based instruction, active learning, higher education, structural equation modeling

INTRODUCTION

Active learning refers to the process of engaging students in activities such as reading, writing, problem solving and reflecting. Such classroom activities put the student at the centre of the learning process enabling them to improve their critical thinking skills in the class. Active learning is often contrasted to the traditional lecture where students passively

receive information from the instructor (Prince, 2004). The whole process of active learning is based on the activities and level of student engagement (Prince, 2004). Hence, the core elements of active learning are student activity and engagement in the learning process. Active learning can also be referred to as query learning (Settles, 2010).

Inquiry-based learning is an approach that is integrated in active learning, and involves students in various classroom activities which can enhance their confidence, understanding and help them to achieve academic excellence (Colburn, 2006). In this approach, inquiry triggers students' thinking to enhance their understanding of concepts in a classroom setting. According to Healey (2005), instruction-based learning is a part of the active learning process where students are involved in research-based activities. Normally, inquiry-based instruction is adopted by teachers in institutions of higher learning (IHL, hereafter) to help promote the research activities and link it with the teaching styles. Inquiry-based instruction is commonly used together with active learning in IHL especially in professional fields of study such as engineering, medicine, sociology and statistical education.

LITERATURE REVIEW

Active learning was a buzzword in the 1990s report to the Association for the Study of Higher Education (ASHE) (Bonwell & Eison 1991). This report discussed many different methodologies to promote "active learning" and emphasized the need for students to be actively engaged in the learning process. Instead of just listening and being passive recipients, students need to be actively involved in reading, writing, negotiating to create meaning and engaged in solving problems. In particular, students must be actively engaged in higher-order thinking tasks involving the analysis, synthesis, and evaluation of the learning process (Renkl, Atkinson, Maier & Staley, 2002). Active learning engages students in two aspects, i.e. doing things and thinking about the things they are doing (Bonwell and Eison, 1991). Based on Catrambone and Yuasa (2006), a student's active involvement in the learning process produces the most robust and flexible learning (e.g., Chi, Bassok, Lewis, Reimann, & Glaser, 1989; Renkl, 1999). Hence, active learning is related to a student being able to produce self-explanations. The best instruction and training programs for knowledge acquisition should therefore be those that induce or enhance some type of active information processing on the part of the learner (Dufresne, Gerace, Hardiman, & Mestre, 1992).

Active learning is a two-way process in which the teacher provides opportunities to students to fully understand the content by promoting student involvement (Lamancussa, Zayas, Soyster, Morell & Jorgensen, 2008). Student involvement is directly linked with the academic performance and experience and refers

to the devotion of the physical and psychological energy for achieving the excellence in academics (Gibbs & Coffey, 2004). Adoption of active learning is just not about the implementation of techniques in the classroom but the collective effort of teachers and students for maintaining the status quo of the class to achieve the academic target and excellence.

Furthermore, active learning can be conducted through collaborative learning which involves group discussions, role playing and structured learning groups. Collaborative learning refers to students working in groups rather than working individually (Prince, 2004). The approaches of active learning like classroom discussions, debates and various group discussions promotes team work and enhances students' interpersonal skills. Obviously, the goal of active learning is to enable the students to recognize concepts and techniques for solving problems and thereby polish their cognitive skills and enhance critical and creative thinking (Cherney, 2008).

According to Alberta Learning (2004), "inquiry is a dynamic process of being open to the world of wonder and attempt to understand the world" (Galileo Educational Network, 2004). Hence, inquiry education is most effective when students are able to apply the relevant knowledge to their own lives. Myers and Warner (2008) posit that inquiry-based teaching is a teaching method that combines the curiosity of students and the scientific method to enhance the development of critical

thinking skills while learning science. A study conducted by Alvarado and Herr (2003) reveal that inquiry-based instruction is a complex process which formulate questions to construct new knowledge and then communicating the learning with colleagues and associates. Beach and Myers (2001) declared that inquiry-based learning initiates with the execution of questions, problems or scenarios. In this type of instruction, the presentation of facts is not sufficient in themselves rather the sense of inquiry and investigation in which questions are answered, and how students are facilitated to memorise the information through the instructional materials that is important. Hanna and Dettmer (2004) advocated that answers to questions are investigated actively by students in inquiry-based learning. Alvarado and Herr (2003) further explained that the inquiry-based approach for teaching promotes intellectual engagement of students and motivates them to improve their performance.

Therefore, Lujan and DiCarlo (2006) stated that inquiry-based instruction enables students to become critical thinkers, problem solvers, and self-directed learners. Inquiry-based teaching instruction shares a common core of teaching ideals with "direct instruction," the "progressive model," and the "constructivist approach," is supported by research done by Jean Jacques Rousseau, John Dewey, and Jerome Bruner. Generally, the instructor facilitates learning through focused instruction for small groups rather than teaching whole groups as in didactic classes. "The teacher's role is to encourage

the development of individual potentialities rather than moulding children according to some preconceived pattern" (Rogers, n.d). Hence, lessons are meaningful to students as they are contextualised to real world situations.

In fact, there are many different explanations for inquiry teaching and learning and the various levels of inquiry that can exist. Banchi and Bell (2008) outline four levels of inquiry for our students namely **Level 1**: Confirmation Inquiry, **Level 2**: Structured Inquiry, **Level 3**: Guided Inquiry and **Level 4**: Open Inquiry. Banchi and Bell (2008) emphasise that teachers should begin their inquiry from level 1 to 4 to effectively develop students' inquiry skills. According to Parr and Edwards (2004), the learning of students is dependent on the teaching style that is student-centered. They elaborated that it is like a professor teaching a science lesson in such a way that students are guided to develop their critical thinking skills by encouraging them to raise queries on the topic discussed. Open inquiry activity can only be successful when students are motivated by intrinsic interests and if they are equipped with the relevant skills to conduct their own research project. In fact, it is important for teachers to acquire a deep understanding on how students can be guided throughout their own studies (Yoon, Joung & Kim, 2012) where the plan is provided by the teacher. Teachers at all schools expressed confidence in facilitating inquiry-based learning; however, they did indicate uncertainty in the formulation of a hypothesis (Ramnarain, 2014).

Nonetheless, Stephenson (2008) argues that inquiry is not merely 'having students to do projects' but rather it strives to nurture deep, discipline-based way of thinking. Classroom tasks that are worthy of students' time and attention, relevant, connected to the world and organized around the 'big ideas' of a subject can develop understanding and intellectual interest and engagement with students. Capacity Building Series (2013) for students highlighted that open-ended investigations into a question or a problem require students to engage in evidence-based reasoning and creative problem-solving, as well as "problem finding." In the meantime, the educators also have to be responsive to students' learning needs, and know when and how to introduce students to ideas that will promote inquiry. Obviously, educators need to play an active role throughout the learning process by establishing a culture where ideas are respectfully challenged, tested, redefined and viewed as improvable, moving students from a position of not sure to a position of firm understanding and further research (Scardamalia, 2002). Underlying this approach is the idea that both educators and students work together, and accept mutual responsibility for in the planning and implementation stages of the learning process (Fielding, 2012).

METHODS

The main aim of this study was to investigate the effect of Inquiry-Based Instruction on Active Learning in higher education. The study was conducted at the Faculty of Computer Science and

Mathematics in a public university in Selangor, Malaysia. Data were collected via survey using a questionnaire. The sample comprised a total of 147 undergraduates who were randomly selected from a population of 329 at the faculty. Approximately 50 students were selected from each course of study at the faculty – i.e. the Mathematics, Statistics, and Computer Science Programs. The survey was conducted with the help of the lecturers.

The main aim of the questionnaire was to gauge students' perceptions towards the practices of inquiry-based instruction and active learning in higher education. The students responded to the questionnaires based on a 5-point Likert-scale. The questionnaire was validated by two Teaching and Learning experts from the Faculty of Education in the same IHL involved in this study. Both experts agreed with most of the items used for the measurement of the inquiry-based instruction and active learning in higher education. Comments given were minimal and minor corrections were made for certain items on active learning. Items suggested for correction were b4, b5, c3, c4, d2, d5. Confirmatory Factor Analysis (CFA) was used to test the measurement model and to ascertain convergent validity. Convergent validity can be ascertained if the loadings are greater than 0.5 as refered to Bagozzi and Yi (1991) or preferable 0.7 as stated in Hair et al. composite reliability greater than 0.7 (Gefen, Straub & Boudreau, 2000; Hair et al., 2010) and the average variance extracted is greater

than 0.5 (Fornell & Larcker, 1981; Hair et al., 2010). The researchers also tested for the discriminant validity using the Fornell and Larcker (1981) criterion whereby the average variance for each construct should be greater than the squared-interconstruct correlations. The model fit was assessed using absolute fit indices (Chi-Square/df, GFI, AGFI and RMSEA) and incremental fit indices (TLI and CFI). The model fits the sample data well if Chi-Square/df is between 2 and 5, GFI≥0.90 and AGFI≥0.90, and TLI≥0.8 and CFI≥0.9 and RMSEA≤0.08 (Rogers, n.d.). Then, Structural Equation Modeling was used to test the proposed structural model of relationships between the variables of inquiry-based instruction and active learning. CFA and SEM were carried out using IBM SPSS AMOS 22.0.

RESEARCH FINDINGS

Reliability Analysis

The Cronbach's alpha was used to assess the internal consistency reliability. Table I presents the reliability analysis results for Inquiry-Based Instruction (A) which consists of three components namely teaching style (AA1), guided discovery (AA2) and active control (AA3). The Active Learning construct are represented by Learning Obligation (B), Learning Effort (C) and Collaboration Learning (D). The Cronbach's alpha value for AA1, AA2, AA3 B, C and D are 0.900, 0.789, 0.796, 0.804, 0.655 and 0.644 respectively. These values exceeded 0.60 indicating that the items are reliable for measuring the respective constructs.

Table 1
Reliability analysis

Factors	Items	Cronbach alpha
AA1 (Teaching Style)	a12, a13, a14, a15, a16, a17, a18, a19, a20	0.900
AA2 (Guided Discovery)	a1, a2,a3, a5,a10,a11	0.789
AA3 (Active Control)	a4, a6, a7, a8, a9	0.796
B (Learning Obligation)	b1,b2,b3,b4,b5,b6,b7,b8,b9,b10	0.804
C (Learning Effort)	c1,c2,c3,c4,c5,c6,c7,c8,c9,c10	0.655
D (Collaboration Learning)	d1,d2,d3,d4,d5,d6,d7,d8,d9	0.644

Factorial Validity of Inquiry-Based Instruction

Confirmatory factor analyses were performed using IBM SPSS AMOS 21.0 to assess the validity and reliability of the A, B, C and D measurement model. Figure 1 illustrate the first-order three-factor structure model. All standardized loading showed greater than 0.5. The overall model chi-square (χ^2) was 236.349 with 167 degrees of freedom, $p < 0.05$, $\chi^2/df = 1.415$, GFI=0.860, AGFI=0.824, TLI=0.934, and RMSEA= 0.053. Ideally, the value of χ^2/df should be between 2 to 5, however a value of 1.415 indicates that the model is still acceptable. Thus, the result showed an acceptable fit of the model to the data.
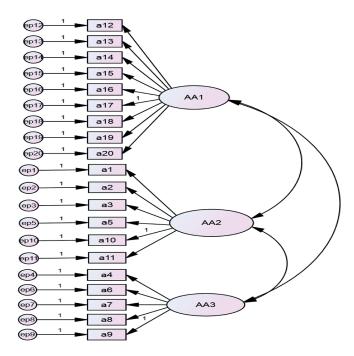
Figure 1. First-order CFA model (Inquiry-based instruction)

Factorial Validity of Active Learning

Active learning was measured by three factors with 29 items. Figure 2 illustrates the first-order three-factor structure model and Table 2 shows the model fitness before and after modification is done. Some modifications involved the deletion of items with low factor loadings to improve the model fit. The initial standardized loading showed that 2 items from variable B (b4 and b5), 5 items from variable C (c3, c4, c5, c6, and c7) and 2 items from variable D (d2 and d5) have a standardized loading below 0.40 and were deleted. The overall model chi-square (χ^2) was 464.481 with 167 degrees of freedom, p < 0.05, χ^2/df = 2.781, GFI=0.759, AGFI=0.697, TLI=0.682, CFI=0.721, and RMSEA= 0.110. Thus, the results still showed a poor fit of the model to the data and modification of the model is needed. Based on modification indices, the errors (e29 and e30) for items b9 and b10 on the feedback and (e41 and e40) for items d1 and d4 on teamwork were correlated. The model fit improved when these modifications were carried out (χ^2/df = 2.275, GFI=0.798, AGFI=0.743, TLI=0.772, CFI=0.802 and RMSEA= 0.093). The Cronbach's Alpha for B, C and D after some items were deleted are 0.814, 0.716 and 0.800 respectively.
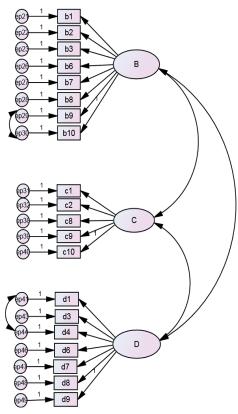
Figure 2. First-order CFA (Active learning)

Table 2
Summary fit indices (First-order Model)

Models		χ^2/df	RMSEA	GFI	TLI	AGFI
Inquiry-based Instruction (A)	Initial	1.415	0.06	0.860	0.934	0.824
Active Learning	Initial	2.450	0.100	0.692	0.571	0.642
	M1	2.781	0.110	0.759	0.682	0.697
	M2	2.275	0.093	0.798	0.743	0.772

Active Learning: Initial: Model with 29 items; M1: Model with items deleted; M2: Model with errors correlated.

The second-order CFA was then performed for construct A. Figure 3 shows the second-order model for A with three first-order constructs. The results for the second-order CFA are shown in Table 3. The fit indices show that the second-order CFA for construct A have a good fit and reasonable error of approximation (GFI=0.860, AGFI=0.824, TLI=0.943, CFI=0.942, RMSEA=0.053, χ^2/df=1.415).

Table 3
Summary fit indices (Second-order Model)

Models	χ^2/df	RMSEA	GFI	TLI	AGFI
Inquiry-Based Instruction (A)	1.415	0.053	0.860	0.943	0.824
Active Learning	2.275	0.093	0.798	0.772	0.743

CFA of the Second-order factor A (Figure 3) with three latent constructs (AA1, AA2, AA3) examined the covariance structure for all latent constructs together. The measurement model does fit well (GFI=0.860, AGFI=0.824, TLI=0.943, CFI=0.942, RMSEA=0.053, even though χ^2/df=1.415 is a bit low, however, the low RMSEA (0.053) indicates the measurement model can be accepted.
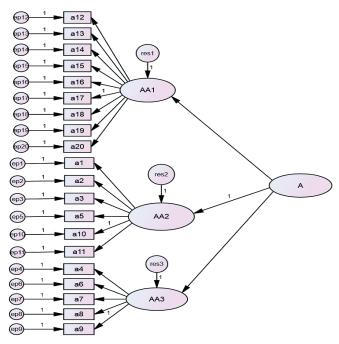
Figure 3. Second-order CFA model (Inquiry-based instruction)

The second-order CFA was then performed for the second order measurement model for active learning in Figure 4. The fit indices show that the second-order CFA for construct active learning has reasonable acceptable indices (χ^2/df=2.275, GFI=0.798, AGFI=0743, TLI=0.772, CFI=0.802, RMSEA=0.093).
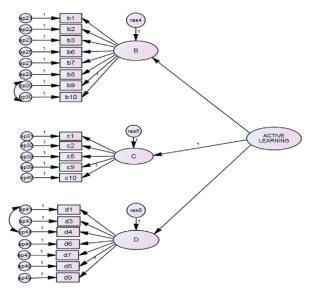
Figure 4. Second-order CFA model (Active learning)

Figure 5 presents the overall measurement model. The fit indices (χ^2/df=1.578, GFI=0.720, TLI=0.817, CFI=0.828, RMSEA=0.063) indicates the measurement model and structural model can be accepted, even though the χ^2/df=1.578 is a bit low.
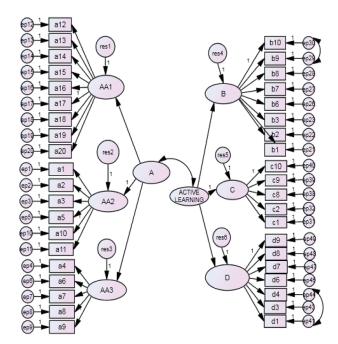
Figure 5. Overall measurement model

Table 4
Summary of fit indices

Model	χ^2/df	RMSEA	GFI	AGFI	TLI
Overall Measurement Model	1.578	0.063	0.720	0.686	0.817
Structural Model	1.578	0.063	0.720	0.686	0.817

Convergent Validity and Discriminant Validity

Table 5 presents the AVE, contsruct reliabilities (CR) and squared-interconstruct correlation (SIC).

