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OF SRI LANKA**

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MESSAGE FROM THE VICE CHANCELLOR

I take pleasure in sending this felicitation message to the Proceedings of the Open University Research Sessions (OURS) 2016. In the last few years the management of the OUSL has put a greater emphasis on research by providing various incentives to the academic community of the university. In this respect I would like to thankfully remember our former Vice Chancellor Dr. Vijitha Nanayakkara for some of the proactive decisions he made to enhance the research capabilities of the academic staff. He instituted a separate research unit under the leadership of a Director and also initiated a number of different research funding mechanisms. He also made arrangements to fund academic staff to disseminate their research findings at the Annual Asian Open Universities Conferences. This year we have opened up this funding facility for staff presenting research papers in other conferences too. As a result, many academics of the University were able to travel overseas and present their findings in international conferences.

As far as the administration of the OUSL is concerned we will provide the necessary logistic and financial support, where necessary, for research initiatives that an individual or an entity in the University wants to embark on. One of the areas which need urgent attention is the procurement procedures for research activities. Currently we are looking at this matter and hope that we would be able to devise a simple mechanism to procure the various items required for conducting research.

Let me also take this opportunity to express my appreciation to the Organizing Committee of the Open University Research Sessions 2016 and other staff who have contributed their time and effort to make this event a success. I am confident that the OURS 2016 would be an academically enriching and rewarding experience for all the presenters and participants.

Thank you very much and all the very best.

Prof. S. A. Ariadurai
Vice Chancellor

PREFACE

This year 2016 marks the 13th year of Open University Research Sessions (OURS2016) which was previously known as Annual Academic Sessions of the Open University of Sri Lanka since 2003. The OURS 2016 commence on Thursday 17th November with the inauguration at 9.00 a.m. and continue until 18th November 2016 at the Open University premises. This volume contains the abstracts that were accepted for presentation and publication in the proceedings. In addition to this publication, the authors will be provided with a compact disc containing the extended abstracts accepted for presentation.

This year we received 58 abstracts and extended abstracts for review. Of those, 05 abstracts were withdrawn while 42 abstracts were selected after going through a rigorous peer review process on the basis of originality, significance, and clarity for the purpose of the conference. The abstracts received cover a wide range of scientific disciplines. Among them are Distance Education, Pure and Applied Sciences, Management, Social Sciences, Law, Education, Engineering, Health Sciences, Computer Science and Agriculture.

One of the special features in OURS 2016 is the inclusion of two invited papers relevant to current issues. Two key note-speakers will also speak on a given subject in a plenary session on both days of Research Sessions. The rest of the presentations have been categorised into 09 areas of which 08 sessions will be held as parallel sessions. Overall, the presentations represent an impressive diversity and depth.

Prof. Lakshman Jayatilake, Chairman, National Education Commission of Sri Lanka and Prof. Arjuna Parakrama, Senior Professor of English, University of Peradeniya have kindly agreed to deliver key note addresses at these sessions. We are very grateful to both of them for taking time off from their busy schedules to be with us at the sessions. The two invited papers are presented by Prof. W.A.J.M. De Costa, Senior Professor and Chair of Crop Science, Faculty of Agriculture, University of Peradeniya and Dr. M.K. Meegahakumbura, Geneticist and Plant Breeder, Coconut Research Institute (CRI) Sri Lanka. Our thanks are due to both invited speakers for the interest shown in sharing the outcome of their research work with OURS.

Being a collaborative mission, the organization of research sessions and compiling a volume of proceedings require the dedicated effort of many people. Hence, on behalf of the Senate Sub-Committee on Open University Research Sessions, we thank all authors in particular, who submitted abstracts to the conference, and all reviewers who helped us in reviewing papers. My thanks go to Senate Sub-Committee members for Annual Research Awards for selecting the awardees within the required time period; the Professors of the OUSL for agreeing to serve as Session Chairs at this event and the language editors for editing manuscripts. Mr. Priyantha Nawaratne made a good job in designing invitations and cover page and compiling the abstracts in a professional manner. Untiring efforts of Mr. Priyantha Nawaratne and Mr. P. H. J. Arunasiri in all session related work and secretarial assistance provided to the Committee are highly appreciated. The support extended by Mr. Mudith Somaratne, Acting Director Operation for his cooperation and Mr. B. A. D. J. Balarachandra are also acknowledged. I wish to thank Ms. Kala Suresh, Deputy Registrar and her staff and all others who helped in numerous ways to make this year's Open University Research Sessions a success.

This year too we were able to issue a conference bag to authors who have registered for the sessions. This would not have been possible without the generous support of CIC Agri Business Pvt. Ltd. Our special thanks go to Dr. Keerthi Kotagama, CEO in this regard.

I also wish to record our thanks to the Vice Chancellor Prof. S. A. Ariadurai for his support in carrying out our work to make this event a success.

Our Chancellor, Prof. Colvin Goonaratna is gracing this occasion as our Chief Guest. We are indeed happy and honoured by his presence.

Last but not least, I sincerely thank all the members of the Senate Sub-Committee of the Open University Research Sessions 2016 for their unstinted support, active participation and significant contribution to all matters pertaining to OURS 2016. No doubt without them this event would not have been a reality.

Finally, let me wish you success in your technical presentations and intellectually stimulating and academically productive deliberations at the Open University Research sessions 2016.

Prof. G. M. Kamal B. Gunaherath

Senior Professor of Chemistry and Deputy Vice Chancellor

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Keynote Address 1

EDUCATION ETC AS IF THE NATION MATTERED

Education at all levels and all that goes with it has turned into a business. The most important implication and concern of this is profitability. The bottom line is an end in itself without any connection with risk management and sustainability.

Edu-business started from the developed nations; and they have made a success of it. We too have turned formal education into a business, and institutionalized it in the form of the tuition industry, which is now an ally of the curriculum developers and teachers.

Education is both a cause and effect of development. Tool making, use of techniques, and understanding the nature of materials and energy led to technologies that resulted in a surplus. This in turn enabled the creation of formal education systems that replaced the traditional methods of producing craftsmen and farmers. Information and knowledge resulting observation and investigation was always a resource and in the cotemporary world has become a commodity. These were the developments made possible by a broad based education.

The educated are not engaged in the creation of national wealth. Sri Lanka is highly dependent on contribution of low-paid manual workers and worker remittances from abroad. The much hyped computing services bring in much less in comparison. This is a telling point about the non-effectiveness of the education system as a contributor to national development.

Whether the academics are using their freedom to contribute to national wellbeing and development is a question demanding an answer. The onset of politicization of the academia can be traced back to petty and individual initiatives by academics who sought personal advantages.

The role of traditional universities and the relevance of Open Education as contributors to national development and the needs open and frank discussion. There is a need for more technological universities as compared to the academic universities in terms of output. The distinction between them must be seen in terms of as sources of doers whom the nation needs in large numbers.

The academic universities admit school-leavers who do not have work exposure and are also not quipped to provide it within their programmes. These have so far failed in producing professionals who can set distinct national standards like in other independent countries.

Our nation has not benefited from formally educating her people. This is being said as an entry to a process of soul-searching on the part of all of us who call ourselves formally educated. Every nation has its own technologies that contribute to its own wealth creating potential. Children are nurtured to make them patriotic and oriented to have a team spirit.

The industrial and post-industrial nations of both the west and the east take pride in describing themselves also as agrarian nations. As a result their national enjoy higher quality of life and health.

Technological now-how is not out there for the asking and cannot be simply accessed if we are fluent in English. Technologies are needed and created by those who use it.

Let us end this conversation with a few comments on how we may convert a formal education that has clearly become parasitic in our national context. The manifestations are clear. It is time that teachers and academics to take stock of their plight and genuinely make amends. The starting point is to make themselves and their students to re-engage with the issues and realities of their respective wider communities and habitats. There are no other escape routes and shortcuts.

Prof. Lakshman Jayathilake

Chairman

National Education Commission of Sri Lanka

Keynote Address 2

MOVING FROM DISGUISED TO PATENT NONSENSE: WHEN RESEARCH PROBLEMS PRODUCE PROBLEMATIC RESEARCH

The rise and rise of crudely positivist and narrowly empiricist science has, within Sri Lankan academic and intellectual discourse, conquered all. Research today, irrespective of its disciplinary origin or focus, is measured by its “scientific” merit, preferably in quantitative terms. Thus, scholars from fields as diverse as literature and law, gender and geography, philosophy and public administration, scramble to trivialize their work into mathematically measurable bytes that confirm or refute simplistic hypotheses.

This paper argues that the hegemony of science, thus narrowly conceived, is not merely non-rigorous and misleading in the Humanities and so-called Social Sciences, it is also suspect in other traditionally “scientific” disciplinary enclaves as well. Even within international scientific scholarship, alternative paradigms have emerged during the last five decades though they still remain marginal, but academics of all stripes in Sri Lanka must not only appear to be *scientific* in order to be credible, they are also evaluated within their respective disciplines as *scientists*, in the most limited of senses carried by this term.