Table 5
Summary of AVE, CR and SIC

Construct	Inquiry-Based Instruction (A)	Active Learning
Inquiry-Based Instruction (A)	**0.720** (0.88)	
Active Learning	0.514	**0.761** (0.905)

Notes: Boldface values on diagonal are AVEs; Construct Reliability (CR) values in parentheses and off-diagonal values are SIC

The AVEs for both Inquiry-Based Instruction (0.720) and Active Learning (0.761) are above 0.5 and the construct reliabilities (0.88) are greater than 0.7, The AVE of each construct are also greater than the squared-interconstruct correlations (0.514), thus indicating that discriminant validity has been established.

Structural Model

Next, we proceeded to test the structural model in Figure 6. The results for the Structural Model are shown in Table 4. The fit indices show that generally the structural model can be accepted ($\chi^2/df=1.578$, GFI=0.720, TLI=0.817, CFI=0.828, RMSEA=0.063).
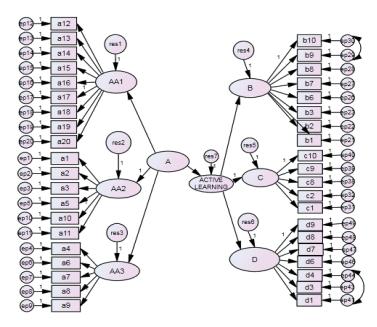
Figure 6. Structural Model

This study found that inquiry-based instruction has a positive and significant effect on active learning (b=0.717, p<0.05). The R-square is 0.514 indicating that inquiry-based learning can explain 51.4% of the variance of active learning. Table 6 shows the standardized path estimates for the effect of inquiry-based instruction on active learning.

Table 6
Standardized path estimates

	Unstandardized beta (SE)	Standardized beta	Findings
Inquiry-Based Instruction ->Active Learning	0.836** (0.159)	0.717	Hypothesis supported

***p-value<0.001; SE=standard error

DISCUSSION AND CONCLUSION

The results of Structural Equation Modeling used in this study indicated a strong, positive and significant relationship between inquiry-based instruction and active learning in higher education. In fact, previous studies have also shown the positive/significant relationship of active learning strategies. In addition, the inquiry training model has a statistically significant effect over traditional teaching method on student academic achievement (Pandey, Nanda, Ranjan, 2011; Akpulluku & Gunay; 2011). Furthermore, Ali (2014) showed the presence of a positive significant relationship between the achievements of students who have been taught using inquiry-based instruction and those who have been taught using the traditional teaching method. Minner, Levy & Century (2010) also support the view that inquiry based instruction has a positive impact not only on student learning outcomes but that it also encourages the retention of the key topics and concepts.

Hence, the conclusion can be drawn from the findings that the active thinking and involvement from the students in the investigation process directly resulted in increased understanding of concepts. Obviously, Inquiry-based instruction is designed to place students at the centre of the learning process with teacher playing the role of guide and facilitator. This concept is different from the traditional classroom where the teacher is viewed as a sage on the stage in a direct instruction classroom (White-Clark, DiCarlo & Gilchriest,

2008). This type of constructivist learning environment promotes students' curiosity and motivates them to investigate their areas of interest associated with the material, which promotes autonomous learning.

There is general consensus in the literature regarding the positive impact of constructivist approaches on student learning outcomes (Burris & Garton, 2007). Herman and Knobloch (2004) found that the constructivist approach such as inquiry-based instruction and active learning generated impact in affective and cognitive outcomes. They also reported that students preferred the constructivist approach because they are allowed to take responsibility for their own learning outcomes. It is exciting to see students building connections, sharing their own learning experiences with others in the classroom, and working together as a team. Consequently, students are motivated by inquiry learning because they are actively involved in the process of finding answers. Furthermore, teachers believe that inquiry-based instruction will have a positive effect on learners by stimulating the gradual infusion of inquiry in the classroom practice (Ramnarain, 2014). Hence, inquiry-based learning should be viewed as an integral part of the active learning approach.

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APPENDIX QUESTIONNAIRE

SECTION A INQUIRY-BASED INSTRUCTION

No.	In the class, my lecturer…
a1	reflects his/her lesson and always makes improvement.
a2	encourages students to discover fundamental principles on their own.
a3	prepares authentic tasks within the context of the curriculum.
a4	helps students gain active control (e.g. ask question when they have doubts) over their thinking process.
a5	believes that guided discovery is more effective than self-discovery in students' learning.
a6	encourages students to connect evidence to knowledge.
a7	asks questions about students' viewpoints.
a8	facilitates the process of gathering and presenting information
a9	encourages students to solve problems.
a10	praises students' performance.
a11	gives clear instruction before expecting students to discuss it on their own.
a12	designs rubrics to support inquiry learning
a13	adjusts grading processes to accommodate new learning approaches.
a14	clarifies value of mistakes in learning.
a15	uses technology to advance inquiry in the class.
a16	ensures a conducive learning environment for the students.
a17	collaborates with students beyond the physical classroom.
a18	encourages students to work with experts and other organizations.
a19	models deep, extended critical thinking.
a20	allows students to plan and carry out their learning experiences.

SECTION B LEARNING OBLIGATION

No.	Statement
b1	I develop a capacity to deal with complexity and ambiguity.
b2	I am open-minded.
b3	I actively participate in discussion.
b4	I study what will be tested in the exams.
b5	I predict exam questions/ topics.
b6	I am intellectually independent.
b7	I acquire graduate attributes.
b8	I respect and comply with academic conventions (e.g. plagiarism).
b9	I provide feedback on their lecturer's teaching qualities.
b10	I provide feedback to the university on the learning environment.

SECTION C LEARNING EFFORT

No.	Statement
c1	I do the same amount of study each week, regardless of whether an assignment is due.
c2	I carefully select what I study and learn in the course.
c3	I study only things that are going to be covered in the assignments.
c4	I have to study constantly if I want to do well in this course.
c5	I could do well without studying much in this course.
c6	I use seniors' work for my assignments.
c7	I put in more effort when assignments are due.
c8	I search for relevant and current materials for my assignments.
c9	I like doing assignments that require field work (e.g. case studies).
c10	I enjoy doing assignments which demand critical thinking skills.

SECTION D COLLABORATION LEARNING

No.	Statement
d1	I enjoy working with my peers in completing our group assignments.
d2	I do better in individual assignments than group work.
d3	I use problem-solving techniques in my study team.
d4	There is a spirit of cooperation within my study team.
d5	There are 'passengers' within my study team.
d6	I take opportunity for all ideas to be exchanged within my study team.
d7	I coordinate with relevant individuals and groups.
d8	I collaborate with my peers in doing assignment.
d9	My creativity and critical thinking are enhanced in group work.

SOCIAL SCIENCES & HUMANITIES

Students' Perceived Understanding and Competency in Probability Concepts in an e-Learning Environment: An Australian Experience

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ABSTRACT

Student understanding and competency in probability have been investigated from different perspectives. Competency is often measured in the form of tests. The purpose of this study was to investigate whether perceived understanding and competency can be calibrated and assessed together using Rasch measurement tools. The study comprised 44 students who enrolled in the STAT131 Understanding Uncertainty and Variation course at University of Wollongong, Australia. Their voluntary participation in the study was through the e-learning Moodle platform where tests and assessment were administered online. Data were analysed using the Rasch measurement models. The study revealed majority of the students had little understanding about conditional and independent events prior to learning them but tended to demonstrate a slightly higher competency level afterward. Based on the Rasch map, there is an indication of some increase in learning and knowledge about probability concepts at the end of the two weeks lesson.

Keywords: Perceived understanding, competency, probability concepts, e-learning, Rasch measurement models

INTRODUCTION

Many studies have examined difficulties faced by students in learning probability concepts (Garfield and Ahlgren, 1988; Shaughnessy, 1992; Garfield, 2003). According to Garfield and Ahlgren (1988) students have an underlying difficulty understanding the fundamentals

of probability. Probability ideas also seem to conflict with students' real time experience in solving problems. Zamalia, Masniyati and Nor Azura (2013) showed that students perceived little understanding of certain basic probability concepts such as conditional probability and independent events.

No matter how the concepts of probability are taught, the question always arises as to how students study and understand the concepts. Educators acknowledge the complexity of this process. Conventional method of assessment takes raw scores as benchmark for student learning. How students perceive their learning and how well they perform in the tests are always treated separately. Therefore, this study will attempt to calibrate these two measures on a single interval scale so students' learning of probability can be gauged accurately.

The following are the research questions:

i. How do students perceive their level of understanding in probability concepts?
ii. What are students' competency in probability concepts?
iii. Do students who profess to having good understanding of probability concepts demonstrate a good competency in probability concepts?

LITERATURE REVIEW

Learning Statistics

Statistics courses are challenging for students in the social sciences (Forte, 1995; Yilmaz, 1996; Townsend, Moore, Tuck, & Wilton, 1998). Research into how students study statistics and probability have also been carried out from the cognitive aspects of learning (Kapadia, 1985; Garfield & Chance, 2000; Kassim, Ismail, Mahmud, Zainol, 2010). This is an important area of study because students with different backgrounds and characteristics undergo the learning processes in many different ways. In spite of the various methods of teaching and learning, many are still facing difficulty in learning statistics because of insufficient computation skills and negative attitudes towards the subject (Garfield, Hogg, Schau & Whittinghill, 2002).

Perceived Ability and Competency in Statistics

Students' perceived ability is an important indicator in predicting the level of performance or motivation among them. Perceived ability or perceived self-efficacy refers to one's belief about one's capabilities to achieve certain level of performance or ability in specific situations (Bandura, 1994). This core belief is the foundation of human motivation, accomplishments, and emotional well-being (Bandura, 1997, 2006). Harter (1982) on the other hand, considers perceived competence as a more global construct than self-efficacy which is consistent with Roberts, Klieber and Duda (1981) that the terms self-efficacy, perceived ability, perceived and physical competence are interchangeable.

Rumsey (2002) states that statistical competence includes data awareness, an

understanding of certain basic statistical concepts and terminology, knowledge of the basics of collecting data and generating descriptive statistics, the ability to describe what the results mean in the context of the problem and being able to explain the results to someone else. Thus, every time the students go through the process, they will reinforce their understanding of the terms and concepts, reasoning and thinking skills.

METHODOLOGY

A survey was conducted among 44 mathematics and computer sciences undergraduates in the in the e-learning Moodle platform to. They had enrolled in the STAT131 Understanding Variation and Uncertainty as part of their programme requirement. They were given two sets of questionnaires to answer. The first set of questionnaire asked how they perceived their understanding of probability concepts. The items were related to the probability concepts requiring students to read through and understand the terms, definitions or/ and examples (see Figure 1).

The students were required to respond based on rating scales (from 1-5) as follows:

1) I have **NO UNDERSTANDING** of the term, definition or example.

2) I have **LITTLE UNDERSTANDING** of the term, definition or example.

3) I have **SOME UNDERSTANDING** of the term, definition or example.

4) I have **GOOD UNDERSTANDING** of the term, definition or example.

5) I have **FULL AND COMPLETE UNDERSTANDING** of the term, definition and example.

B5_i Conditional probability

The conditional probability of B, given that A has occurred, is   (1) (2) (3) (4) (5)

$$P(B/A) = \frac{P(A \cap B)}{P(A)} \text{ if } P(A) \neq 0$$

B5_ii The conditional probability of A, given that B has occurred, is   (1) (2) (3) (4) (5)

$$P(A/B) = \frac{P(A \cap B)}{P(B)} \text{ if } P(B) \neq 0$$

B5_iii Example:

A and B are two independent events such that $P(A) = 0.2$ (1) (2) (3) (4) (5)
and $P(B) = 0.15$. Then, $P(A \cap B) = P(A) = 0.2$

B6_i Independent Events

Event B is said to be independent of event A or event A   (1) (2) (3) (4) (5)
does not affect the probability of the occurrence of event
B. So:
$P(B/A) = P(B)$
$P(A/B) = P(A)$
$P(A \cap B) = P(A). P(B)$

Figure 1. Perceived Understanding of Probability Concepts Items

The second set of questionnaire tests student knowledge and competency in probability concepts. The items are constructed based on how they should solve probability problems. Students are required to state whether the solutions for each question is either true or false (see Figure 2).

1. The completion of construction job may be delayed because of a strike. The probabilities are 0.60 that there will be a strike, 0.85 that the construction job will be completed on time if there is no strike, and 0.35 that the construction job will be completed on time if there is a strike.

a. Draw a tree diagram.

0.60 — Strike
    0.35   Will be completed
    0.65   Will not be completed
0.40 — No Strike
    0.85   Will be completed
    0.15   Will not be completed

b. What is the probability given that the construction job will be completed if there is a strike?   T   F

Figure 2. Items Representing Students' Competency in Probability Concepts

In order for the calibration to hold in both instruments, students were matched in both samples and their responses to the questionnaires were captured in Moodle site and later exported as an Excel file. Data were analysed using Winsteps 3.81.0 software to produce the relevant Rasch output (Linacre, 2007; Linacre, 2011).

Rasch measurement models

Two Rasch measurement models, namely dichotomous and polytomous rating scale, are used for calibrating the instruments. Also known as a probabilistic model, Rasch measurement takes into account two parameters – test item difficulty and the person's ability.

Dichotomous Rasch Model

This is a mathematical probability model that incorporates an algorithm that expresses the probabilistic expectations of item and the person's performances:

$$P_{ni}\{x_{ni} = 1 \mid B_n, D_i\} = \frac{\exp(B_n - D_i)}{[1 + \exp(B_n - D_i)]} \quad (1)$$

Eq. (1) represents the conditional probability of person B_n on item D_i responding with a correct response

(x = 1) or receiving a rating of 1. This Rasch model is a useful way to conceptualise the relationship of responses with person and item locations on the latent variable.

The equation shows that the probability of success is a function of the difference between a person's ability and the item difficulty. Thus, when $B_n = D_i$ and $B_n - D_i = 0$, the probability of a correct answer, $P\{X_{ni} = 1\} = 0.5$ (equal to half or 50%). When $B_n > D_i$ and $B_n - D_i > 0$, the probability of a correct answer, $P\{X_{ni} = 1\} > 0.5$ (more than half or 50%). When $B_n < D_i$ and the difference between $B_n - D_i < 0$, the probability of a correct answer, $P\{X_{ni} = 1\} < 0.5$ (less than half or 50%) (Bond & Fox, 2007).

Rasch Rating Scale Model

Rasch Polytomous / Rating Scale model is an extension of Rasch Dichotomous model where the items have more than two response categories or rating scale such as (1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree) and it is modelled as having three thresholds. Each item threshold (k) has its own difficulty estimate (F), and this estimate is modelled as threshold at which a person has 50/50 chance of choosing one category over another.

The first threshold, for example, is modelled as the probability of choosing a response of 2 (disagree) instead of response 1 (strongly disagree), and is expressed using the following formula:

$$P_{ni1}\{x_{ni} = 1 \mid \beta_n, \delta_i, F_1\} = \frac{\exp(\beta - [\delta_i + F_1])}{1 + \exp(\beta - [\delta_i + F_1])}$$

(2)

where P_{ni1} is the probability of student n choosing "disagree" (Category 2) over "strongly disagree" (Category 1) on any item (i). In this equation, F_1 is the difficulty of the first threshold, and this difficulty calibration is estimated only once for this threshold across the entire set of items in the rating scale. The threshold difficulty F_1 is added to the item difficulty δi to indicate the difficulty of Threshold 1 in item i.

The Rating Scale model decomposes the category parameter, δ_{ij}, into two parameters: a location parameter δ_i that reflects item difficulty and a category parameter τ_j. The separation is achieved by using a probabilistic approach in which a person's raw score in a test is converted into a success-to-failure ratio and then into logarithmic odds that the person will correctly answer the items (Linacre, 2011). This is represented in a logit scale. When this is estimated for all persons, the logits can be plotted on one scale.

Assessing Data Fit

A Rasch analysis is a procedure for assessing the quality of raw score data using fit statistics, z-standard residuals, and point measure correlations (Bond & Fox, 2007). A Rasch analysis involves checking the degree to which the data match a unidimensional measurement model, identifying and diagnosing sources of discrepancy, removing items or persons if they are degrading the overall quality of measurement.

Infit and outfit mean square fit statistics are used in assessing quality of data. They provide summaries of the Rasch residuals,

responses that differ from what is predicted by the Rasch model for each item and person. High mean square fit statistics indicate a large number of unexpected responses. High person mean square values indicate persons who filled in responses randomly and have unusual gaps in their knowledge. Item infit mean square values between 1.5 and 2.0 are considered to be unproductive for measurement, and values higher than 2.0 are actually degrading (Linacre, 2011).