Even among the handful of dissidents in the field, the oft-repeated defensive rationalizations are (a) my discipline/research is different because I do qualitative, not quantitative, studies, and (b) the scientific approach doesn’t cover all types of research. While these claims are obviously valid, they concede too much to this dominant avatar of science in order to carve out a safe space for “non-scientific” studies. Research can be multi- or inter-disciplinary as long as it is *scientific*, if one is a junior academic; if one is sufficiently senior as to evade such scrutiny, one must still rationalize one’s deviance.

Moreover, the hierarchy is further entrenched by the ubiquitous use of science-oriented (concept) metaphors and epistemologies, which I interrogate in order to lay bare the burden of the straitjacket that has been imposed on research *per se*. Nowhere is this more evident than in the demand for postgraduate research and grant applications across the board to identify “research problems” and to test “hypotheses”, when to do so will necessarily result in the distortion and trivialization of the original study. Instead, we now design our research so that they more easily fit this model!

Using a little Wittgenstein and many concrete examples I demonstrate how these misplaced and misleading notions of science and the scientific method vitiate scholarship across a range of disciplines, invariably producing jargonized common (non)sense and platitudes on the one hand, or gross distortions on the other. In order to do so I also critically examine generally unquestioned touchstones of rigour such as “clarity”, “objectivity”, linear “logical frameworks” and the self-evidence of numerical preponderance, positing in their stead a nuanced understanding of how power operates discursively in the making and privileging of meaning, in this instance in determining what legitimately constitutes scholarly research.

Prof. Arjuna Parakrama
Senior Professor of English
University of Peradeniya

Invited Paper 1

ADAPTATION OF SRI LANKAN AGRICULTURE TO CLIMATE CHANGE: SOME THOUGHTS ON OUR STRENGTHS AND WEAKNESSES

W. A. J. M. De Costa

Department of Crop Science, Faculty of Agriculture, University of Peradeniya

ABSTRACT

Analysis of long-term meteorological data in Sri Lanka has shown strong evidence that global-scale estimates of past climate change and predictions of future climate change are reflected at the local-scale as well. Long-term increases in temperature and increasing variability in annual and seasonal precipitation have been key features of climate change in Sri Lanka. Agriculture, especially crop production, is one of the most climate-sensitive activities. As such, measures aimed at adapting Sri Lankan agriculture to future climate change have to be strengthened through research and integrated in to farmer practice through extension and technology transfer (ETT). The objectives of this presentation are: (a) to examine the adaptation options available for agricultural crops and cropping systems in Sri Lanka; (b) to assess the extent to which those options are being pursued via research and ETT; (c) to provide a personal perspective of the strengths and weaknesses that prevail within the institutional framework in Sri Lanka and (d) to make suggestions for improving and strengthening the current efforts to make Sri Lankan agriculture better-adapted and more resilient to future climate change.

A strong argument is brought forward that it will be the technological advances through research, rather than elaborate policy discussions, that will bring about increased climate change-resilience to Sri Lankan agriculture. Among the technological advances, breeding of heat-tolerant crop varieties is identified as the option that will bring the most solid improvement in climate resilience. While it is encouraging to see breeding for heat tolerance being accorded a high priority in all major crop research institutes, an improved precision in the breeding methodology is required to reduce length of the breeding cycle and achieve maximum gain in heat tolerance. Options to increase climate resilience through modified crop management are limited and available options include: (a) increasing the tree cover in farmlands, especially in the dry zone; (b) optimization of planting times and matching crop phenology to climatic variation in the growing environment; (c) soil moisture conservation through mulching; (d) a paradigm shift in irrigation practices coupled with improved irrigation scheduling and greater water use efficiency and (e) intercropping C4-C3 crop combinations. While most of these options are already well-known, their effective implementation is uncertain because of ingrained farmer practices and a weak ETT system. Although Sri Lanka has an elaborate institutional network for research, they are severely under-strength in terms of human and physical resources and therefore needs considerable investment. On the other hand, the institutional network for ETT is dis-organized and dis-jointed and needs a total overhaul. Therefore, a co-ordinated effort to plan and implement the above measures is needed urgently.

Prof. W. A. J. M. De Costa: Email - janendrad@gmail.com

Invited Paper 2

RESEARCH TOWARDS FUTURE PROSPERITY IN COCONUT INDUSTRY IN SRI LANKA

M. K. Meegahakumbura, S. A. C. N. Perera and L. Perera

Genetics and Plant Breeding Division, Coconut Research Institute, Lunuwila, Sri Lanka

ABSTRACT

Coconut is known as “Tree of life” and is currently grown in 96 countries across the globe. Coconut is among the few crops domesticated in Sri Lanka and the earliest plantation crop systematically planted since 8th century (King Agbo’s era at the Anuradhapura kingdom). Coconut Research Institute of Sri Lanka (CRISL) was established in 1929 to fulfil the research needs of this important crop. Today Sri Lanka produces around 2800 million nuts annually and we are self-sufficient as local consumption requires only around 2200 million nuts/year. However, coconut industry requires additional 1300 million nuts annually and currently supply only around 600 million and the remainder is in short supply. Therefore, there is a great need to increase the coconut production up to 3500-4000 million nuts/year.

Coconut is a highly cross pollinating perennial crop hence, conventional breeding is challenging. Land fragmentation, emergence of new pests, diseases and global climate change further challenge the coconut industry. Research programme at the CRISL continuously changed over the past to address these emerging needs. With the aid of molecular tools, high yielding hybrids and drought tolerant cultivars were developed to increase the crop yields. Coconut clones were developed for the first time in the world in Sri Lanka using ovary culture, although refinements need to be made to commercialize the technique. Land suitability maps were prepared to guide the planting of hybrids and other cultivars to maximize the yields. Molecular Disease Diagnosis was carried out to identify novel diseases and pests, and accordingly disease and pest tolerant cultivar development is in progress. Biological control and green pest management concepts were practiced to reduce the yield loss and prevent the environmental pollution with hazardous chemicals. Prediction of coconut yields, development of technologies for virgin coconut oil production, preservation of tender coconuts, breeding new cultivars for beverage purposes are a few noteworthy developments.

KEYWORDS

Coconut industry, Climate change, Land suitability maps, Coconut yield prediction, Coconut in-vitro culture

Dr. M. K. Meegahakumbura: Email - muditha77@hotmail.com

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PREVALENCE AND THE EFFECT OF NON-STARTERS ON COURSE COMPLETION RATES OF THE B.SC. PROGRAMME: A PRELIMINARY STUDY

G. Bandarage*

Department of Chemistry, The Open University of Sri Lanka

INTRODUCTION

Graduation rate is an important measure of efficiency of an academic programme. In general completion rates for Open and Distance Learning (ODL) programmes are lower than their counterparts conducted in face-to-face mode. Open entry, students transferring to other institutes, student settling for intermediate qualifications and other commitments in life such as involvements at work, family responsibilities etc. are suggested as the causes of this “distance education deficit” (Simpson, 2013).

In ODL, defining a meaningful programme completion rate is not straightforward since some students may never intend to complete an entire programme of study. As such, often, individual course completion rates are used in such studies. A high individual course completion rate is a necessary condition for high programme completion rate. As such ODL institutions must strive in improving their course completion rates.

The quantity, $100 \times (\text{Number of students completing}) / (\text{Total number enrolled})\%$ may be considered as the simplest definition of completion rate of a course. This quantity is adversely affected by dropouts. About 80% of dropouts from an ODL course occur very early in the delivery of a course, typically within a week of the commencement of the course (Simpson, 2013, Bates, 2005). As such it has been suggested in using the “stable” student enrolment after initial dropouts (termed *non-starters*) in defining the course completion rates. Stable enrolment consists of the students who have demonstrably started the course; e.g. have completed some graded work (Giguère, 2007).

The student cohort in a course who obtains a zero Continuous Assessment Mark (CAM) includes all the students who have not participated in any graded activity. Experience at the Open University of Sri Lanka (OUSL) has shown that only a minute fraction of those who participates in continuous assessments in a course earns a zero CAM. One may argue that this minute fraction of students has not started engaging adequately with the lesson material. Hence in this preliminary study of *non-starters* in courses in the B.Sc. programme, we define a student who obtains a zero CAM in a course as a *non-starter* in that course. Also, this definition makes the identification of *non-starters* independent of the structure of the assessment activities which vary from course to course. Hence, *non-starters* could be identified easily using the available CAM data in the OUSL management information system.