ANALYSIS AND RESULTS

Perceived understanding and competency in probability concepts

The summary statistics shows the results of the perceived understanding and competency in probability concepts based on the analysis of data using Rasch measurement tools. The mean infit and outfit for person and item mean squares are 0.95, 1.09, 1,0 and 1.09 respectively. This indicates that the data had shown acceptable fit to the model. The mean standardised infit and outfit for person is between -0.4 and 0.1 which is within Rasch measurement acceptable range. The mean standardised infit and outfit for items is between 0.1 and 0.2. This indicates the items measure are slightly overfit and that the data fit the model somewhat better than expected [30]. The standard deviation of the standardised infit is an index of overall misfit for persons and items. Using 2.0 as a cut-off criterion, standardised infit/outfit standard deviation for persons is between 1.5 and 1.8 and standardised infit/outfit standard deviation for items is between 1.2 and 1.3. All show

an overall acceptable fit. Separation is the index of spread of the person positions or item positions. Separation of 2.0 and above indicates the items have sufficient breadth in position. For persons, separation is 3.80 for the data at hand (*real*) indicating an approximately four levels of ability. The item on the other hand has separation index of 2.91 which indicates item difficulty can be separated into 3 difficulty levels. The person separation reliability estimate for this data is 0.94 (Cronbach's Alpha) which indicates a wide range of students' ability. The item separation reliability estimate is 0.89 which indicates items are replicable for measuring similar traits. The mean of the item logit position is arbitrarily set at 0.0, similar to standardised z-score. The person mean is 1.09 which suggests that a small group of students had a slightly good perception of understanding of probability concepts. For quality check, the data had gone through two stages of data cleanup where misfit responses on some items based on outfit mean square values of above 1.6 were identified and removed. Figure 3 shows the most misfitting response came from two male students (corresponding to ID number 26 and 44) with outfit mean square values of above 1.60. The table shows that the students did not respond appropriately according to the Rasch model. For example, student 26 was expected to disagree with a scale of 1 or 2 to the most difficult item 28 and agree with a scale of 3 or 4 to the fairly difficult items 6 and 1. Similarly, student 44 was expected to agree with items which are fairly simple for his ability but the reverse happened.
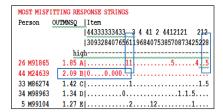
Figure 3. Misfitting Response Strings of Students' Competency in Probability Concepts

Figure 4 shows the Wright map of perceived understanding and competency in probability concepts. The map displays the distribution of students (on the left side of the map) according to their ability from most able to least able in endorsing items as agree or correct. It also displays the items according to the difficulty levels. Four concepts from the perceived understanding instrument (i.e., B7i, B7ii, B7iii, B7iv) at

logit values between 2.0 and 2.5 were found to be difficult to understand by 97% of the students while concepts A1ii, B8iii and B9iii at -1.0 logit value were found easiest to understand by 98% of the students. It was observed that majority of the students perceived little or no understanding about Bayes' theorem and conditional probability prior to the teaching of the concepts. At the competency level, there is a slight increase in the learning of conditional probability in between 1.0 and 1.5 logit. It was discovered that students found it hard to understand the concepts through the Bayes' formula (as in B7i, B7ii, B7iii and B7iv) but they understood more when the concepts were demonstrated in the form of solutions (as in Q1b).
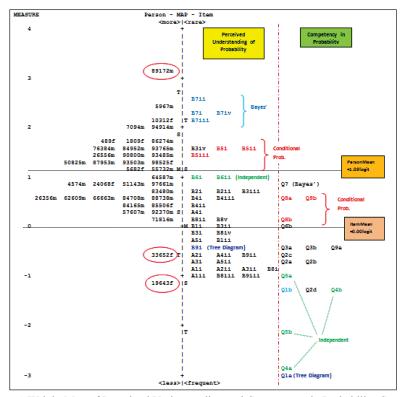
Figure 4. Wright Map of Perceived Understanding and Competency in Probability Concepts

About 40% of the students perceived some understanding to no understanding about the concept of independent events (as in B6i and B6ii) prior to studying it. However, most students found the concepts of independent events (as in Q4a, Q4b, Q5a, Q5b) easy to understand as shown in the location of logit values (between -1.0 and -3.0) on the map. In exploring students' perceived understanding of the probability concepts, about 45% perceived as having moderate to good understanding of about 60% of the concepts. The map shows a wide spread of competency items ranging between +1.0 and -3.0 logit. Small gaps were seen in between the competency items and the range of item difficulty did not match quite well with the ability of 70% of the students. About 70% of the probability test items were considered easy by the students. As the person (mean logit = +1.00) was greater than the item (mean logit =0.00), generally the test was considered easy by majority of the students. In investigating if data fit the model, the distribution of empirical data was plotted across the expected values for the perceived understanding of items in the Likert scale (Group L) and competency in probability concepts dichotomy items (Group D). This is shown in Figure 5. The characteristic curve for all empirical values in Group L falls along the expected ogive curve and within the upper and lower bound of the 95% confidence interval. This indicates a good item person targeting for the perceived understanding towards probability items. On the other hand, the characteristic curve for all empirical values in Group D mostly falls along the upper 50% of expected ogive curve and within the upper and lower bound of the 95% confidence interval. A wide confidence interval is seen around the middle section of the curve compared to the upper section. Two empirical observations did not behave according to the Rasch model. However, these points are considered negligible as most of the other empirical points were closer to the upper section of the expected Rasch model. This also signals the data fit the model better than expected.

Figure 5. Empirical-Expected Item Characteristic Curves for Likert Scale and Dichotomous Items

DISCUSSION AND CONCLUSION

This study has attempted to show that perceived understanding and competency can be calibrated and assessed together using the Rasch measurement tools. Rasch measurement which is based on the Rasch probabilistic models 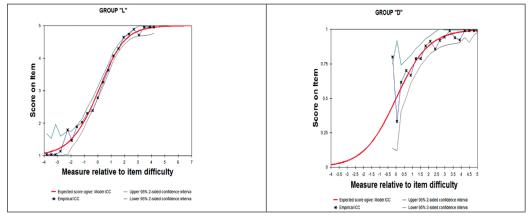were used to calibrate the responses from two survey instruments and investigate the interactions between them. The study showed that majority of the students perceived little understanding about conditional and independent events prior to studying about them but tended to demonstrate a slightly higher competency level afterward. Based on the Rasch map, there was indication of some increase in learning and knowledge about probability concepts at the end of the two weeks lesson. The study discovered that students had perceived a greater understanding of probability concepts after two weeks of exposure to them. However, when perceived understanding was calibrated against their competency in probability concepts, the students performed better than expected. Many students who initially perceived they had little understanding of probability concepts had shown a much higher understanding of the concepts after two weeks of study.

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PERTANIKA
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The Continuous Model of Stochastic *Mudharabah* Investment

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ABSTRACT

In Islam, all decisions, activities, policies, strategies and interactions in the economy are related to human relationships. In the Islamic financial system, the *syariah* rules are considered in all economic activities including investment. Investment is money or capital commitment for the purchase of financial instruments or other assets to gain benefits in the form of interest. Most investment opportunities are interest based but Islamic law strictly prohibits interest or *usury*, also called *riba* in Arabic. The prohibition of *riba* has led to the creation of alternatives schemes for the compensation of investment capital. One of the methods of compensation is by means of profit-sharing and one of the financial contracts that internalise profit sharing is *mudharabah*. It is an investment partnership in which one party called *rab ul mal* provides capital while the other party called *mudharib* brings labour and effort with the provision of profit sharing in some pre-determined proportions. This paper uses the model of stochastic *mudharabah* investment which can be used in forecasting the profits gain by both two parties in a stock market investment.

Keywords: Investment, mudharabah, stochastic

INTRODUCTION

Islam is a complete code of life that is constructed upon the instructions given by Allah SWT and practices of the holy Prophet Muhammad SAW. In Islam, all decisions, activities, policies, strategies and interactions in the economy directly relates to the Hereafter because Islam makes no distinction between the spiritual

and secular world. Therefore, *syariah* rules must be considered in all economic activities, including investment.

Generally, investment relates to interest rates whenever money is invested. If the investment is responsive to interest rates, a small decrease in interest rates will lead to a considerable increase in investment (Lestari, 2010). Interest is an amount paid or received on top of the principal amount based on an agreement between two parties (Ahmad & Humayoun, 2011).

Most investment opportunities are interest based but Islamic law strictly prohibits interest (*usury*) commonly known as *riba* in Arabic (Akram, Rafique, & Alam, 2011). The prohibition against *riba* is found in several verses of the Holy Qur'an and the *Sunnah*. Most Islamic scholars define *riba* as a trade between the goods of the same types but in different quantities, where the increase would not be a proper compensation. According to *syariah*, *riba* is the premium to be paid by the borrower to the lender along with the principal amount as a condition for loans or to extend the loan period (Mohammed, 2009).

The prohibition against *riba* has been discussed by many Islamic scholars. In economic terms, there are those who say that the existence of *riba* will result in uneven distribution of wealth throughout the community by providing a vehicle for the rich to get richer and the poor to be poorer. Others believe that the modern

economic system has not supplied any explanation for the existence of interest rate requirement (Akram et al., 2011).

Alternative schemes for the compensation of investment capital have been introduced to address the problem of riba. The established method of compensation is by means of a profit and loss sharing (PLS) system. The nature and rationale of a PLS system is generally based on its essential features of total rejection of *riba* and establishing a financial alternative system free from this element.

Two types of financial contracts are offered in Islamic jurisprudence for substituting *riba* oriented transactions: *musyarakah* (partnership) and *mudharabah* (profit-sharing). *Musyarakah* as an investment partnership in which profit sharing terms are agreed upon in advance and losses are pegged to the amount invested. In the loss sharing concepts, all the partners in a joint business have to contribute funding and have the right but not the executive authority to implement the project (Ibrahim, Eng, & Parsa, 2009). *Mudharabah,* on the other hand, is an investment partnership in which one party called *rab ul mal* provides capital while the other party called *mudharib* brings labour and effort with the provision of profit sharing in some pre-determined proportions (Siddiqui, 2010). Table 1 shows the difference between *musyarakah* and *mudharabah* (Jaffar, 2006).

Table 1
The Difference between Mudharabah and Musyarakah

Mudharabah	Musyarakah
The capital is from one party (*rab ul mal*) and the effort is from other party (*mudharib*)	The capital is from all involved parties in accordance with an agreed number of shares
Investors are not allowed to work with entrepreneurs	Investors can carry out work in the company and can be rewarded
Losses incurred by investors	Losses incurred by all investors and entrepreneurs
Capital must be in the form of cash	Any property that may be valued in money can be used as a capital

The applications of these two PLS financings are mostly in the Islamic banking system. The Islamic banking and finance movement is a rapidly growing phenomenon in the Muslim world. Most conventional systems are based on profit and loss or the risk is shared by the parties in the contract. In conventional banking, the risks are borne by entrepreneurs whether the project is successful and produces profit or fails and results in losses, while capital owners will earn profits that have been predetermined. In Islam, this kind of unfair distribution is not allowed. In Islamic banking, both investors and entrepreneurs share outcome of the projects in a fair way. In the case of profit, both parties share them in pre-agreed proportions. All financial losses are borne by the capitalist and the entrepreneur. In order to manage unexpected losses from interest-based arrangements, orthodox Islamic finance argues that financing should be based on fair distribution of profit-loss

and risks. The Islamic investment model takes the form of either *mudharabah* or *musyarakah* (Farooq, 2007).

Islamic banking offers a PLS system in non-risky activities such as deposit accounts. The objective of this paper is to propose a new mathematical model for *mudharabah* and to apply it in high risk investment activities such as the stock market. The stock market is the place where shares in a company are bought and sold (Sincere, 2004). This gives the company option to access capital while giving the investors the opportunity to own shares in the company and enjoy the potential benefits of the company's future performance. The stock market is an indicator of the financial health of an economy. It indicates the mood of investors in a country (Tachiwou, 2010). Investors can only invest in shares through the stock exchange; an organised market in which shares are bought and sold under strict rules, regulations and guidelines.

This paper examines the *mudharabah* model using stochastic calculus. Stochastic calculus is very important in mathematical modelling of financial processes because of the underlying random nature of financial markets (Wilmott, 2007). The role of Brownian motion in stochastic processes is similar to that of normal random variables in elementary statistics. In random walk, the discrete counterpart of the (continuous time) Brownian motion is well-known among economics experts since most macroeconomics time series behave in a similar trend (random walk is a special case of what is known as a unit root process).

LITERATURE REVIEW

In the Islamic banking system, the method of financing is adjusted in accordance with Islamic principles. However, the current mathematical model of financing uses conventional methods which must be aligned to or consistent with Islamic principles or this can cast doubt on Islamic banking products.There is a dearth of research on mathematical models pertaining to Islamic banking activities.

The model presented by Khan (1986) is concerned with the overall principle of Islamic banks and did not discuss about specific products such as *mudharabah*. The model by Shaharir (1989) is based on the *mudharabah* principle (profit-sharing).

Presley and Sessions (1994) propose a western model of the *mudharabah* concept. They show that the use of *mudharabah* contract may be productive. The basic idea is that if the results of the project are stochastic and if the manager has more information about this stochastic over investors, then the *mudharabah* contract between both will lead a more efficient revelation of such information.

The models proposed by Jemain (1992) and Malek (2000) are on *musyarakah mutanaqisah* for purchase of commodities such as houses; the principle is to borrow to buy a commodity in the form of shares and pay the rent for these commodities. Jemain's mathematical model Jemain (1992) is identical with the common model if the ratio of rental price is the same with the current interest rate. The model presented by Malek (2000) is an extension of Jemain's. This study focuses on the acquisition of the equity model of the borrower and the bank based on the principle of *musyarakah mutanaqisah*.

The models proposed by (Jaffar, 2006; Maheran, 2010) is on the new *musyarakah* model and *musyarakah mutanaqisah*, which takes into account the investment of two parties, the rate of profit, as well as two profit sharing rates.

The different models of *musyarakah* and *mudharabah* are discussed Jaffar (2010) and some applications are presented in Jaffar, Maad, Ismail and Samson (2012).

METHODOLOGY

In order to understand the derivative of the different equations, the *mudharabah* investment model introduced by Jaffar (2006) and Maheran (2010) are studied. The *mudharabah* investment partnership model is introduced as the equity of the capital provider, time t is E_t and the equity of the entrepreneur, time t is Q_t. The capital provider provides the initial capital and the entrepreneur manages the capital. The profit will be shared between the capital provider and the entrepreneur with a ratio of $k:(1-k)$. At initial time t_0 there is no initial capital made by the entrepreneur but his equity can exist in this investment. The profit rate at time t is r_t. The *mudharabah* model can be mathematically expressed as follows:

$$E_t = E_{t-1} + r_t k E_{t-1} \text{ for } t = 1,2,3,... \quad (1)$$

and

$$Q_t = Q_{t-1} + r_t(1-k)E_{t-1} \text{ for } t = 1,2,3,... \quad (2)$$

The model is to manage the deterministic and the non-risky type of investment.

In this research, the joint venture begins when the capital provider invests in risky businesses such as the stock market that moves randomly. The assumptions for the *mudharabah* investment model are as follows:

- the investment is between two parties (the capital provider and the entrepreneur).

- investing in one stock by using one volatility and one drift.

- investing in *syariah* counters only.

- parameter $k : (1-k)$ is between 0 and 1. It can be in the form of a percentage or decimal point.

- the *mudharabah* investment model only considers the value of k when r_t is positive, $r_t > 0$

- assume there are no external factors such as seasonal factors, political issues, announcement from the company, natural disaster and etc.

- assume the *syariah* stock prices follow the log normal random walk.

- assume the *mudharabah* investment model follows the log normal random walk.

Equations (1) and (2) may be written in a matrix form,

$$\begin{pmatrix} E_t \\ Q_t \end{pmatrix} = \begin{pmatrix} E_{t-1} \\ Q_{t-1} \end{pmatrix} + \begin{pmatrix} r_t k E_{t-1} \\ r_t(1-k)E_{t-1} \end{pmatrix}$$

$$= \begin{pmatrix} E_{t-1} \\ Q_{t-1} \end{pmatrix} + \begin{pmatrix} r_t k & 0 \\ r_t(1-k) & 0 \end{pmatrix}\begin{pmatrix} E_{t-1} \\ Q_{t-1} \end{pmatrix}$$

$$\begin{pmatrix} E_t \\ Q_t \end{pmatrix} - \begin{pmatrix} E_{t-1} \\ Q_{t-1} \end{pmatrix} = \begin{pmatrix} r_t k & 0 \\ r_t(1-k) & 0 \end{pmatrix}\begin{pmatrix} E_{t-1} \\ Q_{t-1} \end{pmatrix}$$

$$\tag{3}$$

This equation can be further expressed as follows

$$X_t = X_{t-1} + \mathbf{A_t}X_{t-1} \quad t = 1,2,3,... \tag{4}$$

where $X_t = \begin{pmatrix} E_t \\ Q_t \end{pmatrix}$ and $\mathbf{A_t} = \begin{pmatrix} r_t k & 0 \\ r_t(1-k) & 0 \end{pmatrix}$.