The probability of a student dropping out is high in courses at the entry level to an academic programme. Ideally, any remedial measures in improving completion rates should be administered at this level. Hence, we have studied the prevalence of *non-starters* and their effect on the completion rates at the entry level (Level 3) of the B.Sc. programme at OUSL.

It has been shown that in designing activities for improving course completion rates it is useful to work with completion rates of students who register in a course for the first time, termed as *Fresh-student Completion Rates* (FCR) (Bandarage *et. al.*, 2012). Hence, we have studied the effect of non-starters on FCR.

Courses amounting to 9 OUSL credits (7.5 Carnegie credits) are offered, at Level 3 of the B.Sc., in each of the 7 disciplines, Botany (BOT), Chemistry (CHEM), Zoology (ZOO), Physics (PHY), Computer Science (COMP), Pure Mathematics (PMATH) and Applied Mathematics (AMATH). We studied non-starters in all these discipline based courses (a total of 18: BOU1101, BOU1200, CMU1121, CMU1200, ZLU1280, ZLU1181, PYU1160,

*Corresponding author: Email - gband@ou.ac.lk

PYU1161, PYU1162, CPU1140, CPU1141, CPU1142, PUU1140, PUU1141, PUU1142, APU1140, APU1141 and APU1142). Continuous assessment activities in these courses consist of tests, workshops, laboratory classes, student presentations and field visits.

Research questions:

1. How prevalent are *non-starters* in discipline-based courses at level 3 of the B.Sc. degree programme?
2. What is the effect of *non-starters* in discipline based courses at level 3 on Fresh-student Completion Rates?

METHODOLOGY

In studying the *non-starters* of a course, in a particular academic year, we have identified four categories of registrants in a course based on their level of experience with ODL as well as the course, at the time of registration: (a) *New registrants* (N) – those who register in the B.Sc. programme for the first time in that academic year, (b) *Old, non-repeaters* (Onr) – those who register in the course for the first time in that academic year but have registered in the B.Sc. programme in a previous academic year, (c) *Repeaters* (R) – those who register in the course in that academic year as repeat students and (d) *Fresh registrants* (F) – *New registrants* and *Old, non-repeaters* taken together. The last category consists of all who offer the course for the first time in the academic year under consideration. [*Fresh registrants* and *Repeaters* taken together is the total registrants in the course.] The prevalence of *non-starters* in the i^{th} course ($i = 1, 2, \dots, 18$), in student category, $\alpha (= N, Onr, R, F)$, in an academic year k , is

then calculated using $ns_{\alpha}(i;k) = (X_{\alpha}(i;k)/Y_{\alpha}(i;k)) \times 100\%$ where $X_{\alpha}(i;k)$ and $Y_{\alpha}(i;k)$ are the number of registrants with CAM = 0 and the number of registrants in category α in the i^{th} course in the academic year k , respectively. Prevalence of *non-starters* in registrant category α in a discipline is calculated using $NS_{\alpha}(k;\Phi) = \left(\frac{\sum_j X_{\alpha}(j;k)}{\sum_j Y_{\alpha}(j;k)} \right) \times 100\%$

where the summations are performed over all the courses in that particular discipline. Here Φ indicates any one of the seven disciplines. When the summations are performed over all the courses, irrespective of the discipline (i.e. $i = 1$ to 18), one obtains the overall prevalence of *non-starters* in academic year k (in all discipline based courses) in the faculty. The prevalence of *non-starters* in a registrant population in a discipline over a number of academic years is

defined using $NS_{\alpha}(\Phi) = \left(\frac{\sum_k \sum_j X_{\alpha}(j;k)}{\sum_k \sum_j Y_{\alpha}(j;k)} \right) \times 100\%$ where the summation

over k is performed over the academic years under study. As mentioned earlier one can obtain the corresponding overall quantity for the faculty by performing the summation over j over all the courses. The number of *Active registrants*, $Z_{\alpha}(i;k)$, in the i^{th} course, in academic year k , in registrant category α is defined as $Z_{\alpha}(i;k) = Y_{\alpha}(i;k) - X_{\alpha}(i;k)$.

The *Fresh-student Completion Rate* (FCR) of the i^{th} course in academic year k is defined by $FCR(i;k) = (P_F(i;k)/Y_F(i;k)) \times 100\%$ where $P_F(i;k)$ is the number of *Fresh registrants* (out of $Y_F(i;k)$) who complete the course (i.e. obtains a pass grade) in that same year (Bandarage *et. al.*, 2012). FCR for a particular discipline, Φ , in academic year k , is then defined by $FCR(k;\Phi) = \left(\frac{\sum_i P_F(i;k)}{\sum_i Y_F(i;k)} \right) \times 100\%$ where the summations are performed over all the courses in discipline Φ . In order to estimate the effect of *non-starters* on FCR , we define *Active Fresh-student Completion Rate*, $AFCR$, by

$AFCR(i;k) = (P_F(i;k)/Z_F(i;k)) \times 100\%$ which indicates the number *Fresh registrants* completing the course as a percentage of the *Active registrants*. The discipline counterpart of it is then defined by $AFCR(k;\Phi) = \left(\sum_i P_F(i;k) / \sum_i Z_F(i;k) \right) \times 100\%$.

Using line plots and bar charts we have carefully studied $ns_\alpha(i;k)$ and $FCR(i;k)$ for the 18 discipline based courses and $NS_\alpha(k;\Phi)$, $NS_\alpha(\Phi)$, $FCR(k;\Phi)$ and $AFCR(k;\Phi)$ for the seven disciplines in the B.Sc for the academic years that began in 2011, 2012 and 2013.

RESULTS AND DISCUSSION

All registrants in the 18 discipline based courses during the academic years that began in 2011, 2012 and 2013 were used in the study. Discipline based summary of the registrations is given in Table 1. The total number of registrants in each registrant category, in each year, is indicated in the last row; "Overall".

Table 1: Course registrations at level 3 for the years 2011, 2012 and 2013

Subject	New registrants			Old, non-repeaters			Repeaters		
	2011	2012	2013	2011	2012	2013	2011	2012	2013
BOT	636	798	924	707	599	473	68	98	134
CHEM	1160	1205	1360	559	472	312	382	374	460
ZOO	645	794	864	693	614	441	197	191	273
PHY	553	635	710	320	381	411	146	158	124
COMP	635	580	769	313	528	494	110	181	185
PMATH	373	470	643	276	251	181	92	144	180
AMATH	466	473	558	255	246	205	152	192	183
Overall	4468	4955	5828	3123	3091	2517	1147	1338	1539

It is observed that in any of the three academic years, *New registrants* and *Repeaters* form the largest and smallest cohorts of registrants in discipline based courses at level 3 in the faculty.

Prevalence of *non-starters* in the seven disciplines, $NS_\alpha(\Phi)$, over the three years in the above mentioned registrant categories are depicted in Figure 1. It is observed that the prevalence of *non-starters* is higher in the *New registrant* category compared to that in the *Old, non-repeat* category, in all seven disciplines, although both groups were offering the respective courses for the first time. Unlike the *New registrants*, the *Old, non-repeat* registrants have some ODL experience prior to registration in courses under consideration. Hence, this result is consistent with the general observation that the probability of dropping out of a course is less among students who have already followed some ODL courses (Bates, 2005). Similarly the prevalence of *non-starters* is higher in the *Repeat* registrant category compared to that in the *Old, non-repeat* category. High dropout may be due to the lack of motivation among course repeaters. Same observations have been made with corresponding quantities, $NS_N(k;\Phi)$, $NS_{Or}(k;\Phi)$ and $NS_R(k;\Phi)$, each year.

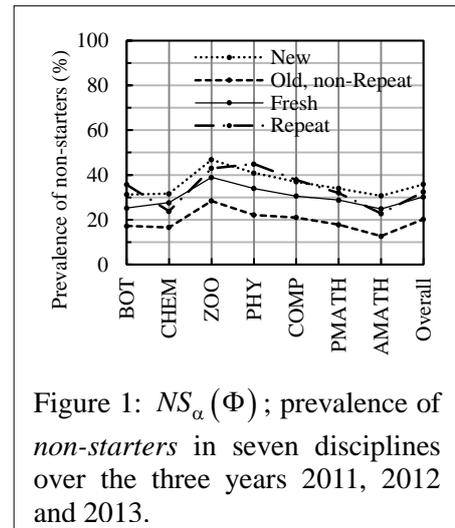


Figure 1: $NS_\alpha(\Phi)$; prevalence of *non-starters* in seven disciplines over the three years 2011, 2012 and 2013.

Figure 1 also shows that about quarter or more of *Fresh registrants* in each of the seven disciplines are *non-starters*. Furthermore, it is observed that about 30% of all the *Fresh registrants* and about 31% of *Repeat* registrants in the faculty at level 3 are *non-starters*.