At the beginning of the period $t = 0$, the equity parts of capital provider and entrepreneur are E_0 and Q_0 respectively. If the rate of profit r_t is fixed which is r therefore matrix $\mathbf{A_t}$ is scalar $\mathbf{M}$. The equation (4) becomes

$$X_t = X_{t-1} + \mathbf{M}X_{t-1} \quad \text{for } t = 1,2,3,...$$

where

$$X_0 = \begin{pmatrix} E_0 \\ Q_0 \end{pmatrix} \text{ and } \mathbf{M} = \begin{pmatrix} rk & 0 \\ r(1-k) & 0 \end{pmatrix}.$$

The solution of this equation is by using matrix theory. The eigenvalues of matrix $\mathbf{M}$ is rk and 0. The *mudharabah* model has the profit-sharing rate k which satisfies $0 < k < 1$. The conclusion is that $\lambda_1 \neq \lambda_2$ and the matrix $\mathbf{M}$ has distinct eigenvalues.

The Continuous Model of *Mudharabah* Investment

The continuous model for the *mudharabah* investment can be obtained from (3) by revealing it as (4).

The time unit is small enough such that the nano-seconds $t \to \infty$ until $X_t - X_{t-1} \to \overset{\bullet}{X}(t)$ which gives

$$\overset{\bullet}{X}(t) = \mathbf{A}(t)X(t) \tag{5}$$

with

$$\overset{\bullet}{X}(t) = \begin{pmatrix} \overset{\bullet}{E}(t) \\ \overset{\bullet}{Q}(t) \end{pmatrix}, \quad X(t) = \begin{pmatrix} E(t) \\ Q(t) \end{pmatrix}$$

and

$$\mathbf{A}(t) = \begin{pmatrix} r(t)k & 0 \\ r(t)(1-k) & 0 \end{pmatrix}.$$

This equation is the same with the conventional investment model if $X(t)$ is the investment and $\mathbf{A(t)}$ is the profit rate at time t. The difference is that the conventional model is in scalar but the *mudharabah* model is in the vector. The significant difference is the conventional investment model involves only one party but the *mudharabah* model involves two parties that are capital provider and entrepreneur. Solving linear equations (5) gives us

$$X(t) = X(0)e^{\int_0^t A(S)dS}.$$

In the case $r(t) = \rho$ constant, the solution is $X(t) = X(0)e^{\mathbf{N}t}$ where $\mathbf{N}$ is a matrix $\begin{bmatrix} \rho k & 0 \\ \rho(1-k) & 0 \end{bmatrix}$. In order to get the values of $e^{\mathbf{N}t}$ as detailed, we must find the eigenvalues of matrix $\mathbf{N}$ first. The eigenvalues of the matrix $\mathbf{N}$ are $\lambda_1 = \rho k$, $\lambda_2 = 0$.

Similar to matrix $\mathbf{M}$, matrix $\mathbf{N}$ also have the different eigenvalues which is $\lambda_1 \neq \lambda_2$. Hence, the following results:

$$e^{\mathbf{N}t} = \begin{bmatrix} (e^{\lambda_1 t})^2 - e^{\lambda_1 t}e^{\lambda_2 t} & 0 \\ (1-k)\left[\dfrac{e^{\lambda_2 t} - e^{\lambda_1 t}}{k}\right] & -e^{\lambda_1 t} \end{bmatrix} \tag{6}$$

The detailed solution for the case $r(t) = \rho$ is

$$\begin{pmatrix} E(t) \\ Q(t) \end{pmatrix} = \begin{bmatrix} (e^{\rho kt})^2 - e^{\rho kt} & 0 \\ (1-k)\left[\dfrac{1 - e^{\rho kt}}{k}\right] & -e^{\rho kt} \end{bmatrix} \begin{pmatrix} E(0) \\ Q(0) \end{pmatrix} \tag{7}$$

This equation allows us to calculate in detail the value of investment for both parties at any time and with the initial value of the investment.

The Continuous Model of Stochastic *Mudharabah* Investment

Let say in a joint venture with the concept of *mudharabah*, the investors want to invest in a risky investment such as in the stock market that the stocks are recognized by *syariah* on Bursa Malaysia. The initial capital for the capital provider and the entrepreneur are $E(0)$ and $Q(0)$.

The profits are shared with the ratio $k : (1-k)$ between a capital provider and

the entrepreneur respectively. Let say the equity of capital provider and the equity of entrepreneur at time t are $E(t)$ and $Q(t)$. The quantity $r(t)$ is the profit rate; the ratio $k:(1-k)$ is the rate of profit for capital provider and entrepreneurs.

If the investment at time t is without risk, the investment model is similar with equation (5). The nature of the development of stock prices is not fully known and it depends on the effects of random environment. This effect can be included in the rates of return/profit of $r(t)$. Therefore,

$r(t) = \alpha(t) +$ a function of white noise.

$$r(t) = \alpha(t) + f(p) \qquad (8)$$

where p is the white noise that involves unsystematic risk and systematic risk. The habits of white noise are not precisely known but it has distribution. A variable $\alpha(t)$ is a deterministic profit rate or profit rate that is identified for a risk-free investment. Substitute (8) into equation (5) will produce

$$\overset{\bullet}{E}(t) = r(t)kE(t)$$

$$= (\alpha(t) + f(p))kE(t)$$

$$= \alpha(t)kE(t) + f(p)kE(t)$$

and

$$\overset{\bullet}{Q}(t) = r(t)(1-k)E(t)$$

$$= (\alpha(t) + f(p))(1-k)E(t)$$

$$= \alpha(t)(1-k)E(t) + f(p)(1-k)E(t)$$

In this regard, the use of white noise as the standard is agreed and similar to the Brownian motion or Weiner process. Variable of $f(p)$ can be modelled as

$$f(p) = \lambda \overset{\bullet}{W}(t)$$

with $\overset{\bullet}{W}(t)$ as the standard white noise or Weiner process and λ is a constant. By using this in the previous two equations, we get

$$\overset{\bullet}{E}(t) = \alpha(t)kE(t) + \lambda \overset{\bullet}{W}(t)kE(t)$$

and

$$\overset{\bullet}{Q}(t) = \alpha(t)(1-k)E(t) + \lambda \overset{\bullet}{W}(t)(1-k)E(t).$$

This can be expressed as

$$\overset{\bullet}{X}(t) = \mathbf{C(t)}X(t) + \mathbf{D}\overset{\bullet}{W(t)}X(t) \qquad (9)$$

where

$$\mathbf{C(t)} = \begin{pmatrix} \alpha(t)k & 0 \\ \alpha(t)(1-k) & 0 \end{pmatrix} = \alpha(t)\begin{pmatrix} k & 0 \\ 1-k & 0 \end{pmatrix}$$

is the expected drift rate of the investment risk of $X(t)$, while

$$\mathbf{D} = \lambda \begin{pmatrix} k & 0 \\ 1-k & 0 \end{pmatrix}$$

is the volatility of stock price $X(t)$. Equation (9) is in the form of differential equations that can be expressed as follows

$$\frac{dX(t)}{dt} = \mathbf{C(t)}X(t) + \mathbf{D}X(t)\frac{dW(t)}{dt}$$

Integrate with respect to t, we get

$$dX(t) = \mathbf{C(t)}X(t)dt + \mathbf{D}X(t)dW(t)$$

Suppose this stochastic differential equation is solved and for easier derivatives, it is expressed in a simpler form as follows:

$$dS = \mathbf{C(t)}S\,dt + \mathbf{D}S\,dW(t).$$

By using Ito Lemma,

$$dV = \frac{dV}{dS}dS + \frac{1}{2}\frac{d^2V}{dS^2}dS^2 + \ldots$$

$$dV = \frac{dV}{dS}(\mathbf{C(t)}S\,dt + \mathbf{D}S\,dW(t)) + \frac{1}{2}\frac{d^2V}{dS^2}(\mathbf{C(t)}S\,dt + \mathbf{D}S\,dW(t))^2 + \ldots$$

By using $dX_1^2 = dX_2^2 = dt$, $dX_1\,dX_2 = \rho\,dt$,

omitting all insignificant terms, we have

$$dV = \frac{dV}{dS}(\mathbf{C(t)}S\,dt + \mathbf{D}S\,dW(t)) + \frac{1}{2}\mathbf{D}^2S^2\frac{d^2V}{dS^2}(dW(t))^2$$

$$= \frac{dV}{dS}(\mathbf{C(t)}S\,dt + \mathbf{D}S\,dW(t)) + \frac{1}{2}\mathbf{D}^2S^2\left(-\frac{1}{S^2}\right)dt$$

$$= \frac{1}{S}(\mathbf{C(t)}S\,dt + \mathbf{D}S\,dW(t)) - \frac{1}{2}\mathbf{D}^2\,dt$$

$$= \mathbf{C(t)}\,dt + \mathbf{D}\,dW(t)\frac{1}{2}\mathbf{D}^2\,dt$$

$$dV = \left(\mathbf{C(t)} - \frac{\mathbf{D}^2}{2}\right)dt + \mathbf{D}\,dW(t)$$

$$\int dV = \int\left(\mathbf{C(t)} - \frac{\mathbf{D}^2}{2}\right)dt + \int\mathbf{D}\,dW(t)$$

$$V(t) = V(0)\exp\left[\int_0^t\left(\mathbf{C(S)} - \frac{\mathbf{D}^2}{2}\right)dt + \int_0^t\mathbf{D}\,dW(S)\right] \tag{10}$$

The equation (10) can be expanded to capital provider's equity model and entrepreneur's equity model. The capital provider's equity *mudharabah* model is

$$E(t) = E(0)\exp\left[\left(\alpha(t)k - \frac{1}{2}(\lambda k)^2\right)t + \lambda k(X(t) - X(0))\right] \tag{11}$$

where $\alpha(t)$ is the drift of stock prices, λ is the volatility of stock prices and $(X(t) - X(0))$ are random values. The entrepreneur's equity *mudharabah* model is

$$Q(t) = Q(0)\exp\left[\left(\alpha(t)(1-k) - \frac{1}{2}(\lambda(1-k))^2\right)t + \lambda(1-k)(X(t) - X(0))\right] \tag{12}$$

Equations (11) and (12) can be used to forecast the return of investment for two parties in Bursa Malaysia.

RESULT AND DISCUSSION

This section presents the result and the discussion of the forecast investment and profit for capital provider and entrepreneur.

The equations (11) and (12) can be used to forecast the profit for two parties: the investor or capital provider and the entrepreneur. One of the examples is the forecast profit for *mudharabah* investment on AIRASIA. The result of the forecast profit for *mudharabah* investment on AIRASIA is shown in Table 2.

Table 2
The Forecast Profit for mudharabah Investment on AIRASIA

| Date | Time | Real Price (RM) | *Mudharabah* Investment | | | | Single Investment | |
| | | | Capital Provider | | Entrepreneur | | | |
			Forecasted Investment E(t)	Forecasted Profit	Forecasted Investment Q(t)	Forecasted Profit	Forecasted Investment	Forecasted Profit
24-May-11	0.004	3.02	10239.02	239.02	10101.78	101.78	10343.1	343.1
25-May-11	0.0079	3.04	10280.79	280.79	10119.46	119.46	10403.33	403.33
26-May-11	0.0119	3.04	10322.73	322.73	10137.17	137.17	10463.92	463.92
27-May-11	0.0159	3.01	10364.84	364.84	10154.91	154.91	10524.86	524.86
30-May-11	0.0198	2.98	10407.12	407.12	10172.68	172.68	10586.15	586.15
31-May-11	0.0238	3.02	10449.58	449.58	10190.48	190.48	10647.8	647.8
1-Jun-11	0.0278	2.99	10492.21	492.21	10208.32	208.32	10709.81	709.81
2-Jun-11	0.0317	3	10535.01	535.01	10226.18	226.18	10772.18	772.18
3-Jun-11	0.0357	2.99	10577.99	577.99	10244.08	244.08	10834.92	834.92
6-Jun-11	0.0397	3.05	10621.15	621.15	10262.01	262.01	10898.02	898.02
7-Jun-11	0.0437	3.24	10664.48	664.48	10279.97	279.97	10961.49	961.49
8-Jun-11	0.0476	3.2	10707.98	707.98	10297.96	297.96	11025.32	1025.32
9-Jun-11	0.0516	3.2	10751.67	751.67	10315.98	315.98	11089.53	1089.53

Table 2 shows that the forecast investment and profit for capital provider or investor, $E(t)$, the forecast investment and profit for the entrepreneur, $Q(t)$ and the forecast investment and profit for single investment which did not involve profit sharing rate. The initial capital is RM 10, 000 that is from capital provider and the profit-sharing rate is (70:30). From this table, it indicates that the investors and the entrepreneur are getting the maximum profit in the two week short-term investment. It means that if these two parties invest on the 23/05/2011, they should sell the stock two weeks later on the 09/06/2011 since on that day the forecast profit for a capital provider and entrepreneur are RM 751.67 and RM 315.98 for AIRASIA.

CONCLUSION

The proposed stochastic *mudharabah* model is able to forecast the investment of two parties when the capital is invested in stock market. Profit is divided accordingly to the agreed predetermined rates between the two parties.

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The Role of Exploratory Data Analysis (EDA) in Electricity Forecasting

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ABSTRACT

Exploratory Data Analysis (EDA) is an approach introduced by Tukey. The aim is to obtain an in depth understanding of data using graphics. This contradicts the classical approach which uses statistical summaries such as mean and standard deviation among others. Skipping EDA in investigating data can jeopardise the validity and reliability of the results. In this study, we highlight the crucial role of EDA in electricity forecasting via line chart to understand the existence of the four-time series components i.e. trend, seasonal, irregular and cyclical. Daily electricity load for financial year 2002 to 2006 are used. The EDA showed irregular patterns identified in the line chart are not irregular components but moving seasonal components which require different techniques of forecasting.

Keywords: Graphical, classical approach, time series components, line chart, moving seasonal

INTRODUCTION

"Exploratory Data Analysis (EDA) is detective work – numerical detective work – or counting detective work – or graphical detective work ... unless exploratory data analysis uncovers indications, usually quantitative ones, there is likely to be nothing for confirmatory data analysis to consider ... [it] can never be the whole story, but nothing else can serve as the foundation stone - as the first step." (Tukey, 1977). The EDA is an approach for data analysis, introduced by, Tukey in which he emphasises the importance of EDA as the first step in understanding data. This aligns with the first step of univariate forecasting procedures that is to plot data and identify the existence of the time series components (Bowerman, O'Connell & Koehler., 2005, Ord & Fildes, 2013) based on data patterns.

The existence of certain components will determine suitable forecasting techniques to be employed. The EDA approach involves arts and science techniques whereby the former is employed to extract information by investigating reasons behind those patterns of data which contradicts with classical approach that focus more on techniques and statistical summaries (such as mean, standard deviation) (Bluman, 2014).

In this study, we highlight the crucial role of EDA in electricity forecasting in Malaysia via a line chart to understand four time series components i.e. trend, seasonal, irregular and cyclical.

METHODOLOGY

The daily electricity load data for financial year 2002 to 2006 were used in this study. The financial year is from 1st September until 31st August each year. Daily data was plotted using line chart and Exploratory

Data Analysis (EDA) approach was used to obtain an in depth understanding regarding data patterns.