[Calculations also show that for each of the three years, $28\% < NS_F(k; Overall) < 32\%$ and $30\% < NS_R(k; Overall) < 34\%$.] Figure 1 also shows that the prevalence of non-starters among *New registrants* in the faculty is about 38%. [It is interesting to note that about 38% of the new registrants in a course in Open University of United Kingdom (OUUK) leave before submitting the first assignment (Simpson, 2013).

Figure 1 also indicates that Zoology has the highest prevalence of *non-starters* among *Fresh registrants* (which is close to 40%). Similarly in any year, out of the 7 disciplines, Zoology has the highest prevalence of *non-starters* with $35\% < NS_F(k; ZOO) < 41.1\%$.

FCR, *AFCR* and $(AFCR - FCR)$ for all disciplines in the three years are shown in Figure 2. They form three groups of curves. As expected, in a given discipline $AFCR > FCR$. *FCR* within a discipline fluctuates from year to year. However, it is remarkably stable in Zoology which remains close to 32% over the three years. The gain in *FCR* by performing the course completion calculation using only the active students (to obtain *AFCR*) is shown as $(AFCR - FCR)$. The gain is more than 10% in each discipline in each year. At highest, it is close to 22% for Zoology and Physics in 2012. Overall faculty gain is about 15%. As such substantial improvement in course completion rates can be achieved by using *AFCR* in place of *FCR*.

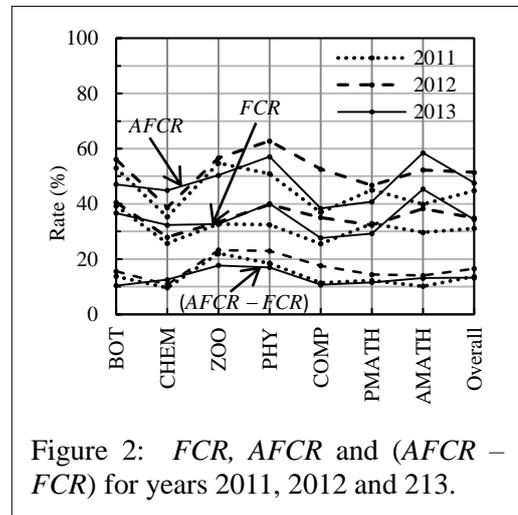


Figure 2: *FCR*, *AFCR* and $(AFCR - FCR)$ for years 2011, 2012 and 2013.

CONCLUSIONS/RECOMMENDATIONS

About 30% of the total set of registrants in discipline based courses in the B.Sc. programme at level 3 becomes *non-starters*. They have an adverse effect on the course completion rates. An overall improvement of about 15% in *Fresh-student completion rates* may be achieved by using only the *Active registrants* in evaluating the completion rate. At the same time it is desirable to study the underlying issues which make a large fraction of students *non-starters* and take remedial measures in minimizing early dropouts.

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EXPLORING THE INPUT OF OPEN DISTANCE LEARNING PROCESSING SYSTEM OF THE OPEN UNIVERSITY, SRI LANKA: DETECTING POSSIBLE INFLUENTIAL FACTORS FOR REGISTERING STUDENTS FOR THE B.SC DEGREE PROGRAMME

K. A. J. M. Kuruppuarachchi^{1*}, P. Dias², N. C. Kannangara³

¹ Department of Botany, ³ Centre for Educational Technology & Media,
The Open University of Sri Lanka, Nugegoda,

² Departments of Statistics, University of Sri Jayawardenepura, Nugegoda, Sri Lanka.

INTRODUCTION

A natural or an artificial processing system (PS) consists of input, process and output. Many factors which influence its components are interconnected and hence makes it a huge complexity. PS makes changes due to spatial and temporal variations. Where an education of PS is concerned the input is first time registered students and their diverse characteristics. The process will be the components of teaching learning process including diverse academic and management structures. Output is considered as the developing skills of students, knowledge and possible changes in their mind set and behavior.

Where the OUSL is concerned the input is comparatively diverse Viz. existing qualification of students, socio-economic factors, age, attitudes and needs, governing forces for education etc. (Jayatilaka *et al.*, 1997). The major components (teachers, students and academic and management structures) of a ODL, PS play comparatively different roles. But finally, the quality of output should be equal or higher than in conventional setups. Exploration and evaluation of the nature of input is very important for future application to make suitable changes in PS as well as making final best quality products efficiently with minimizing losses. Quantification of different factors which belong to different segments (Input, process and output) of PS is very important for sustainable management and prediction of ODL PS of OUSL. As an initiative step we evaluated the nature of input (first registrant) of ODL, PS of B.Sc. degree program adapted by OUSL.

Objective of the study

To identify student characteristics.

To find out possible influential factors for selection.

To explore the main purposes for registering as a B.Sc student at OUSL.

To find out the student's attitude on the standard of OUSL.

To explore the student's future hopes and target after completion.

METHODOLOGY

Surveying technique was adapted for with a piloted structured questionnaire to explore the source of information, attitude on OUSL, purpose of registering and characteristics of the 456 (approximately 35% of the population) B.Sc. undergraduates, OUSL who are first registered in 2013/2014. The questionnaire included 14 items to evaluate personal characteristics and other influential factors for selecting the OUSL (Kuruppuarachchi and Gunerathne, 2014). An open ended section to recognize student's future hopes and target after completion of the program was also included.

* Corresponding author: Email - kajmKuruppu@gmail.com

Statistical analyses:

Frequency tabulation and cross tabulation tests were performed for the answers of each item using the SPSS statistical package. Answers for the open ended component were quantified as Response Frequency percentages (AAPOR, 2000).

RESULTS AND DISCUSSION

Identification of the student characteristics.

Status of permanent residence of students was distributed as rural (31%), semi-urban (43.4%), and urban (24.8%). Their school education was different from highly popular school (36.4%), urban national school (38.4%), Semi-urban (15.9%) and rural school (8.3%) respectively. It indicates that most of students has “good school background” due to most of science G.C.E (A/L) discipline being mainly restricted to popular schools. Distance to OUSL from the student’s permanent residence showed that 0-49 km (39.6%), 50-99km (27.6%), 100-150km (16.4%), >150km(15.9%) respectively. It is clear that 67% are residing less than 99 km distance. Comparatively more face to face contact sessions were included into the science based disciplinary. It is convenient that a student may be able to travel to the university within less than 2 hours. A total monthly family income of the students represented as less than Rs. 15,000(21%), Rs. 16,000-30,000(47.5%), Rs.31, 000-45,000(16.7%), Rs.46, 000-60,000(8.1%) and more than Rs.60, 000 (0.2%) respectively. According to the Department of Census and Statistics, 2013, the monthly mean and median household income in year 2012 in Sri Lanka was as Rs.46, 207 and Rs.30, 400 respectively, which includes that urban (Rs.68, 336, Rs.41, 958), rural (Rs.42, 184, 28,921), estate sector (Rs.31,895, 25,668). It showed that a majority of students registered for B.Sc. degree are from the lowest income categories (68.5% below Rs.30, 000). Hence, the study group can be classified into lower middle class or as economically lowest categories. Economically poor students have a lack of confidence based on real or perceived weaknesses in preparation (Lee Warren, 2016). They are naturally come to university with a lower level of academic skills than their middle and upper class peers.

The highest educational level of father/mother or other family members of registrants are mostly (84%) below G.C.E. (A/L). It implies that most of them are middle class employees and they show more ambition on further education. Most of students are unmarried (92%) and employed (53%) below 27 years old (92%). Educational expenses are born by parents or a family member (60%) and self-finance (38%). Generally, low-income students struggle to survive the transition from home to college because their experiences and social class backgrounds often leave them confused about the middle-class cultural norms that are expressed in university life (Karen Collias, 2014). In addition, physically isolating nature of ODL teaching- learning process also create psychological distress, social exclusion, and academic anxiety for such adolescence groups. Kuruppuarachchi *et al.*, 2012 found out that, B. Sc. undergraduates of OUSL are comparatively psychologically distressed due to adjustment difficulties to the university life. So, the Faculty of Natural Sciences, OUSL has recently (2014) introduced ‘Peer- Assisted Study Sessions’ (PAAS) for first registering students with the help of existing and newly graduated OUSL students as young mentors (Bandarage *et al.*, 2015). But, it is recorded that poor students participation will affect the PASS programme. So, the university has a big role to play to guide students to adjust themselves to the new environment of the university. These findings are very important for decision makers to make future educational administrative decisions in the Faculty.

Possible influential factors for selection.