RESULTS AND DISCUSSION

Figure 1 displays daily electricity load for financial year 2002 to 2006 i.e. a total of 1826 data points. Data shows rapid increase in demand for electricity consistent with Malaysia's push for a developed country status by 2020. No cyclical component was present since it was data covering a span of four 4 years. Consistent seasonal patterns and perhaps irregular components were also observed. Since there were many data points (1826), it was difficult to really confirm the presence (and reasons for) of seasonal and irregular components. Therefore, we plotted daily data for each financial year cross checking them with two variables: as day type (i.e. weekday: Monday to Friday or weekend: Saturday & Sunday) and public holiday (i.e. fixed or moving).
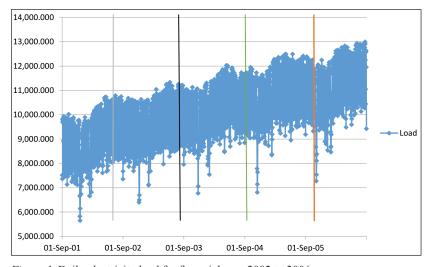
Figure 1. Daily electricity load for financial year 2002 to 2006

Figure 2 to Figure 7 present daily electricity load according to days and weeks for financial year 2002 (1st Sep 2001 – 31 August 2002). From the figures, it was obvious during weekend (Saturday and Sunday) the load was lower compared with weekdays and Sunday was the lowest. Figure 3 reveals irregular low pattern for week 16 (15 – 21 Dec 2001) due to EidulFitri celebration starting from the beginning of week 16 and followed by Christmas (Tuesday) in week 17 (22 – 28 Dec 2001). Other low irregular patterns identified were week 11 (Wednesday) due to Deepavali holiday, week 12 (Thursday) because of the King's birthday celebration and week 18 (Tuesday) due to New Year (1st Jan 2002) celebration.
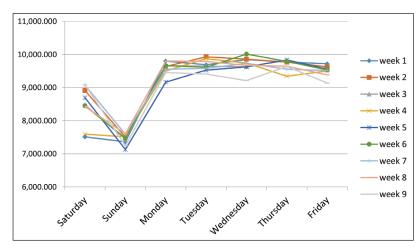
Figure2. Daily electricity load for financial year 2002 based on days and weeks (1 to 9)
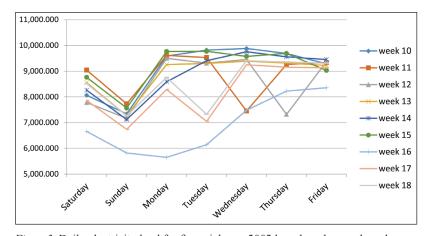
Figure3. Daily electricity load for financial year 2002 based on days and weeks (10 to 18)

As for week 19 to 27 (Figure 4), there were 3 observable irregular patterns. First, the down fall of load at week 24 starting from Monday to Friday due to Chinese New Year holidays; lower load in week 22 (Monday) due Thaipusam celebration and at week 26, Saturday's load was lower than Sunday attributable to EidulAdha.
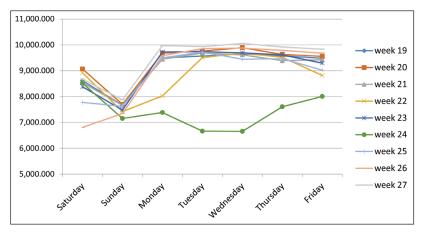
Figure 4. Daily electricity load of financial year 2002 based on days and weeks (19 to 27)

In Figure 5, a bit down fall on Friday week 28 related to Awal Muharam, followed by week 34 (Thursday) due to appointment of new Agong and week 35 (Wednesday, 1st May) was celebration of Labour Day. Figure 6 shows lower load at week 39 (Sunday & Monday) and week 40 (Saturday) because of Wesak and the King's birthday celebrations respectively. Lower load at end of week 52 (Saturday: 31st August) was due to National Day (Figure 7) celebrations.
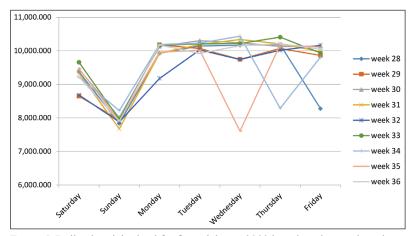

Figure 5. Daily electricity load for financial year 2002 based on days and weeks (28 to 36)
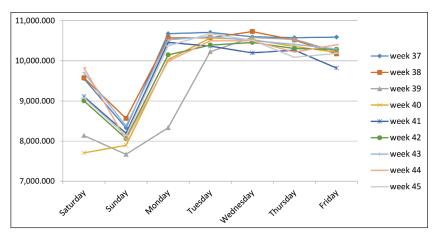
Figure 6. Daily electricity load for financial year 2002 based on days and weeks (37 to 45)
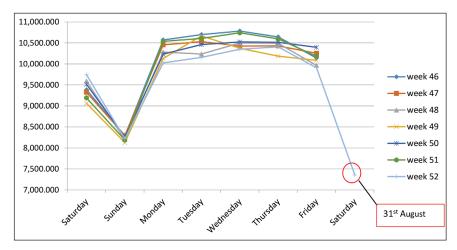
Figure 7. Daily electricity load of financial year 2002 based on days and weeks (46 to 52)

Similar patterns and results were obtained for financial years 2003 to 2006. These irregular patterns in the plots were due to festive celebrations (EidulFitri, EidulAdha, Chinese New Year, Deepavali and etc) indicating they were not irregular component but moving seasonal effect or special day effect (Soares & Medeiros, 2008, Arora & Taylor, 2013) or calendar variation effects. Therefore, in this study,

only two time series components existed, trend and seasonal, but consisted of fixed and moving seasonal effects.

Table 1 displays the effect of weekend (Saturday & Sunday) and public holidays (fixed & moving) on electricity load. The weekend percent change was calculated based on the difference between weekend load (either Saturday or Sunday) and the average weekday's value for the same

week. As for public holidays, percent change was measured using the difference between public holiday value and the previous week's value of the same day.

It means that if a public holiday falls on Wednesday week 16, then Wednesday week 15 will be used in obtaining the percentage change.

Table 1
Effect of weekend and public holidays on electricity load for financial year 2002 to 2006

Day Type / Public Holidays		2002 %	2003 %	2004 %	2005 %	2006 %	Average %
Weekend	Saturday	-9.01	-8.15	-7.98	-8.58	-7.44	**-8.23**
	Sunday	-11.90	-11.34	-10.58	-10.15	-9.56	**-10.71**
Public Holidays:	Christmas	-27.88	-20.90	-18.68	-18.72	-15.91	-20.42
Fixed	New Year	- 22.15	-22.94	-20.13	-13.17	-20.43	-19.76
	Labour Day	-25.55	-26.08	-19.60	-20.49	-26.07	-23.56
	Agong Birthday	-19.54	-16.75	-20.13	-20.01	-11.65	-17.62
	National Day	-24.51	-23.75	-24.19	-23.27	-26.94	-24.53
Public Holidays:	**EidulFitri**	-37.14	-36.66	-38.69	-38.33	-35.81	**-37.33**
Moving	EidulAdha	-18.73	-25.84	-25.27	-24.66	-26.61	-24.22
	Chinese New Year	-31.22	-27.03	-27.91	-29.27	-29.02	**-28.89**
	Deepavali	-24.58	-25.61	-21.08	-19.57	-26.36	-23.44
	AwalMuharam	-15.85	-14.71	-13.92	-17.37	-16.65	-15.70
	MaulidurRasul	-15.04	-20.71	-16.58	-15.63	-16.73	-16.94
	Wesak	-21.18	-19.08	-20.41	-12.50	-13.07	-17.25
	Thaipusam	-15.03	-13.23	-14.02	-9.27	-8.13	-11.94

The values indicated by percentage changes (Table 1) support earlier findings (as indicated in Fig. 2 to Fig. 7) regarding the reduction of load during weekend. Sunday showed the lowest (average of 10.71%) as compared to Saturday (8.23%). Additionally, all the years revealed decreased during public holidays. On the average EidulFitri contributed to the highest decline of 37.33% followed by Chinese New Year (28.89%). Deepavali, EidulAdha and National Day shared similar percentages of 23% to 25%. Based on the patterns and percentages it is clear that weekends and public holidays (fixed and moving) affect electricity load in Malaysia.

CONCLUSION

Due to EDA, the irregular patterns identified in the line chart are not irregular component but moving seasonal component which requires different techniques of forecasting. Thus, the EDA assists in discovering the components.

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SOCIAL SCIENCES & HUMANITIES

PERTANIKA JOURNALS

Improving Prediction of Gold Prices through inclusion of Macroeconomic Variables

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ABSTRACT

This paper uses a method based on multivariate power-normal distribution for predicting future gold prices in Malaysia. First let $\mathbf{r}(t)$ be the vector consisting of the month-t values of m selected macroeconomic variables, and gold price. The month-$(t+1)$ gold price is then modelled to be dependent on the present and l-1 on past values $\mathbf{r}(t)$, $\mathbf{r}(t-1)$, …, $\mathbf{r}(t-l+1)$ via a conditional distribution which is derived from a $[(m+1)l+1]$-dimensional power-normal distribution. The mean of the conditional distribution is an estimate of the month-$(t+1)$ gold price. Meanwhile, the $100(\alpha/2)\%$ and $100(1-\alpha/2)\%$ points of the conditional distribution can be used to form an out-of-sample prediction interval for the month-$(t+1)$ gold price. For a given value of l, we select various combinations of m variables from a pool of 17 selected macroeconomic variables in Malaysia, and obtain the combinations of which the corresponding mean absolute percentage errors (MAPE) are relatively smaller while the coverage probabilities and average lengths of the prediction interval are still satisfactory. It is found that the parsimonious model is one of which $l = 2$, $m = 1$ and involving the macroeconomic variable derived from the Gross Domestic Product, Kuala Lumpur Composite Index or Import Trade.

Keywords: Multivariate power-normal distribution, macroeconomic variables, prediction interval, parsimonious model

INTRODUCTION

Gold has long been a popular investment due to its liquidity and appreciation of value especially during periods of inflation. Apart from being used to diversify risks, it has also been used as a hedge against

inflation, deflation or currency devaluation. As the gold market is subject to speculation and volatility, it is important to have a good prediction of the future price of gold together with the possible range of fluctuation of the price.

Time series models have been proposed to predict future gold prices in Malaysia. Pung, Miswan & Ahmad (2013) showed that GARCH (1,1) model was a good fit to predict Malaysian gold prices from 18th July 2001 to 25th September 2012. Ahmad & Pung (2014) showed that TGARCH(1,1) was an improvement of GARCH(1,1) model to predict the daily Malaysian gold prices. Ahmad, Pung, Yazir & Miswan (2014) on the other hand showed that the hybrid model of ARIMA(1,1,1)-GARCH(2,1) were able to improve the forecasting accuracy by using ARIMA(1,1,1) only.

A number of researchers have studied the relationship between gold price and macroeconomic factors in Malaysia and foreign countries such as Pakistan, India, and the United States of America (Bapna, Sood, Totala, & Saluju, 2012; Ernie, 2013; Sindhu, 2013; Warda, Zakaria & Farrukh, 2014; Anuar, Hazila & Saadah, 2015). Ibrahim & Baharom (2011) applied the regression method to analyse the relationship between gold price in Malaysia and the once-lagged stock return (Kuala Lumpur composite index) from August 2001 to March 2010. Ibrahim, Kamaruddin & Hasan (2014) used multiple linear regression to determine the significant relationship between gold price

in Malaysia with crude oil price, inflation rate, and exchange rate. Their results show an existing significant relationship between the gold price and all the factors. However, they indicated the need to consider other factors such as unemployment rate, political risks, gross domestic product and etc. in future studies.

In this paper, we investigate the improvement in forecasting accuracy affected by inclusion of macroeconomic variables in the time series model based on multivariate power-normal distribution. It is found that a good model would be a lag-1 model involving only one of the macroeconomic variables derived from Gross Domestic Product, Kuala Lumpur composite Index and Import Trade.

METHOD BASED ON MULTIVARIATE POWER-NORMAL DISTRIBUTION

Let us begin with Yeo & Johnson's (2000) non-normal distribution. These authors introduced the following power transformation:

$$\tilde{\varepsilon} = \psi\left(\lambda^+, \lambda^-, z\right) = \begin{cases} \left[(z+1)^{\lambda^+} - 1\right]/\lambda^+, & \left(z \geq 0, \lambda^+ \neq 0\right) \\ \log(z+1), & \left(z \geq 0, \lambda^+ = 0\right) \\ -\left[(-z+1)^{\lambda^-} - 1\right]/\lambda^-, & \left(z < 0, \lambda^- \neq 0\right) \\ -\log(-z+1), & \left(z < 0, \lambda^- = 0\right) \end{cases}$$
$$(1)$$

If z in Eqn. (1) has the standard normal distribution, then $\tilde{\varepsilon}$ has a non-normal distribution which is derived by a type of power transformation of a random variable with normal distribution. We may say that $\tilde{\varepsilon}$ has a power-normal distribution.

Let y be a vector consisting of k correlated random variables. The vector y is said to have a k-dimensional power-normal distribution with parameters $\mu, H, \lambda_i^+, \lambda_i^-, \sigma, 1 \le i \le k$ if

$$y = \mu + H\varepsilon \qquad (2)$$

where $\mu = E(y)$, H is an orthogonal matrix, $\varepsilon_1, \varepsilon_2, ..., \varepsilon_k$ are uncorrelated,

$$\varepsilon_i = \sigma_i [\widetilde{\varepsilon}_i - E(\widetilde{\varepsilon}_i)] / \{var(\widetilde{\varepsilon}_i)\}^{1/2}, \qquad (3)$$

$\sigma_i > 0$ is a constant, and $\widetilde{\varepsilon}_i$ has a power-normal distribution with parameters λ_i^+ and λ_i^-.

When the values of $y_1, y_2, ..., y_{k-1}$ are given, we may find an approximation for the conditional probability density function (pdf) of y_k by using the numerical procedure in Pooi (2012).

Denoting t as the present time (month) and letting $x^* = \{x_1^*, x_2^*, ..., x_m^*\}$ to be a subset chosen from a pool $\{x_1, x_2, ..., x_M\}$ of M selected macroeconomic variables while x_{M+1} as the gold price variable, we may choose the variables $y_1, y_2, ..., y_k$ for the lag-(l-1) model to be those given by the values of $\{x_1^*, x_2^*, ..., x_m^*, x_{M+1}\}$ at time t, t-1, ..., t-l+1 together with the value of x_{M+1} at time t+1.

Using data spanning over T months, we can form a table of T-l rows with each row representing an observed value of $(y_1, y_2, ..., y_k)$. From the table, we can form the i_w-th moving window of size n from the i_w-th row till the $(i_w + n$-1)-th row. We can form a total of N-l-n such windows of size n. We next find a k-dimensional power-normal distribution for $(y_1, y_2, ..., y_k)$ using the data in the i_w-th window. The procedure for parameter estimation to obtain the k-dimensional power-normal distribution can be found in Section IV of Pooi (2012).

Letting $y_1, y_2, ..., y_{k-1}$ be given by the first k-1 values in the $(i_w + n)$-th row immediately after the i_w-th window, we may now find a conditional distribution for y_k when $y_1, y_2, ..., y_{k-1}$ are given. The mean $\hat{y}_k^{(iw)}$ of the conditional distribution is then an estimate of the value of the gold price next month. On the other hand, the $100(\alpha/2)\%$ and $100(1-\alpha/2)\%$ which point to the conditional distribution may be regarded as the lower and upper limits of the nominally $100(1-\alpha)\%$ out-of-sample prediction interval for the gold price next month. The mean absolute percentage errors (MAPE) is given by

$$\text{MAPE} = \left[\frac{1}{T-l-n} \sum_{iw=1}^{T-l-n} \left| \hat{y}_k^{(iw)} - y_k^{(iw)} \right| / y_k^{(iw)} \right] \times 100\%$$

$$(4)$$

whose $y_k^{(iw)}$ is the observed value of the gold price next month. The value of MAPE which is small ($<5\%$) is an indication that the predictive power of the model is good (Wang, 2010).

The coverage probability of prediction interval may be estimated by the proportion of prediction intervals which include observed gold price the following month. Meanwhile, the expected length of the prediction interval may be estimated by the average length of the prediction intervals. When the estimated coverage probability is

close to the target value 1-α, a small value of the average length is indicative of good predictive power of the model (Hahn & Meeker, 1991).

If we choose the variables for a lag-(l-1) model to be those given by the value of x_{M+1} at time t, t-1, …, t-l+1 together with the value of $\hat{x}_{M+1}$ at time t+1, then we can similarly find an estimate of the gold price next month and a nominally 100(1-α)% out-of-sample prediction interval for the gold price next month.

By comparing MAPE and the estimated coverage probability together with the average length of the prediction interval when x^* is used in forming $y_1, y_2, ..., y_k$ to those of the model when x^* is not used in forming $y_1, y_2, ..., y_k$, we may examine the effect of including x^* on the one-step forecasting performance of the prediction interval.

MEASURES OF PERFORMANCE OF MODELS

To investigate the performance of the method in previous section, we use the monthly Malaysian gold prices for the period January 2006 to December 2012. Data set for the macroeconomic variables is obtained from the Statistics Department of the National Bank of Malaysia. The 17 macroeconomic variables used in this study are listed in Table 1. The monthly values of m macroeconomic variables together with the monthly gold price, form the vector r(t) with $1 \le t \le T = 84$. There are $^{17}C_m$ ways of selecting m macroeconomic variables from the pool of 17 macroeconomic variables. Each combination of m macroeconomic variables will yield a lag-(l-1) model from which we find the MAPE, and the estimated coverage probability and average length of the nominally 95% prediction interval for the gold price next month.