Table 1. Source of information about OUSL

Source of information	Number of responses	Percentage (%)
Former OUSL students	140	34.1
Other friends	72	17.6
News papers	68	16.6
School teachers and adults	60	14.6
OUSL web site	44	10.7
Television	26	6.3

Information on OUSL perceived by first registrants were represented in Table 01. Source of information for selection of OUSL are former OUSL students (34%), other friends (18%) and teachers/adults (15%) which contributed more than 66%. Result showed that personally or individually broadcasting of information on OUSL by human interactions is the most effective system. Results show that, providing of information by newspapers (16.4%) or the OUSL web site (11%) is more powerful than TV advertisements. So, the upgrade and development of the existing OUSL web site in a user friendly manner will have considerable impact on broadcasting information about OUSL in future.

Purpose for getting registered as a B.Sc. student at OUSL.

Table 2. Main purpose of registered as a B.Sc. student at OUSL.

Main purpose of getting registered	Number of Responses	Percentage (%)
Eager to study more	182	44.1
Future prospects of the current job	90	21.8
Adding a qualification to get a job	63	15.3
Easy to follow the degree due to part time nature	36	8.7
Easy payment scheme	28	6.8
No alternative after A/L	14	3.4

Table 02 indicates the inner needs of individuals to get an OUSL degree. It is mainly governed by “eager to study more” which contributed 44%, “future prospect of current job” 22%, “adding qualification for the purpose of finding employment” was provided 15%. “Easy payment schemes” or “part-time nature in ODL system” has become minor factors. Hence, academic structure of B.Sc. degree program should provide knowledge on “future education prospects in the field” in addition to job oriented course units. Cross tabulation results showed that unemployed students are more eager (52.6%) to learn when compared with their

counterparts (36.6%). It would be the fact that unemployed students have comparatively less other commitments, hence more attention on further education. Similarly students who get financial support from parents (48%) are registered as “eager to study more” compared to the self-financed group (38%). Students those who studied at popular schools (43%), Urban national schools (47.4%), Semi-urban national schools (36.9%), Rural Schools (50%) selected “eager to study more” as their option.

Student’s attitudes on the standard of OUSL.

Table 3. Students’ attitudes on standard of OUSL.

Student’s attitudes	Number of Responses	Percentage (%)
Equal to other state universities	326	81.1
Below the state universities	06	1.5
Above the state universities	20	5.0
Equal to private universities	14	3.5
Below private universities	03	0.7
Above the private universities	33	8.2

More than 88% of the students perceived that the standard of the OUSL is equal to that of other state universities (80%) or greater than that of private universities (8%). A positive impression on OUSL at the beginning would be a motivation factor for future success in educational achievements.

Students’ future hopes and targets after the completion of the programme.

The Perceived answers for open ended part on “*future hopes and target after completion of the program*” can be categorized as “*find a suitable employment*” included 38.19 frequency percentages. From this more than 50% frequencies prefer government jobs including teaching, employment related to chemistry or microbiology subject areas. “*Further development of career*” was provided 30.40%. For “*Further education and improvement of knowledge*” weight was given only 17.08%. Then, *lack of future hopes* (8.29%), *migrate to better country* (2.75%), *service to the country and the society* (2.51%), *getting better social recognition* (0.75%) were given comparatively lower preference. whether the student’s purpose for registration ranked as is “*Eager to study more*” (Table 03), the future hopes would be mainly on employment development strategies. Most of new registrants to the B.Sc. degree programme in 2012/13 is from low income categories. Naturally, such group of students need to fulfill their basic needs rather than thinking about “*service to the nation*” or higher order needs. Maslow's Hierarchy of Needs clearly highlighted that one must satisfy lower level basic needs before progressing on to meet higher level growth needs (Huitt, 2007). So, a majority of B.Sc. undergraduates would be hoping to find suitable employment as soon after completion of the degree programme. To facilitate the clients’ requirements, the curriculum of the B.Sc. degree should be given more applicable areas based on skill development, suited to accommodate the future job market while maintaining the dignity of subject areas of the science degree.

CONCLUSIONS/RECOMMENDATIONS

In conclusion, a majority of B.Sc. undergraduates represent the employed, late adolescent lower middle class. Therefore, policy makers of the faculty should consider such specific characters

of students when formulating future education strategies. Former OUSL students have become the most powerful media source for attracting students to OUSL. Hence, client based efficient individual counselling procedure is proposed to increase the future student numbers. More job oriented applied areas and strengthening of career guidance for the B.Sc. undergraduates are recommended to cater to future hopes of students.

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TOWARDS OPEN EDUCATIONAL PRACTICES WITH REFLECTIVE PRACTICE

S.P. Karunanayaka^{1}, S. Naidu², S. Kugamoorthy¹, T.D.T.L. Dhanapala¹, A. Ariyaratne¹,
L.R.Gonsalkorala¹, M.Rajini¹, W.M.S. Weerakoon¹, W.M.S. Wanasinghe¹, S.Karunanayake¹,
M.L. Sudarshana¹, N.M.R.K. Nawaratne¹, M.N.C. Fernando¹ and K. Gnaneratnam¹*

¹Faculty of Education, The Open University of Sri Lanka

²Monash University, Australia

INTRODUCTION

The Open Educational Resources (OER) movement has empowered teachers to become more innovative in their pedagogical practices, through the openness and flexibility in educational resource use permitted by open licensing of materials. The 5Rs of openness in OER - Retain, Reuse, Revise, Remix and Redistribute (Wiley, 2014), enable user engagement in innovative use of resources moving beyond mere 'access' to them, resulting in 'Open Educational Practices' (OEP) (Ehlers, 2011). Nevertheless, teachers' adoption of OER in such a manner will necessitate a 'change' in their pedagogical thinking and actions.

The Faculty of Education at the Open University of Sri Lanka is implementing a research project engaging student teachers of its Postgraduate Diploma in Education Programme to integrate OER in their teaching-learning process and studying its impact. The study is conducted at nine Centres of OUSL representing the nine provinces of the country. The study adopts a design-based research approach, which is a systematic and flexible methodology aimed at improving educational practices through iterative analysis, design, development, and implementation (Reeves, 2006). During an intervention programme designed and implemented in several stages, various aspects in relation to adoption of OER by teachers are examined through multiple strategies of data collection and analysis. Self-reflections of the participants is a key strategy adopted throughout the study to unfold the ideas, thoughts and feelings of the participants reflecting on their experiences during the intervention process. This paper focuses on investigating how and to what extent a designed reflective practice process can support enacting 'change' in teachers' pedagogical practices towards OEP.

Conceptual framework:

The significance of reflective practice in the teaching profession has been widely discussed and well-researched. While reflection is a form of mental processing that is used to fulfil a purpose, reflective learning emphasizes the intention to learn from current or prior experience (Moon, 2013). Through a reflective practice process the insights and learning gained through experiences can be used by the practitioners to continuously learn, grow and develop in and through practice. The notions of reflection-in-action, and reflection-on-action allows practitioners to engage in a process of continuous learning through critical reflection.

Among various models that have been presented to establish a structure for reflection, Rolfe, Freshwater, & Jasper (2001) provides a simple framework that adapted Borton's (1970) developmental model of reflective practice which composes three questions to the practitioner: *What, So what, and Now what?* This framework allows practitioners to analyze an experience by first describing a situation, then examine what has been learnt through the experience, and subsequently reflect on ways in which they can personally improve and the consequences of their actions. This framework guided designing the reflective practice process in the study and analyzing its effect on changing teachers' pedagogical practices. According to Rolfe et al. (2001) framework: 'What?' describes the situation; achievements,

* Corresponding author: Email - spkar@ou.ac.lk

consequences, responses, feelings, and problems; ‘So what?’ – discusses what has been learnt; learning about self, relationships, models, attitudes, cultures, actions, thoughts, understanding, and improvements; and ‘Now what?’ identifies what needs to be done in order to improve future outcomes, and develop learning.

METHODOLOGY

Research Design and Research Questions

The study adopted a naturalistic inquiry under the qualitative research approach. The key objective of the study was to investigate how and to what extent, a designed reflective practice process supported enacting change in teachers’ pedagogical practices towards OEP, during the intervention programme on integration of OER in the teaching-learning process. The following specific research questions guided the inquiry:

1. What are the changes that had occurred in pedagogical thinking and practices of teachers as revealed by their reflections?
2. How has the designed reflective practice process affected enacting change in teachers’ pedagogical practices towards OEP?

Participants

The participants constituted 85 student teachers from nine OUSL Centres – Anuradhapura, Badulla, Batticaloa, Colombo, Jaffna, Kandy, Kurunegala, Matara, Ratnapura, clustered in 22 small groups as indicated in Table 1:

Table 1. The participants

Centre	Anu.	Bad.	Bat.	Col.	Jaf.	Kan.	Kur.	Mat.	Rat.	Total
No. of Participants	06	02	24	04	23	11	04	06	05	85
No. of Groups	02	01	04	02	05	02	02	02	02	22

METHODS OF DATA COLLECTION AND ANALYSIS

The key method of data collection was via self-reflective narratives written by the participant groups, in the form of ‘stories’, during the evaluation workshops titled “Tell Us Your Story – Becoming Reflective Practitioners”, held at each Centre. Participants were provided with guidelines and a structure to write their narratives. They were requested to work in small groups, writing a story of their collaborative journey in “Integrating OER in teaching and Learning”, in any language they were comfortable with, reflecting on their perceptions and perspectives about OER, any changes in their thinking, teaching practices, and impacts on their teaching-learning process. To facilitate their reflective thinking and writing process, a template with some trigger questions was provided (see Table 2).