Table 1
Macroeconomic Variables and Their Assigned Numbers

Assigned Number	Macroeconomic Variable	Assigned Number	Macroeconomic Variable
1	Gross domestic product	10	Market indicative yield
2	Producer price indicator	11	Average discount rate on Treasury bills
3	Industrial production index	12	Consumer price index (inflation)
4	Gross domestic savings	13	Oil price
5	Unemployment rate	14	Trade (export)
6	Interbank rate	15	Trade (import)
7	Money supply M2	16	Foreign exchange rate (RM/USD)
8	Money supply M3	17	Kuala Lumpur Composite Index
9	Total reserve money		

Table 2 shows five combinations of variables of which the corresponding values of MAPE, estimated coverage probability and average interval length are relatively more satisfactory when the values of l $(1 \leq l \leq 3)$ and m $(1 \leq m \leq 2)$ are given. The corresponding performance measures when $m = 0$ are also given in the same table. In getting the results in Table 2, we choose n to be 50, which is generally recommended for time series analysis (Box, Jenkins & Reinsel, 1994).

Table 2

Performance Measures of Relatively Better Models ($\alpha = 0.05$, n = 50)

l	m	x_1^*	x_2^*	Estimated Coverage Probability	Average Length	MAPE
	0	-	-	0.84848	259.6848	4.506679
		1	-	0.84375	247.2800	4.369345
		17	-	0.84375	254.7200	4.469481
	1	2	-	0.84375	257.1600	4.563729
		13	-	0.84375	257.1200	4.572080
1		16	-	0.84375	259.6000	4.582659
		1	2	0.787879	235.7915	4.185093
		1	13	0.818182	240.0970	4.189502
	2	13	17	0.848485	236.6836	4.298899
		1	12	0.787879	237.3042	4.327562
		1	17	0.848485	249.5224	4.337109
	0	-	-	0.87500	222.8400	4.106300
		1	-	0.84375	214.2800	3.861602
		17	-	0.81250	212.4400	4.079795
	1	15	-	0.90625	219.0800	4.092122
		14	-	0.87500	222.0000	4.166314
2		13	-	0.81250	220.4000	4.188430
		1	17	0.81250	205.8000	3.824358
		1	13	0.78125	210.8800	3.898503
	2	1	15	0.84375	204.8800	3.968209
		1	12	0.84375	200.7600	3.970212
		1	3	0.84375	206.7600	3.971066
	0	-	-	0.80600	209.9200	4.265282
		13	-	0.80645	207.6077	4.165282
		15	-	0.80645	207.2774	4.190802
	1	14	-	0.80645	208.7226	4.217964
		17	-	0.80645	193.4865	4.231128
3		3	-	0.80645	208.1858	4.309082
		1	13	0.74194	198.1111	3.967482
		1	15	0.77419	199.2671	4.019773
	2	1	3	0.77419	197.2026	4.072391
		1	5	0.77419	196.4181	4.073602
		1	17	0.77419	189.0684	4.133222

From Table 2, we notice that the performance measures tend to improve when l or m increases. In order to obtain a parsimonious model, we try to keep l and m to be small while still obtaining reasonably good values of the performance measures. Table 2 shows that a parsimonious model would be obtained when $l = 2$, $m = 1$ and $x_1^* = 1$, 15 or 17. These values of x_1^* correspond respectively to the macroeconomic variables given by the Gross Domestic Product, Import Trade and Kuala Lumpur Composite Index.

The values of MAPE shown in Table 2 are obtained by using moving windows of size 50 over the fairly long period from January 2006 to December 2012. The values of MAPE which are consistently smaller than 5% indicate that the multivariate power-normal distribution based on a moving window of size 50 provides a fairly good fit to the actual distribution. Thus, the out-of-sample prediction based on the moving windows of size 50 would also be accurate for the future moving windows which involve post December 2012 data.

The lag-1 model based on the Gross Domestic Product is particularly promising with a reduction of MAPE, 14.3%, compared with the lag-0 model without any macroeconomic variables and a reduction of MAPE, 5.9%, compared with the lag-1 model without any macroeconomic variables.

CONCLUSION

The numerical results in previous section show that the inclusion of only one suitable macroeconomic variable is able to improve the predictive power of the model. The estimated coverage probability of the prediction interval rarely goes beyond 0.9. This shows that the gold price next month may not be always concordant with the distribution based on the historical data due to sudden changes in economic conditions. Further research may look into developing a more versatile model which takes into account the possible sudden changes in economic conditions.

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SOCIAL SCIENCES & HUMANITIES

Does Having Children Influence Female Lifespan in Mauritius?

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ABSTRACT

This paper investigates the potential relationship between longevity and parity among women. Mortality records from 2005 to 2014 were retrieved from the Health Statistics Unit of the Ministry of Health, Mauritius. Descriptive statistics and graphics were used to explain this relationship. A survival analysis was performed to investigate the risks of dying with respect to parity. While causality cannot be established due to the lack of potential confounding variables for mortality, the fitted Weighted Cox Regression model revealed a positive relationship between parity (above two children) and female lifespan. On the other hand, mothers having between one and two children were found to have lower survival probabilities compared with nulliparous females.

Keywords: Longevity, Parity, Survival analysis, Weighted Cox Regression

INTRODUCTION

Reproductive factors, such as parity and fertility are considered to have an effect on women's health. The capacity to reproduce is often measured by the Total Fertility Rate which represents the number of children a woman would bear if she was to live to the end of her childbearing years and bear children in accordance with current age-specific fertility rates (Martin, Hamilton, Ventura, Osterman, Kirmeyer, Mathews, & Wilson, 2011). While the inverse relationship in the direction in which fertility figures and life expectancy numbers move might suggest a negative correlation between parity and longevity, it should be appreciated that both decline in fertility and increase in longevity are linked to improved social and economic status in countries around the world and across time (Mondal & Shitan, 2014). The trade-off between reproduction and longevity has provide evidence on the type of

relationship that might exist between these two variables (Gavrilov & Gavrilova, 1999).

Few studies have dealt with the association between mortality and parity among women and these results have been debated. Little has been studied about childbearing and its impact on women's health. Some of the studies have found a statistically significant positive association between mortality and the number of children conceived and the results have also been extended to cardiovascular and cerebrovascular diseases (Beral, 1985; Green, Beral, & Moser, 1988; Hinkula, Kauppila, Näyhä & Pukkala, 2006). However, the inverse relationship between parity and mortality has also been studied by Kvale, Heuch, & Nilssen (1994). To date, no studies have looked at the link between parity and mortality in developing countries such as Mauritius. Hence, this aim of this paper is to examine the effect of parity on female longevity.

METHODOLOGY

Data Sources

Mortality data between January 2005 and July 2014 was obtained from the Health Statistics Unit of the Local Ministry of Health which is responsible for collecting, analysing and disseminating heath statistics data in Mauritius. Initially, the data set consisted of 40,214 records. Missing values were deleted and the final dataset consisted of 34,794 female death records with limited variables such as cause of

death, age at death, number of live births, marital status and occupation at death. Around 950 records were deleted since the belonged to those below the age of 15. Occupation as a variable was not used given that at death, most of the individuals were retired and it was not possible to obtain data pertaining to the occupation of the women. For the purpose of this study, we define nulliparous women as those who had no live births recorded in the database. Consequently, the variable 'number of live birth' corresponds to the number recorded of live births.

Statistical Analysis

A data-cleaning step was performed to identify imperfect data such as missing values and outliers. Female records below the age of 15 were not considered. Records with missing values (number of live birth, year at death and age at death) were removed from the original dataset. Exploratory analysis was performed by constructing Trellis boxplots using the 'lattice' package (Sarkar, 2015) in R for, first of all, various causes of mortality separately and second for all-cause mortality, to investigate the distribution of age at death by parity, measured by the 'number of live births' variable.

Survival analysis, used to model time to an event (in this case death) was identified as the appropriate method to investigate the potential effect of having more children on female lifespan. The final data did not contain any censored information and only consisted of death (observed cases). Using

all-cause mortality data, Super-Imposed Kaplan Meier curves were constructed after categorising the females as 'nulliparous', "two live births" and "more than two live births". The latter categorisation was based on the initial exploratory trellis boxplots. The Kaplan Meier curves were estimated as follows:

Suppose that there are observations on N females and that there are (k<N) distinct times t_1<t_2<…< at which events of interest occur. Suppose furthermore that, at these times, $d_1, d_2, …, d_k$ events of interest (or "deaths") occur respectively and that between times t_j and $t_{(j+1)}$, there are c_j censored observations, Then the number of females at risk at time t_j (see Equation 1) will be:

$$n_j = N - \sum_{i=1}^{j-1} c_i - \sum_{i=1}^{j-1} d_i \quad for \ j = 1, 2, …., k \tag{1}$$

Therefore, the Kaplan-Meier estimator of S(t) is given by:

$$\hat{S}(t_k) = \prod_{j=1}^{k} \left[1 - \frac{d_j}{n_j} \right] \tag{2}$$

Initially, proportional hazards model (Cox, 1972) was fitted to model the 'time to death' using 'parity' and 'year of death' as explanatory variables using the 'survival' package (Therneau, 2015) in R. The variable 'year of death' was included as an additional explanatory term to control for the potential evolution in quality of life across time. The tenability of the proportional hazards assumption was investigated first, using plot of the estimated log cumulative hazard function (with 'number of live births' as explanatory variable) versus log time for each subject group on the same graph. The proportionality of all the predictors in the model was also tested. Since the latter assumption appears to be violated, Weighted Cox Regression, as proposed by (Schemper, Wakounig & Heinze, 2009) was fitted using the 'coxphw" package (Ploner, Heinze & Dunkler 2015). The estimates of the coefficients from separate models fitted by disease were also provided for further insight. The weighted estimation within the Cox's model is explained as follows:

In a sample of n females, we observe m distinct and uncensored survival times t_j ($1 \le j \le m$) among the n possibly censored survival times t_i ($1 \le i \le n$). A covariate vector $x_i = (x_{i1},…,x_{ir},…,x_{ik})$ is related to each individual as is a censoring indicator η_i (1 for censored, 0 for dead). The set of individuals alive and uncensored prior to t_j, the risk set is denoted by R_j, as is also the size of this set. A vector β of k regression parameters is to be estimated. Then the log partial likelihood for Cox's model is defined as:

$$\log L(\beta) = \sum_{j=1}^{m} \left[x_j\beta - \log\left\{ \sum_{h \in R_j} \exp(x_h\beta) \right\} \right] = \sum_{j=1}^{m} l_j \tag{3}$$

Where l_j is the contribution to the log likelihood at failure time t_j.

RESULTS

The boxplot showed a lower lifespan for female with one or two children compared with nulliparous women. However, lifespan appears to experience a 'boost' and longevity seems to be higher for women who have more than two children. Based on these findings, Kaplan Meier curves were constructed after categorising women into three groups; nulliparous, with one or two children, and more than two children. The Kaplan Meier curves, which show the survival probability (with 95% Confidence Limits) of living beyond a certain age was found to be higher for women with more than two children (compared with the other groups). Furthermore, trellis plots were created to visually assess the effect of parity on longevity for each cause of mortality separately (Classified according to the International Classification of Diseases). The resulting plot reveals the same trend as observed for all-cause mortality in terms of age at death, i.e. a decrease in lifespan before a general increase.

To investigate the tenability of the Cox Proportional Hazards Model, the estimated log cumulative hazard function is plotted against log time for each subject group, with the plots being superimposed on a single graph (refer to Figure 1). If the proportional hazards assumption is valid, then the resulting plots should be parallel to each other. From the plot below (Figure 1), the proportional hazards assumptions seem to have been violated. An assessment of Weibull or exponential models did not produce satisfactory diagnostic plots

either, thus calling for the use of Weighted Cox Regression as proposed by Schemper et al. (2009).

Table 1 displays the results for fitting the various Cox Proportional Hazards (CPH) models: first, a Proportional Cox Regression model was fitted to compare women with more than two children with nulliparous women; Second, it was fitted to compare women with one or two children versus nulliparous women. The two models mentioned were again fitted, but this time using a Weighted Cox Regression as proposed by Schemper et al. (2009). Given the violation of the proportional hazards assumption (see Figure 1), only the results of the Weighted Cox Regression were interpreted.

Table 1 shows that the hazards of dying among women having more than two children was 0.816 times less than that of nulliparous women. Moreover, for women having 1 or 2 children, the hazard of dying was 1.310 times higher compared with nulliparous women.

In other words, the yearly probability of dying is reduced by approximately 19% for women with more than 2 children compared with those who have not given birth to any children. Turning to year of death, for a one-unit increase in year of death, the hazard of dying for women having greater than 2 children was 0.987. Similar results were demonstrated for those women having only 1 or 2 children (Hazard of dying = 0.999). It was worth noting that the covariate 'Year of death' was insignificant for women having 1 or 2 children (p-value = 0.787).
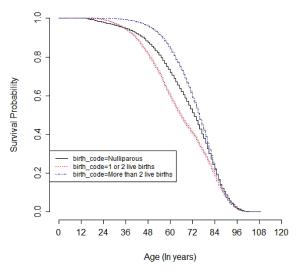
Figure 1. Superimposed Kaplan Meier curves for various groups of women

Table 1
CPH and Weighted CPH Regression Models

Model	n	Variables	*exp*(coef)	*se*(coef)	*p*-value
CPH	29906	> 2 children	0.950	0.012	<0.001*
		Year of death	0.984	0.002	<0.001*
	20703	1 or 2 children	1.181	0.016	<0.001*
		Year of death	0.993	0.003	0.011*
Weighted CPH	29906	> 2 children	0.816	0.013	<0.001*
		Year of death	0.987	0.003	<0.001*
	20703	1 or 2 children	1.310	0.019	<0.001*
		Year of death	0.999	0.003	0.787

Note: * Statistically significant (*p*-values less than 0.05)

Results from Table 2 displays CPH models for women suffering from different diseases. Six types of diseases including neoplasm; endocrine, nutritional and metabolic; circulatory; respiratory; digestive and genito-urinary were considered. The hazard of dying for women suffering from any of the abovementioned diseases and at the same time having 1 or 2 children and those having greater than 2 children were examined by the CPH models against nulliparous women. Results indicated that the hazard of dying for women suffering from neoplasm and who had 1 or 2 children was 1.551 times the hazard of dying for nulliparous women. It was observed that across all the diseases, the hazard of dying decreased for women having greater than 2

children in comparison to those having 1 or 2 children against the nulliparous ones. The highest hazard (exp(coef) = 1.551) of dying for those having 1 or 2 children were women suffering from any form of neoplasm and the lowest hazard (exp(coef) = 1.019) was noted for those suffering from respiratory problems.

Table 2
CPH Models by Diseases

Disease	Variables	n	*exp*(coef)	*se*(coef)	*p*-value
Neoplasm	1 or 2 children	4639	1.551	0.041	< 0.001*
	> 2 children		0.863	0.033	< 0.001*
	Year of death		0.987	0.006	0.025*
Endocrine, nutritional & metabolic	1 or 2 children	9843	1.216	0.033	< 0.001*
	> 2 children		0.941	0.022	0.005*
	Year of death		0.977	0.004	< 0.001*
Circulatory	1 or 2 children	12614	1.141	0.028	< 0.001*
	> 2 children		1.035	0.019	0.074
	Year of death		0.986	0.003	< 0.001*
Respiratory	1 or 2 children	2447	1.019	0.065	0.780
	> 2 children		0.895	0.044	0.011*
	Year of death		0.980	0.008	0.010*
Digestive	1 or 2 children	883	1.434	0.095	0.000*
	> 2 children		0.919	0.077	0.270
	Year of death		0.949	0.013	< 0.001*
Genito-urinary	1 or 2 children	657	1.190	0.112	0.120
	> 2 children		0.955	0.087	0.590
	Year of death		1.010	0.014	0.500

Note: * indicates *p*-values less than 0.001

DISCUSSION

The main finding of this study was that the hazard of mortality was lowest among women with more than 2 children compared with nulliparous women (see Figure 2). Additionally, low parity with 1 or 2 children was associated with an increased hazard of dying from neoplasm. Data was drawn from a cohort, which was representative of the general population, consisting of records of mortality and parity of all women between 2005 to
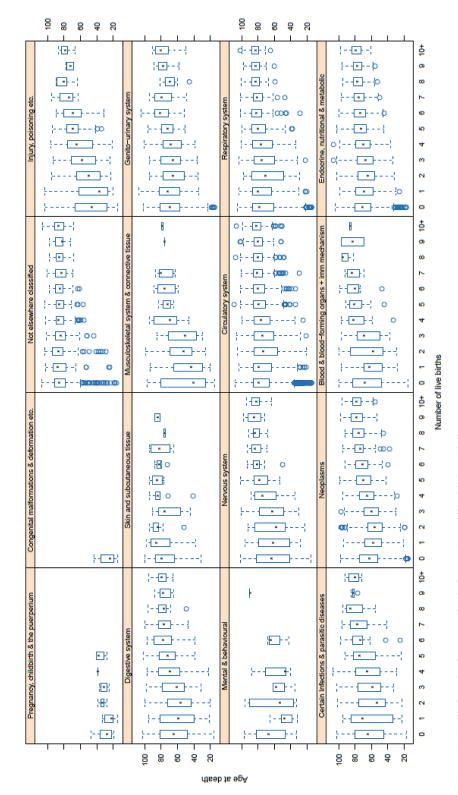
Figure 2. Trellis boxplot for age at death, by number of live births and disease

2014 in Mauritius. The study confirmed the findings of previous studies, which compared mortality between nulliparous and parous women.