‘Narrative analysis’ of teachers’ stories was conducted using a ‘thematic analysis’, coding and categorizing various aspects of the accounts that were told (Reissman, 2008), discovering patterns and developing themes. These were then organized based on Rolfe et al. (2001) framework, providing a causal link among ideas that made sense. This process helped to ascertain the changes that had occurred, mainly in the pedagogical thinking and practices of teachers.

RESULTS AND DISCUSSION

The themes that emerged during the narrative analysis of 22 stories are presented in Table 2, according to the Rolfe et al. (2001) framework on reflective practice, with supportive quotes.

Table 2. Summary of data analysis on reflective practice

Frame work	Questions	Themes	Supportive Quotes (Examples)
“What”	What were your first impressions on OER?	Novel Concept	<i>First time we heard about OER...They are attractive, easy, low cost, and freely available resources...Vast amount of materials at a click...A ‘gold mine’...Helpful to improve access to learning opportunities.</i>
“What	What is the starting point of OER adoption?	OER Workshop	<i>We started to use OER as teaching materials after the first workshop ...Came to know about copyrights, CC licenses, 4Rs...Realized that downloading and using materials from the Internet without any regard to the ownership of those resources is a wrong practice.</i>
“So what”	How did you adopt/integrate OER? (What are the different ways?)	Teaching-learning activities	<i>Used different forms of OERs such as animations, diagrams, activities, video clips as teaching aids... Linked OERs at every step of lessons ...introduction of the concepts, engagement, elaboration, evaluation, making activity cards, question papers...etc.</i>
“What”	What are the challenges/frustrations you faced?	Challenges	<i>Spent lot of time to find and integrate OERs...Truly time consuming and a little tedious task in making sure about the relevance, standard, quality... Lack of computers and internet facilities at schools, technical issues...Most OER were available only in English.</i>
“So what”	How did you deal with these challenges?	Solutions	<i>Faced barriers with great enthusiasm...Got help from colleagues...Trained students to find and use OER... Used home computers...Translated OER to Tamil/Sinhala...Created our own OER.</i>
“What”	What were your achievements/successes?	Achievements	<i>Published a handbook on OER links for selected subjects... Conducted workshops at schools to raise awareness...Motivated peers to use OER... Made CDs with OER and distributed... Forming a student group of ‘self-learners’ who search and share OER.</i>
“So what”	What are your feelings about the successes?	Feelings	<i>Happy and satisfied... Felt we have offered a valuable contribution for the development of our education field...Happy to get appreciations of the school society...Happy to see the motivation of students.</i>
“Now what”	What did you learn during the process?	Insights	<i>Motivated self-learning of students as well as teachers... Reduced educational costs...Increased access to materials...Provided free sharing and collaborative opportunities... Productive... Enhanced the quality of education.</i>
“Now what”	What are any good practices?	Good practices	<i>Change and modify OER according to our purposes...Sharing knowledge, skills and resources with colleagues...Creating OER in our mother tongue.</i>
“Now what”	What are the impacts on the teaching and learning process	Impacts	<i>Integration of OER made our teaching interesting, challenging, creative, attractive...Increased students’ interest, active participation and motivation...Able to change from traditional teaching methods...Enhanced our teaching skills... Teach with more self-confidence... Enhanced sharing culture.</i>
“Now what”	What are your future plans?	Future plans	<i>Revise and remix available OER according to the requirements...Create and share OERs in Tamil/ Sinhala... Introduce OER as self-learning materials. ...Awareness raising activities...Promote OER use.</i>

The critical analysis of narratives revealed that a significant amount of changes had occurred in pedagogical thinking and practices of teachers. As evident by data presented in Table 2, exposure to the novel concept of OER has resulted not only in developing teachers' knowledge and skills in searching, identifying and integrating OER in their teaching-learning process, but also a range of new insights and good practices. The findings also denote that the designed reflective practice process has stimulated teachers to re-examine and think purposefully about shifts in their thinking and practices that had occurred during the process ('What' and 'So what'), and discuss about them meaningfully and plan for further improvements ('Now what'), moving towards a positive change. The trigger questions have supported teachers to engage in a deeper and meaningful reflective process and a more in-depth enquiry. The identification and description of the activities, analyzing and evaluating feelings and discussing about the effects of actions has guided them to consider implications leading to the formulation of action plans for the future.

For instance, through the awareness of OER, and having free and open access to a pool of varied resources with permission to reuse/revise/remix/redistribute without any legal issues has resulted in changing their thinking and practices from traditional methods of teaching and resource use, enhancing creativity, innovative thinking, as well as a sharing culture. Further, they are challenged, encouraged and motivated to engage in integration of OER in a more productive manner in their future activities. Such use, creation and management of OER via innovative pedagogical methods stress the notion of OEP (Ehlers, 2011).

CONCLUSION

Reflection and practice have nurtured each other in this context. Reflective practice, as an active process that happens in real time, dealing with real, complex situations (Moon, 2013), has assisted teachers to analytically examine between their thinking and practices during the process promoting a conceptual change in pedagogical thinking and pedagogical practices towards OEP. Hence, it was evident that the designed reflective practice process has affected enacting change in teachers' pedagogical practices towards OEP.

KEY WORDS

Open Educational Practices, Open Educational Resources, Reflective Practice, Pedagogical Thinking, Pedagogical Practices

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ACHIEVING LEXICAL THRESHOLD FOR SCIENCE UNDERGRADUATES LEARNING EAP IN THE ESL CONTEXT

F. S. Izzadeen*

English Language Teaching Unit, University of Peradeniya

INTRODUCTION

The increasing number of students reading for a degree in their second language (L2) has increased the focus on English for Academic purposes in the L2. Although vocabulary had been relegated to the back benches, a surge in vocabulary research has re-established the importance of vocabulary to achieving language competence (Laufer & Nation, 2011). As studies reveal that even at undergraduate level lack of vocabulary creates the most difficulty. This is an issue that needs to be addressed. While academics are in agreement of the need of a minimal coverage of 95 % for text comprehension (Laufer & Ravenhorst-Kalovski, 2010; Nation & Hu, 2000) there are differing views as to how this is best achieved. In the case of academic language the General Service List (GSL) created by West (1953) together with Coxhead's Academic Word List (AWL) (Coxhead, 2000) has been said to provide a coverage of around 90 %. However studies indicate that this does not hold true in the science based disciplines where the coverage by GSL and AWL has been shown to be much less (Nassaji & Vallipouri, 2013; Chen & Ge, 2007). It is also argued that the concept of an academic vocabulary common to all disciplines is not valid (Hyland & Tse, 2007) and attention needs to be paid to the academic vocabulary of each discipline or domain. In order to investigate this claim and also to investigate what vocabulary science undergraduates need to focus on in order to achieve the lexical threshold, a 252,400 word corpus of language encountered by science undergraduates in the discipline of Chemistry was compiled and analyzed. A list of Domain Specific Academic Words in Chemistry (DAWLIC) which would help in targeted EAP courses for science undergraduates was compiled from this corpus.

METHODOLOGY

Compilation of the corpus

Samples for the corpus were selected on the basis of being written academic language of different text types and communicative functions, which undergraduate students encounter in the discipline of Chemistry. Material used at the University of Peradeniya within a time frame of ten years was selected.

The corpus was compiled following principles in corpus design. Special attention was paid to the issues of sample size and type in order to avoid bias and achieve balance and representativeness.

Only part of the material was available in soft copy format. Therefore a majority of the material had to be transformed into a computer friendly format. This was achieved by two methods. Legibly printed material was scanned and converted to .txt format using optical recognition software. A large part of the material was typed via the keyboard. In both these methods material was proofread to ensure accuracy.

The material was divided into four sub-corpora according to the sub-disciplines in chemistry they were from.

Analysis of the corpus

The corpus was analyzed using the corpus analysis software RANGE which can be downloaded at <http://www.victoria.ac.nz/lals/staff/paul-nation/nation.aspx> . This software can be used to compare the vocabulary of up to 32 texts at a time. It gives information about the

*Corresponding author: Email - sherzana.i@gmail.com

frequency of words as well as how many of the texts being compared it occurs in. Using RANGE it is also possible to find out what words from the first and second thousand words in the GSL and Coxhead's AWL are present in a text or corpus being analyzed.