However, recently, a handful of studies have suggested a different type of relationship between parity and lifespan. One of the recent studies by Simons, Simons, Friedlander & McCallum (2012) conducted on Australian women revealed that "all-cause mortality fell progressively with increasing parity in women". Muller, Chiou, Carey, & Wang (2002) used a historical French-Canadian cohort who lived beyond the age of 50 and concluded that increased fertility was linked to increased, rather than decreased, post-reproductive survival. In another study, the positive relationship between (not causation) late fertility, particularly between 33 and 37 years of age and survival time was established. Women who lived longer were found to be those who had children after the age of 33, the odds of living up to the older group increasing by 5% for every additional year added to the cut-off point.

Van den Berg, Gupta & Portrait (2010) concluded that "fertility has a protective causal effect on female mortality in post-reproductive years". Moreover, Gagnon, Smith, Tremblay, Vézina, Paré, & Desjardins (2009) used three historical databases (Québec in Canada and Utah in United States) and concluded that higher parity was associated with increased mortality rate but that late fertility was associated with increased survival rate.

McArdle, Pollin, O'Connell, Sorkin, Agarwala, Schaffer, King, Shuldiner, & Mitchell (2006) found that that lifespan increased in a linear fashion with increased number of children for both mothers and fathers from an Amish community in Pennsylvania. Total mortality was found to be lowest among women with 2-4 livebirths in Finland but high parity was associated with increased risk of mortality from vascular complications after adjusting for confounding factors such as age, age at menarche and background factors (Koski-Rahikkala, Pouta, Pietiläinen & Hartikainen, 2006).

CONCLUSION

The main finding of this study was that women with more than 2 children compared with those without any children had a lower mortality hazard. One of the limitations of this study was that it failed to adjust for any confounders since limited demographic data was available. The study put forward the association between parity and female lifespan given the inconsistency of results from previous studies. Future studies can look into the effect of confounders, which past studies had not been able to adjust for.

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SOCIAL SCIENCES & HUMANITIES

Relationship between Emotional Intelligence and University Students' Attitude

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ABSTRACT

"Attitude is the key to success" is an age-old saying and widely used in education to indicate that attitude may lead towards academic success. This exploratory study aims to investigate emotional intelligence of university students and their attitudes. The study involves a survey using self-administered questionnaire. The sample comprised 324 Malay undergraduate students studying at a university located in the East Coast of Malaysia. The emotional intelligence of undergraduate students was assessed using Schutte Emotional Intelligence Scale (SEIS) while their attitude was evaluated using a Student Attitude Scale. Second order Confirmatory Factor Analysis (CFA) model was implemented to test the factorial validity of the Emotional Intelligence and Student Attitude constructs. CFA results confirmed the four-factor structure of SEIS and three factor structure of Student Attitude scale. The Structural Equation Modeling results demonstrated that emotional intelligence has a weak positive effect on students' attitude.

Keywords: Emotional intelligence, students' attitude, second-order CFA, structural equation modelling

INTRODUCTION

In a developing country, education is important for economic growth and social advancement. Educated individuals are expected to be valuable assets to the country and society.

Determinants of academic performance have been the subject of ongoing debate

among educators, academicians and policy makers. Most studies have reported the significant effects of teacher and school factors, students' attitude, socio economic, family background, and language proficiency on students' academic achievement (Pajares & Schunk, 2001; Zahyah, 2008; Baharudin & Zulkefly, 2009; Kamariah, Rohani, Rahil, Habibah, Wong, & Ahmad Fauzi, 2010). Several other studies have reported significant factors as well, such as: self-efficacy (Schunk, 1991; Zimmerman, Bandura, & Martinez-Pons 1992; Pajares, 1996; Zajacova, Lynch, & Espenshade, 2005; Gore, 2006; Adeyemo, 2007); stress (Zajacova et al., 2005; Gore, 2006; Adeyemo, 2007; Yasin & Dzulkifli, 2011); and emotional intelligence (Wong, Wong, & Chau, 2001; Adeyemo, 2007; Ferrando, Prieto, Almeida, Ferrandiz, Bermejo, Lopez-Pina, Hernandez, Sainz, & Fernandez, 2011; Saroja, 2011). More recently there has been interest in the impact of social and emotional competency on academic achievement; and it has been found that there are strong connections between emotional intelligence and academic achievement (Goleman, 1995).

Interest in emotional intelligence was spurred by the idea that cognitive ability alone is insufficient to explain human behaviour and success. Goleman, (1995) claims that possessing a high IQ is not enough to determine one's success in work and life as there are also personal qualities that need to be taken into account and important for success.

The term "emotional intelligence" coined by the American psychologists, Peter Salovey and John D. Mayer in 1990 refers to "the ability to monitor one's own feelings and emotions and those of others, to discriminate among them, and to use this information to guide one's thinking and actions". It includes the ability to accurately perceive emotions in order to assist thoughts, to understand emotions and to reflectively regulate emotions to promote emotional and intellectual growth.

While, attitudes are emotionalized sets that can influence behaviour by referring to all situations or objects to which they are related. In other word, it is one's attitude towards something or someone involving feelings of like or dislike, trust or distrust and attraction or repulsion (Sarwar, 2004).

In a study in Nigeria, it was reported that emotional intelligence, self-efficacy, happiness and life satisfaction over and above depression predicted college students' behaviour and attitude. It was discovered that students who were happy, high in self-efficacy and good in controlling their emotions were motivated to participate in relevant academic activities and had developed positive attitudes that can lead to academic success (Salami, 2010).

The effect of hope, self-efficacy, English anxiety, teachers' factor and students' attitude on academic achievement was investigated by Fairoze (2011). The exploratory analysis on attitudes scale

extracted three factors structure for the students' attitude scale. This study found that hope and teacher's factor have significant positive effect on student's self-efficacy. However, students' attitude did not have a significant effect on their self-efficacy.

Although a plethora of research has been conducted on emotional intelligence the last two decades, recent researchers question the validity of emotional intelligence instruments suggesting they have unstable factor structure (Van Rooy, Whitman, & Viswesvaran, 2010; Sharma, Gangopadhyay, Austin, Mandal, & Louis, 2013). The replication of validation study on a different population would help to verify the measure's utility beyond that of the inventory developers' setting (Kaplan & Saccuzzo, 2009). Therefore, this study is important as it also tests the factorial validity and applicability of the Schutte Emotional Intelligence Scale (SEIS) by Schutte, Malouff, Hall, Haggerty, Cooper, Golden, & Dornheim (1998) in Malaysia.

This study first investigates the factorial validity of emotional intelligence and students' attitude constructs, and then determines the relationship between emotional intelligence and university students' attitude specifically among the Malay students. In addressing this issue, the following hypotheses were developed and investigated.

H1: The four-factor structure of emotional intelligence is valid

H2: The three-factor structure of students' attitude is valid

H3: There is a significant positive relationship between emotional intelligence and students' attitude

MATERIAL AND METHODS

Research Design

The design of this survey research is to investigate the relationship between emotional intelligence and students' attitude. The participants are 1015 Malay undergraduate students from a local university located in East Coast of Malaysia, using proportionate stratified sampling of three faculties. The data was collected using a structured questionnaire and 500 questionnaires were distributed to undergraduates while class was in session. A total of 361 set of questionnaires were returned out of which 324 were used for further analysis.

Research Instrument

The structured questionnaire consists of three sections which are Section A: Respondent's background information; Section B: Emotional Intelligence (EI) scale and Section C: Student's Attitude scale.

Schutte Emotional Intelligence Scale (SEIS). Emotional intelligence scale (SEIS) was adopted from Schutte et al., (1998) and has 33 items with a response scale of "strongly disagree" (1) to "strongly

agree" (5). Out of 33 items, there are 30 positive and only 3 negative items. In this study, items B5, B28 and B33 were recoded as they are negatively correlated with other items due to statement B5 ("I find it hard to understand the nonverbal messages of other people"), B28 ("When I am faced with a challenge, I give up because I believe I will fail") and B33 ("It is difficult for me to understand why people feel the way they do") being negative statements. The 33 items represented the conceptual model of Salovey and Mayer (1990) in which 13 items measure the appraisal and expression of emotion category, 10 items for the regulation of emotion category and 10 items for the utilization of emotion category. An internal consistency (Cronbach's alpha) of 0.90 for the 33-item scale was reported by Schutte et al., (1998). There are many arguments on the dimensions of SEIS. In a study on SEIS involving 260 university students, principal components analysis using both orthogonal and oblique rotation extracted four components. The four components are optimism, appraisal of emotions, social skills and utilisation of emotions (Petrides and Furnham, 2000). EFA was done by Saklofske, Austin, and Minski (2003) to extract the components for emotional intelligence and they also support the four factors obtained by (Petrides and Furnham, 2000).

Student's Attitude Scale (SA). This study measures students' attitude towards learning and behaviour in class. The Students' Attitude (SA) scale was adopted from Fairoze (2011) and consists of 18 items with a response scale of "definitely false" (1) to "definitely true" (8). Out of 18 items, there was one negative item. Item C2 ("Class is very boring for me") was recoded as it is a negative statement whereas the others are positive statements. The Cronbach's alpha reported by Fairoze (2011) was 0.861 for the 18- items scale and Exploratory Factor Analysis using a sample of 196 undergraduate students extracted three factors which are teamwork, presentation and internet usage. The Cronbach's alpha for all three factors were 0.86, 0.88 and 0.64 respectively. Table 1 summarizes the number of items for each construct of this study.

Table 1
Constructs and number of items

Construct	Number of items	Label
Emotional Intelligence (EI)	33	B1 – B33
Student's Attitude (SA)	18	C1 – C18

Statistical Analysis

Cronbach's alpha was used in this study to determine the reliability of the EI and SA constructs. A pilot study involving 33 randomly selected undergraduate students revealed Cronbach's alpha of 0.765 and 0.605 for EI and SA respectively. Then, the actual survey was carried out. The descriptive analysis for the demographic profile was performed using IBM SPSS

Statistics 18.0. The measurement model for emotional intelligence and students' attitude constructs were checked for reliability and validity using Confirmatory Factor Analysis (CFA). The validity of constructs was examined using convergence validity and discriminant validity. Furthermore, CFA using IBM SPSS AMOS 18.0 was carried out to test the first order and second- order factor model of EI and SA as well as to determine the relationship between them.

Participants

Out of 324 respondents, 246 (76%) are female and only 78 (24%) are male respondents. The students are in Semester 2(30%), Semester 3(19%), Semester 4(24%), Semester 5(18%) and Semester 6(9%). For age group distribution, 111 (34%) respondents are age less than 21 years while 213 respondents (66%) are age more than 22 years.

RESULTS AND DISCUSSION

Reliability Analysis

The Cronbach's alpha was used in order to assess the internal consistency reliability for each constructs. The values for EI and SA are 0.879 and 0.800 respectively, and exceeded 0.70 indicating that the items are reliable for measuring the respective constructs. Kline (1999) claimed that when dealing with psychological constructs, values of Cronbach's alpha below 0.7 can realistically

be expected because of the diversity of the constructs that were measured even though the general accepted value ranges from 0.7 to 0.8.

Factorial Validity of the Emotional Intelligence Construct

Confirmatory factor analyses were performed using IBM SPSS AMOS 18.0 to assess the validity and reliability of the EI measurement model. The EI scale is measured by four factors which are optimism, appraisal of emotions, emotions utilization and social skills. Figure 1 illustrates the first-order four-factor structure model and Table 2 summarizes the model fit before and after modification which involve deletion of items that have low factor loadings to achieve better data-to- model fit. The initial model did not fit the data well ($\chi 2$ (428df) =1582.007, $p < 0.05$, $\chi 2/df=3.696$) and the fit indices (GFI=0.767, AGFI=0.730, CFI=0.661) were below 0.90 while RMSEA= 0.091. Therefore, some modifications were needed to improve the goodness of fit of the model. The modifications involve deletion of items with low factor loadings (Hair, Black, Babin, and Anderson, 2010). Since the sample size is greater than 200, items which have factor loadings below 0.50 were dropped (Hair et al., 2010). The initial standardized loading showed that 7 items (B19, RB28, B11, RB5, RB33, B4 and B1) have a standardized loading below 0.50 and these items were deleted.
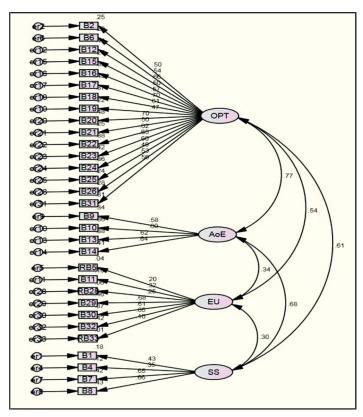
Figure 1. EI four factors first-order CFA model

The modification indices (MIs) also identified 4 items (B15 and B25, B12 and B26) with correlated errors. The items B15 "I am aware of the nonverbal messages I send to others" and B25 "I am aware of the nonverbal messages other people send", B12 "When I experience a positive emotion, I know how to make it last" and B26 "When another person tells me about an important event in his or her life, I almost feel as though I have experienced this event myself" questions are quite similar to each other. Even though they are similar, these four items are important in explaining the emotional intelligence, thus the modification by allowing errors to be correlated were done rather than deletion of items. The model fit improves with better fit indices (GFI=0.823, AGFI=0.782, CFI=0.781, RMSEA=0.087, χ^2 (244df) =846.221, p < 0.05, χ^2/df=3.468). A value of RMSEA about 0.08 or less indicates reasonable error of approximation (Kline, 2005).

Factorial Validity of the Students' Attitude Construct

Students' attitude was measured by three factors which are participation, presentation and reading preference. Figure 2 illustrates the first-order three-factor structure model

and Table 2 shows the model fitness before and after modification is done. The overall model Chi-square (χ^2(116df)) was 644.999 with $p < 0.05$, $\chi^2/df = 5.56$, GFI=0.814, AGFI=0.755, CFI=0.728 and RMSEA= 0.119. A value of χ^2/df between 2 to 5 indicates that the model is acceptable (Hair et al., 2010). Thus, the result showed a very poor fit of the model to the data and some modifications were needed to improve model fit.
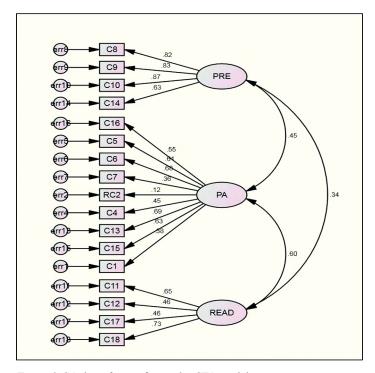

Figure 2. SA three factors first-order CFA model

Based on standardized loadings below 0.50, 6 items (RC2, C1, C4, C7, C12 and C17) were dropped from the model. The MIs showed that two pair of items: (C15, C16) and (C5, C6) have correlated errors. Since item C15 "I keep on studying and improving my grades in test and exam", C16 "If I have trouble in understanding any topics in the class, I use lots of different strategies to help me understand such as asking friend and meet the lecturer personally after class", C5 "I enjoy discussing and studying in group with others" and C6 "I come to my group prepared and ready to contribute" are important to measure student's attitude in general, therefore the items were not removed but modification was done by correlating the error terms.

After modification, the overall model chi-square (χ^2) was 172.876 with 39 degrees of freedom, p < 0.05, and χ^2/df =4.433. Other measures of fit indices namely GFI (0.916), AGFI (0.857), and CFI (0.908) indicate that the model is acceptable. The root mean square error of approximation (RMSEA) is 0.103.

Table 2
Summary Fit Indices (First-Order Model)

Model		χ^2/df	RMSEA	GFI	CFI	AGFI
Emotional Intelligence	Initial	3.696	0.091	0.767	0.661	0.730
	Final	3.468	0.087	0.823	0.781	0.782
Students' Attitude	Initial	5.560	0.119	0.814	0.728	0.755
	Final	4.433	0.103	0.916	0.908	0.857

The second-order CFA was then performed for both EI intelligence and SA construct. The EI second-order model is composed of four first-order latent constructs. Meanwhile, the second-order model for SA is composed of three first-order constructs. The results for the second-order CFA are show in Table 3. The fit indices show that both second-order models have reasonable fit and reasonable error of approximation.