Creation of DAWLIC and the technical word list

In order to create a List of academic words specific to the domain of Chemistry, words belonging to the GSL and AWL were excluded by making use of the data from the analysis using RANGE. Words were selected for inclusion in DAWLIC on the criteria of at least 4 occurrences in the corpus and a minimum range of appearing in at least two of the sub-corpora. Abbreviations, proper nouns and chemical formulae were not included. Technical vocabulary was identified using a rating scale developed on the lines of Nation & Chung's (2003) work. A separate list was compiled of the technical vocabulary thus identified.

RESULTS AND DISCUSSION

Vocabulary coverage of corpus by different word lists

The coverage of the compiled corpus, by the GSL, AWL and other words which do not belong to either category, is presented in table 1. As seen in the table, the first and second thousand GSL words respectively account for 64.71 and 5.87 % of the vocabulary. Thus the total cover by the first 2,000 GSL words is 70.58 % of the tokens. In terms of types, the first and second 1000 GSL words together account for 17.41% and 8.31%. Although in terms of tokens the GSL covers 64.71 % of the corpus, this accounts for only 17.41% of different word types, indicating a small number of GSL words occur repeatedly in this corpus.

The AWL accounts for 9.13 % of the words in this corpus resulting in the AWL together with the GSL providing a coverage of 79.71 %, which accounts for a little less than four fifths of the total. The remaining 20.29 % of the corpus is made up of non- GSL/ AWL words. These include academic vocabulary specific to the domain, technical words, low frequency words and proper nouns.

Table 1. Coverage of corpus by different word lists

Word lists	Tokens	Percentage in COLC %	Types	Percentage in COLC %
1 st 1000 GSL	155206	64.71	2045	17.41
2 nd 1000 GSL	14075	5.87	976	8.31
AWL	21905	9.13	1262	10.74
Non GSL/AWL	48664	20.29	7463	63.54

Domain Specific Academic Word List in Chemistry (DAWLIC) and Technical word list compiled from the corpus

The academic words occurring in Chemistry which are not included in Coxhead's AWL were identified using the output from the analysis of the corpus using the software RANGE. A total of 559 words met the criteria for inclusion in DAWLIC. This accounts for 4.76 % lexical coverage.

191 words covering 1.62 % of the vocabulary were identified as technical words.

CONCLUSIONS AND RECOMMENDATIONS

In this study it was shown that the GSL and AWL together accounted for only 79.71 % of the vocabulary in a specialized corpus of language in science. This is consistent with the values obtained in other studies involving science corpora (Valipouri & Nassaji, 2013; Coxhead and Hirsch, 2007). Thus the findings of this study re-emphasize the need to take the academic vocabulary specific to the discipline into account in scientific domains if the lexical threshold is to be achieved. In this situation, the DAWLIC can make an important contribution to English courses catering specifically for science undergraduates.

It is recommended that the contexts of the words in DAWLIC should be examined and they should be taught maintaining the context as discipline specific words may take on different meanings when out of context. As some of the highly specialized meanings of the words in DAWLIC could cause difficulties for the language teacher a two pronged approach involving both language and content teacher would be advisable.

While technical words make a contribution to the vocabulary that cannot be ignored, this is generally considered beyond the purview of the language teacher. One approach to dealing with technical language is the use of subject specific glossaries. However, these are usually vast, covering the entire scope of the subject. This results in poor motivation on the part of the student to use glossaries. In contrast, the use of technical word lists compiled from a corpus has the advantage of giving the most frequent and necessary words only, enabling targeted learning. If the technical words are provided with the equivalent term in the first language the language teacher will be released from explaining scientific principles.

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INVESTIGATING THE RELATIONSHIP BETWEEN LEADERSHIP STYLES (LSs) AND DECISION MAKING STYLES (DMSs) WITH SPECIAL REFERENCE TO MANAGERS IN BLUE CHIP COMPANIES IN SRI LANKA

P. A. B. H. Amarathunga^{1*}, S. Pathiratne²

¹Department of Business Management, Wayamba University of Sri Lanka

²Faculty of Computing, ESOF Metro Campus

INTRODUCTION

Decision making is one of the key functions of a manager (Gardner, 1990). Making high quality management decisions is a fundamental feature in determining organizational performance. Hence, the effectiveness of any organization depends on the managerial approach to decision making (Kaur, 1993).

Primary purpose of the present research was examining the relationship between Leadership Styles (LSs) and Decision Making Styles (DMSs) with special reference to managers in Blue Chip Companies in Sri Lanka. As blue chip companies are the largest companies listed in the Colombo Stock Exchange, they are providing a pivotal contribution to the economy in numerous ways by generating employment opportunities, introducing newest technology to the country, and so on. The quality of the leaders'/ managers' decisions is a significant contributor in determining organizational performance. Accordingly, it is necessary to have suitable leaders for managing largest companies in the country rather than other business organizations. Both leadership style and decision making approach are expected to affect organizational performance (Russ et al., 1996). If an association between LSs and DMSs is identified, it will aid to forecast the DMS of a manager. Present research has been taken into account rational, dependent and avoidant DMSs by (Scott and Bruce 1995) and transformational, transactional and Laissez faire LSs by (Baas and Avolio 1995). Rational DMS refers to the "logical evaluation of alternatives", dependent DMS refers to "depending on advice from others before making important decisions" and avoidant DMS means that "avoiding to make decisions" (Salo and Allwood, 2011). Transformational leaders are encouraging followers to solve problems in their own way with providing interesting and challenging tasks (Pounder, 2003). Transactional leaders influence the followers to achieve their valued outcomes (e.g. wages, promotions) to motivate subordinates to perform as expected by the leader (Den Hartog *et al.*, 1997). Laissez faire leaders are not offering feedback or supporting to the followers, delaying decision makings, giving up responsibilities and avoiding decision making (Robbins *et al.*, 2007).

Objective of the Research

To identify the relationship between Leadership Styles (LSs) and Decision Making Styles (DMSs) with special reference to managers in Blue Chip Companies in Sri Lanka and providing findings to the other small and medium scale enterprises in the country.

METHODOLOGY

Sample

Fifty one managers of blue chip companies were selected as the sample of the present study through simple random sampling method. As blue chip companies are the largest companies listed in the Colombo Stock Exchange, blue chip companies were selected through the ranked list of well performing companies in the Colombo stock exchange. A total of 60 questionnaires were distributed and 51 valid responses collected.

* Corresponding author: Email - buddhini@wyb.ac.lk

Table 1. Demographic Profile of the Respondents

Features	Frequency	Percentage (%)
Age (in years) 28 to 35	11	22%
36 to 42	22	43%
43 and above	18	35%
Total	51	100%
Levels Lower	9	18%
Middle	24	47%
Top level	18	35%
Total	51	100%
Experience 5-10 years	9	18%
11-20 years	23	45%
21 and above	19	37%
Total	51	100%

Data Collection Methods

Two standardized questionnaires were selected for data collection. Multifactor Leadership Questionnaire (MLQ) developed by Bass and Avolio (1995) was used to measure LSs. MLQ consisting with 36 items to be measured on a five point scale from 1 to 5. The reliability analysis revealed Cronobach's Alpha value is ranging between 0.70 to 0.82 for all the three styles of the present study. General Decision Making Style (GDMS) Questionnaire developed by Scott and Bruce (1995) was used to measure DMSs. GDMS questionnaire measures DMSs consisting with twenty five items using five points lickert scale from 1 to 5. The Cronobach's alpha value was between 0.69 and 0.79 for all the DMSs on the study sample of present study.

Data Analysis Methods

Research data were analyzed through descriptive statistics (mean, standard deviation) and Spearman's correlation analysis in order to estimate the relationship between LSs and DMSs using SPSS version 21.

Correlation coefficient of the present study has been interpreted based on the interpretation of correlation coefficient made by Vaus (2002) as, if correlation coefficient from 0.01 to 0.09 relationship is trivial, from 0.10 to 0.29 low to moderate, from 0.30 to 0.49 moderate to substantial, from 0.50 to 0.69 substantial to strong, from 0.70 to 0.90 very strong and from 0.90 to 0.99 there is a near perfect relationship.

Hypotheses of the Research

Hypothesis 01: Rational DMS positively correlated with Transformational LS

Hypothesis 02: Dependent DMS positively correlated with Transactional LS

Hypothesis 03: Avoidant DMS positively correlated with Laissez-faire LS

RESULTS AND DISCUSSION

Table 2. Correlation coefficients, Means and Standard Deviations

Variables	R	D	A	TFM	TSL	LF	Mean	SD
R	1						23.44	2.1
D	0.121	1					15.38	3.8
A	0.102	0.107	1				10.13	3.9
TFM	0.587**	0.157	0.034	1			77.56	6.9
TSL	0.334*	0.498*	0.102	0.629**	1		43.42	4.3
LF	-0.134	0.197	0.516**	0.011	0.137	1	8.13	2.7

R- Rational, D- Dependent, A- Avoidant, TFM- Transformational, TSL- Transactional, LF- Laissez-faire, * $p < 0.05$, ** $p < 0.01$

Hypothesis 01: Rational DMS positively correlated with Transformational LS

Rational DMS and Transformational LS were found substantially positively correlated to each other as the correlation coefficient is 0.587 at 0.01 level of significance. Accordingly, it is revealed that leaders who have transformational leadership style substantially using rational decision making style.