Table 3
Summary Fit Indices (Second-Order Model)

Model	χ^2/df	RMSEA	GFI	CFI	AGFI
Emotional Intelligence	3.510	0.088	0.821	0.775	0.781
Students' Attitude	4.433	0.103	0.916	0.908	0.857
Overall	3.425	0.087	0.760	0.724	0.725

A CFA of overall measurement model was then conducted to test the adequacy of the measurement model involving both EI and SA constructs. The overall measurement model is done to observe the covariance structure for all latent constructs together. The measurement model does not fit well (GFI=0.760, AGFI=0.725, CFI=0.724, RMSEA=0.087, χ^2/df=3.425). Although the fit indices (GFI, AGFI and CFI) for the overall measurement model are not above the 0.9 threshold, the model is acceptable as this is an exploratory study. The RMSEA and χ^2/df is less than 5, thus indicating the measurement model can be accepted.

The correlation between emotional intelligence and students' attitude (0.42) indicates a significant weak positive relationship exists between them. Figure 3 presents the path diagram the measurement model with two second-order constructs.
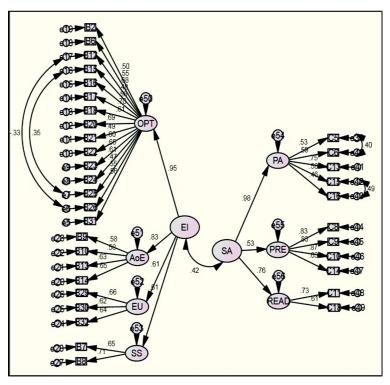

Figure 3. Measurement model

Convergent Validity and Discriminant Validity

Table 4 presents the AVE, CR and SIC (squared inter- construct correlation) for each construct in this study. The rule of thumb to satisfy discriminant validity is the AVE for each construct should be larger than corresponding Squared Inter-Construct Correlation (SIC) (Hair et al., 2010). The AVE values for the constructs are 0.582 for emotional intelligence and 0.611 for students' attitude while the construct reliability for each construct is 0.843 and 0.816 respectively. Since the AVE values are greater than SIC (0.173), these conclude discriminant validity has been established. The AVE are larger than 0.5 and construct reliability also greater than 0.70 indicates that the EI and SA constructs are reliable and valid.

Table 4
Summary of AVE, CR and SIC

Construct	Emotional Intelligence	Students' Attitude
Emotional Intelligence	**0.582**	
	(0.843)	
Students' Attitude	0.173	**0.611**
		(0.816)

Notes: Boldface values on diagonal are AVEs; Construct Reliability (CR) values in parentheses and orthogonal values are SIC

CONCLUSIONS

This study examined the relationship between emotional intelligence and the attitude of undergraduates. Confirmatory Factor Analysis was used to validate the components of the Emotional Intelligence and components of Students' Attitude. This study supports the findings by Petrides and Furnham (2000) as four factors were extracted from the EI scale which is optimism, appraisal of emotions, emotions utilization and social skills. Additionally, three factors were extracted from the Students' Attitude scale (participation, presentation and reading preference). However, the items for the three factors are differ with the findings by Fairoze (2011). Convergence and discriminant validity results showed that the constructs are distinct, reliable and valid. Since the measurement model does not fit well, this study needs to be replicated and more data needs to be collected to further validate the model. This exploratory study found that there is a significant weak positive relationship between emotional intelligence and student's attitude indicating students with positive emotions would tend to have positive attitudes and behaviours in class. Similarly, with the finding found by Güven (2016) in his study that weak positive relationship between the attitudes of the students towards using the media and ICT tools in learning English and their emotional intelligence. While, Parimala and Pazhanivelu (2015) reported that students' attitude towards science have moderates impact on emotional intelligence. Emotional intelligence is an important determinant of factors such as attitude, self-efficacy, happiness, satisfaction, leadership and performance. Recently, Elipe, Mora-Merchán, Ortega-Ruiz, and Casas (2015) reported that perceived emotional intelligence moderates the relationship between cyber bullying victimization and its emotional impact.

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A Study of Students' Choice of Higher Education in Achieving Their Career Aspirations

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ABSTRACT

This paper aims to examine the factors that influence SPM leavers [n=694] in their choices of university courses. Socio-economic and personality factors such as interest in work-related experience and ambivalence have been frequently cited as the main factors affecting students' career aspirations. Noting that the cost of tuition fees correlate strongly with the affordability of the course chosen, and taking into consideration the fact that the cost of enrolling in a public university is lower than in a private university, this study found no evidence to suggest any significant difference between the career aspirations of students studying in public and private universities. This study, found choice of university is dependent on gender (Chi-square =7.131, p=0.008), that is more female students (67.6%) prefer to attend a public university in contrast with males (55.7%). The study also found that the most important criterion in the decision making is the availability of scholarships.

Keywords: career aspirations, career choice, gender difference, higher education, socio-economic status

INTRODUCTION

Upon graduating from high school, aspiring higher-level education students typically do not know what their dream jobs are.

Students from lower-income families without financial resources, cannot study at a private university in view of the absence of education grants or loans. Those from higher-income families have the luxury of attending public or private universities. Based on data from Higher Education Research Institute (2010) cost and financial resources is a deciding factor in the selection of courses.

Regardless of the route (private or public university) a student selects according to Woodruff (2013), there is

always the possibility a student's career aspiration being disfigured and distorted through the university's own filtering system especially in public universities. A student's career aspiration is almost certainly subjected to a degree of admission requirements.

The Malaysian government has provided loans for students studying at public and private universities.

For high-achieving students, the government of Malaysia has awarded loans and grants to allow them to pursue higher education not only in Malaysia, but also overseas. This said, regardless of whether the university is a private or a government-sponsored one, the main challenge for a university is always to produce high-quality graduates that go on to become dynamic professional individuals with high characters that will be absorbed in today's marketplace at costs generally achievable by the majority of the Malaysian population.

LITERATURE REVIEW

The study on students' career choices is vast. Ahmed, Alam and Alam (1997) suggest personality factors such as interest and work-relevant experiences were frequently reported as important factors behind students' course selection. It has to be noted that besides internal factors such as the students' own interest contextual factors such as financial constraints and social support also act as barriers on course and career selection.

Ahmed et al. (1997) qualitatively examined the influences behind choice of university and career. The factors were categorized as follows: (1) factors affecting students' occupational choices, (2) factors that supported/restrained students from pursuing their choices, and (3) ways in which the students overcame the barriers keeping them from their course and career of choice. From a survey of 295 students from five universities in New Zealand, they found that students desiring to pursue a charted accountancy (CA) program placed significantly greater importance on financial, job-related and perceived benefit-cost ratio factors when compared to those opting for other careers.

Studies done by Kasperzack, Ernst and Piquart (2014), Puffer (2014), and Oztemel (2014), found personality factors such as that of ambivalence to be significant in career selections.

Pascarella and Terenzini (2005) carried out a longitudinal empirical study and found that degree programs tended to pay-off better than diploma programs in terms of occupational earnings. The studies found that although education affected future earnings, there is no significant difference in net occupational earnings or status between students opting for public or private based universities. This paper aims to examine factors that affect choices of university courses among SPM leavers.

METHODOLOGY

This section discusses the survey methodology.

Target Population

This research targeted students that intend to further their education upon completion of their secondary school education. Since the students that will seek entry into university in 2015 would have sat for the Sijil Pelajaran Malaysia (SPM) exams in 2014, the sample came from students who will be taking the SPM exams in that year. Additionally, some students who were already enrolled in colleges at the time this study was conducted were also sampled in order to determine the reason for course selection.

Samples

The respondents came from students sitting for the 2014 SPM exams in the state of Selangor, Wilayah Persekutuan Kuala Lumpur, and the state of Pahang. These three states were chosen due to their close proximity and their rapid economic growth. Students from both urban and rural schools were randomly sampled by using the random stratified sampling method. As can be seen in Table 1, a total of 694 SPM leavers were sampled.

Procedure of Data Collection

Data for this research was obtained through open-faced interviews by well-trained lecturers from Universiti Teknologi MARA (UiTM). This method was proven efficient to ensure that the respondents did not avoid answering questions, or, correspondingly, only respond to questionnaires with simple, cookie-cutter-like answers which failed to reflect their views truthfully.

Data Analysis

Data were analysed using IBM Statistical Package for the Social Sciences (SPSS). The demographic information of the respondents were analysed using descriptive analysis for the variables gender, state of school, current educational major, hometown, ethnic group, family income, level of parents' education, preferred place of study and preferred courses of study. Then the factors that affect choices of university among respondents were cross tabulated with the demographic information to obtain the percentage on the preference of university based on perceptions and views.

Table 1
Distributions of Respondents

States	Number of Respondents
1. Selangor	231
2. Pahang	207
3. Kuala Lumpur	256
Total	694

Research Tools

A two-part questionnaire was developed to determine the students' choice of higher education. The first part of the questionnaire involved personal questions such as:

a) personal biography, b) preferred place of study, c) courses by which the student intended to study, and d) preferred fees. In the second part of the questionnaire, respondents were expected to answer questions in order to determine their views and thought-process prior to deciding and pursuing their preferred institute of higher education using a 5-point Likert scale, given that 1 = Strongly Disagree and 5 = Strongly Agree. The factors on perceptions and views were grouped into 7 categories of affected factors, such as; relaxed campus environment, modern building, many exciting activities, low tuition fees, provide scholarship, reputable academic program, prestigious university.

RESULTS AND DISCUSSION

Looking at the data quantitatively, there were 344 male students and 350 female students surveyed. From the survey, both the male and female students reported to have chosen public universities over private ones. Interestingly, the data tabulated for private universities came out exactly the same as that of studying in universities overseas [see Figure 1].

The mean for each variable involved in the study is shown in Table 2. All variables have a mean score of above 2.00. The result shows that majority of the respondents agree with the statement of items for each variable. All variable listed seem to be important in influencing the choice of university among SPM leavers. Generally, in comparison of means of variables, "Provide scholarship" has the highest mean score (3.30), followed by " relaxed environment" and "Reputable academic program". "Prestigious university" has the lowest mean score among these variables. When the data was analysed further using crosstabs, it was found that more female students choice is public (49%) university as shown in Figure 1.

Table 2
Means of Items According to Variable

Variable	Importance	
	Mean	S.D
Provide scholarship	3.30	1.102
Relaxed Environment	3.27	1.178
Reputable academic program	3.24	1.193
Many exciting activities	2.76	1.229
Low tuition fees	2.67	1.358
Modern building	2.75	1.321
Prestigious university	2.35	1.948

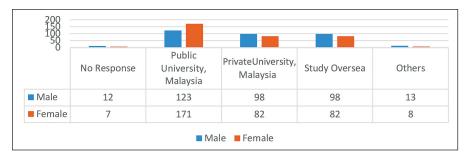|	No Response	Public University, Malaysia	PrivateUniversity, Malaysia	Study Oversea	Others
■ Male	12	123	98	98	13
■ Female	7	171	82	82	8

■ Male ■ Female

Figure 1. Students Choices of Higher Education

As in the case between genders, there were 3.5% male and 2% female students who were indecisive (no response) about their choice of university for higher education. In terms of course-selection among male and female students surveyed, male students were reported to have chosen engineering (34.9%) more than any other field of study while female students reported choosing medicine (31.4%) as their preferred course. We then analyzed the choice of programs among different ethnicity. Results in Figure 2 shows that a Malay students choice is Engineering, Chinese students prefer Business while Indians prefer Medical programmes. It is noted, however, that there were 157 students (22.6%) who showed no response (i.e. who were still indecisive) about their choice of field of study. This ambivalence that was highlighted in studies conducted by Kasperzack et al. (2014), Puffer (2014), and Oztemel (2014), earlier is greatly seen among Malaysian students.

	No Response	Business	Engineering	Medical	Computing and IT	Architecture	Others
■ No Response	1	1	0	2	0	0	0
■ Malay	72	56	90	79	15	24	9
■ Chinese	65	70	47	51	16	11	8
■ Indian	16	12	13	15	8	0	3
■ Others	3	2	0	3	1	0	1

■ No Response ■ Malay ■ Chinese ■ Indian ■ Others
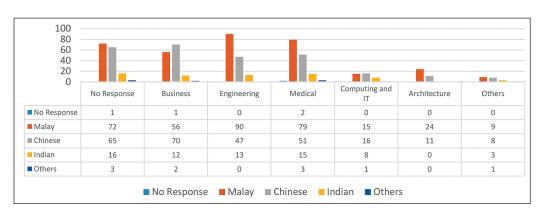
Figure 2. Choices of Higher Education Between Ethnicity

The Chi-Square test results in Table 3 shows a significant association (Chi-Square=7.131, p=0.008) between choice of university (public or private) and gender. A higher proportion of female students (67.6%) choice is public university compared to male (55.7%) students.

Table 3
Choices between Public versus Private University and Gender

	Public	Private
Male	171 (55.7%)	98(44.3%)
Female	171(67.6%)	82(32.4%)

Note: Chi-square (1 *df*) =7.131, p=0.008

In Malaysia, low income family are families whose monthly income is less than RM3000. The middle income family are those in RM3001 to RM10000 range and those with incomes exceeding RM10000 considered high-income. This study concurred with many studies on socio-economic status (Jackson, 1982; Ekstrom, 1985; Flint, 1992), where it was found that there were significant association (Chi-Square (6df=)68.867, p=<0.01) between the different socio-economic status and students' choice of higher education. Results Table 4 show evidence that majority of student in low income (65.2%) and middle income (46.2%) family prefer public university. Meanwhile, students from high income families prefer Private (39%) or study oversea (37.1%).

Table 4
Choice of Higher Education Between Family Income

Family Income	University Choice			
	Public University, Malaysia	Private University, Malaysia	Study Oversea	Others
Low Income	122	26	34	5
	65.2%	13.9%	18.2%	2.7%
Middle Income	127	71	68	9
	46.2%	25.8%	24.7%	3.3%
High Income	36	62	59	2
	22.6%	39.0%	37.1%	1.3%

Note: Chi-square (6 df) =68.867, p<0.01

Among the factors affecting university selection are: low tuition fees, reputable programs and universities, and whether the university will provide loans, grants or scholarships. As can be seen from Figure 3, this study found that the most important factor (32%) is the availability of scholarships to aspiring students, followed by the environment and the university's overall reputation.
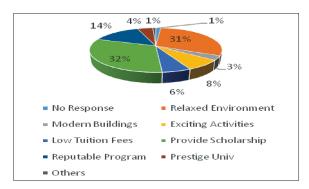
Figure 3. Factors in deciding university selections

CONCLUSION

The three major differences between public university and private colleges are: 1) tuition fees, 2) the size and degree offerings, 3) class size and demography (Peterson, 2014). In this study, it was found that there are significant difference in the students' choices between public and private universities. This study also found significant difference in gender as well as socio-economic status on students' in the choice of career and hence on which courses to attend. The result of this study is in direct contrast to that of Ahmed et al. (1997).

In a survey by Higher Education Research Institute in the United States it was found that the most important factor in choosing a university is not the ranking of the university (16.7%), but its academic reputation (67.7%). University financial assistance was ranked third (45.3%) in the students' list of priorities.

This contrasts with studies done in Pakistan [N=226] by Sabir, Ahmad, Ashraf and Ahmad (2013), where

higher education commission ranking, institutional reputation, employment, and career prospects are deemed more important.

Our study concurs with that done by Kitsawat (2013) in Thailand [N=1012] where it was found that three most important factors in influencing selection criteria are university environment and study atmosphere, university reputation and the availability of financial assistance. In 2009, Wagner and Fard (2009) identified the significant factor behind Malaysian students' choice of higher education is the cost of education. This finding is reflected likewise in the findings of this study where financial aid is deemed incredibly significant in students' list of priorities when selecting both the area of study and the institute of higher education.

ACKNOWLEDGEMENTS

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(Manuscript Preparation & Submission Guide)

Revised: June 2016

> Please read the Pertanika guidelines and follow these instructions carefully. Manuscripts not adhering to the instructions will be returned for revision without review. The Chief Executive Editor reserves the right to return manuscripts that are not prepared in accordance with these guidelines.

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    Regular articles are full-length original empirical investigations, consisting of introduction, materials and methods, results and discussion, conclusions. Original work must provide references and an explanation on research findings that contain new and significant findings.

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    These report critical evaluation of materials about current research that has already been published by organizing, integrating, and evaluating previously published materials. It summarizes the status of knowledge and outline future directions of research within the journal scope. Review articles should aim to provide systemic overviews, evaluations and interpretations of research in a given field. Re-analyses as meta-analysis and systemic reviews are encouraged. The manuscript title must start with "Review Article:".

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George Swan[1] and Nayan Kanwal[2]

[1]Department of Biology, Faculty of Science, Duke University, Durham, North Carolina, USA.,
[2]Office of the Deputy Vice Chancellor (R&I), Universiti Putra Malaysia, Serdang, Malaysia.

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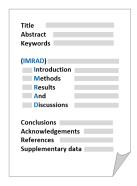
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And
Discussions

Conclusions
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