Hypothesis 02: Dependent DMS positively correlated with Transactional LS

Dependent DMS and Transactional LS were found moderately positively correlated to each other as the correlation coefficient is 0.489 at 0.05 level of significance. Hence, it is shown that leaders who have transactional leadership style slightly using dependent decision making style.

Hypothesis 03: Avoidant DMS positively correlated with Laissez-faire LS

Avoidant DMS and Laissez-faire LS were found substantially positively correlated to each other as the correlation coefficient is 0.516 at 0.01 level of significance. Consequently, it is revealed that leaders who have laissez faire leadership style substantially using avoidant decision making style.

CONCLUSIONS/RECOMMENDATIONS

Based on the findings the association between LSs and DMSs can be summarized as follow,

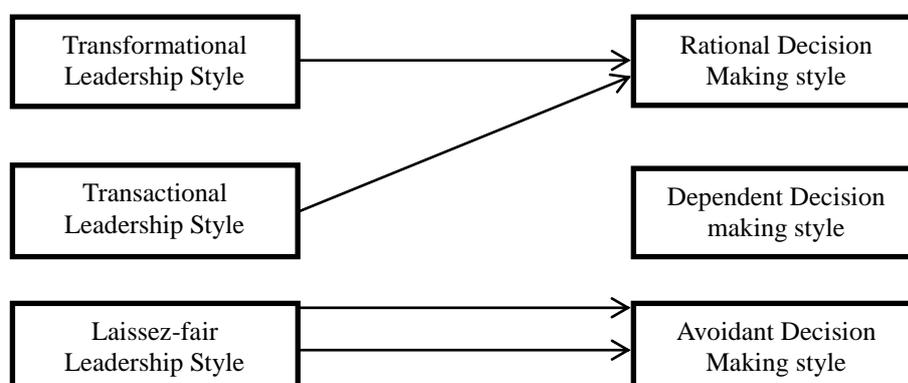


Figure 1. Association between LSs and DMSs

Transformational leaders have rational decision making style. Transactional leaders are mostly having dependent decision making style but they are using rational decision making style as well because there is a moderate positive relationship between transactional LS and rational DMS as the correlation coefficient is 0.334 at 0.05 level of significance. Scott and Bruce (1995) also mentioned that the DMS are not mutually exclusive. Hence it is possible that managers may adopt more than one DMS simultaneously. Accordingly, a certain style may dominate and decision making behavior of a person, but it may be accompanied by other styles. There was a significant association between Laissez-fair LS and avoidant DMS which is categorized as association with delays, denial and poor performance. Accordingly, as Laissez-fair leaders are avoiders and they rescue the decision making tasks, top management should organize necessary training sessions and workshops in order to improve the decision making skills of Laissez-fair leaders.

Findings of the present research might contribute substantially to forecast the decision making styles of managers because an effective decision making is one of the vital and necessary function of high quality leadership. It can be suggested for further researchers investigating the association between demographical factors and decision making styles of managers because there could be other variables which are determining leadership styles and decision making styles of managers.

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**“THE BOY IS FINISHED, CAN’T WALK, CAN’T TALK, WON’T LIVE”:
CAN DISABLED NARRATORS IN SRI LANKAN LITERATURE BECOME
ABLED SPOKESPERSONS FOR POST WAR ISSUES OF SRI LANKA ?”**

*N. V. Munasinghe**

Department of Language Studies, The Open University of Sri Lanka

INTRODUCTION

Disability or a disabled narrator is a common theme in literary narratives. Salman Rushdie in his controversial novel, *The Moor’s Last Sigh*, transforms a narrator with a disability into an active agent of social mobility. In his globally famed novel touching on Indian independence, *The Midnight’s Children*, his main protagonist’s faint disability or ability, depending on reader perception becomes an instrument by which he represents and articulates the affairs of the nation. Thus, it would not be inaccurate to declare that disability and the nation are bonded, at least in textual enterprises of globally famed authors. Sri Lankan English literature too has its own disabled narrators with at least two award winning authors experimenting with such narrators to achieve their own ends. Both the narrators in Elmo Jayawardena’s *Sam’s Story* and Lal Medawattegedara’s *Playing Pillow Politics at MGK*, are males with disabilities. Sam, in Jayawardena’s novel is seemingly ‘mentally retarded’ in addition to a speech disorder and a learning disability which impede his book learning. Deshan, who narrates Medawattegedara’s novel, is physically incapacitated as a result of a birth defect—unlike Sam, he is nothing more than a wheel chair bound ‘vegetable.’ However, these biological shortcomings which should hinder their functioning as ‘normal’ citizens of society rather help them to be sensitive, observant and archival individuals when it comes to post-war issues in Sri Lanka. In fact it could be confidently said that they surpass their able counterparts in this aspect. How do these narrators aid post-war Sri Lanka through their sensitivities? How do they overcome their lacks to undertake this task? And thereby, can disability be transcended—or transformed into positive aspect in one’s life? Through a close reading and a parallel comparison of the two narrators this study wishes to answer those questions.

Literature Review

While there is a dearth of scholarship on Sri Lankan English writing per se, there have been no focused attention paid to the disabled narrators in the novels selected for discussion in this paper. However, both the novels *Sam’s Story* and *Playing Pillow Politics at MGK* have attracted scholarly attention on different areas of interest. The scope of the present work, which is to bring the two narrators of the two mentioned novel into a comparative analysis has not been attempted as far as this writer is aware.

Methodology

This paper will attempt an ‘against the grain’ reading of the two novels, where a dominant reading of a text would be followed by an alternative or ‘resistant’ reading, where I would scrutinize the beliefs and attitudes that typically go unexamined in a text, drawing attention to the gaps, silences and contradictions.

* Corresponding author: Email - nadikamunasinghe@yahoo.com

RESULTS AND DISCUSSIONS

Sam's story

In Jayawardena's *Sam's Story*, the protagonist Sam's mental condition, the cause of his learning impediments and speech disorder, allows him to have a child-like perspective on the happenings of his time/space dimension. As such, his narrative of war-torn Sri Lanka is not inhibited by discourses that surround him—he narrates things and happenings as he experiences them. For example, take his utterance: “You see, my master was also a driver like Harrison. He didn't drive cars but big aeroplanes in the sky.” (Jayawardena 2001, p.31) Here, his so called mental retardation enables him to give due value to labor, regardless of the social position of the one who provides the service. Thus, his so called ‘mental disability’ makes him sensitive--his disability is an ability in reality. He transcends his disability by making it a positive aspect of his life. As his learning disability, which impedes his book learning, also empowers him in other ways: he is more employable than his so called skilled counterparts who have completed their secondary education as Sam is willing to undertake any task. This is clear in the utterance: “After all the years these three had spent in school learning many things, they were no better than the rest of us in the village. Loku just wrote letters and got empty replies.” (Jayawardena 2001, p.63) This statement is poignant as Sam's wry sense of humour which is engendered by his mental condition highlights the issues of the education system of war torn Sri Lanka--it depicts that it fails to address pressing social issues of rural Sri Lanka, which is to alleviate poverty through creating jobs that match qualifications. Thereby, Sam who is more skilled than his so called ‘normal’ counterparts is also the bread winner of the family. This makes him mentally empowered. This is complemented by the quote: “I didn't need the money. I knew it would make my mother happy to get some money. She could eat with it and do other things, as she always wanted to do. Since my brothers had gone to become soldiers there was only Loku, Podi, and my mother and our chickens. They could all eat well with my money.” (Jayawardena 2001, p.105 & 106) Here, Sam's simplistic outlook towards life which is brought on by his medical condition, allows him to be mentally empowered, as it enables him to give an accurate but sensitive portrayal of the issues faced by the economically deprived rural community of Sri Lanka. Therefore, here too, Sam manages to use his sensitivity to transcend his disability into a positive aspect of his life by being mentally empowered. Sam's honest and loving concern for the welfare of his family reiterates this as he is a far more efficient provider for his family, than the ‘capable’ politicians who only provide platforms of empty promises of better prospects to the poor during elections. Thus, Sam's ‘disability’ is an ability as it secures better prospects for his family, as the sensitivity that is engendered through Sam's ‘disability’ makes him more ‘able-d’ than his counterparts. Thus, he has transcended his disability by making it a positive aspect of his life. At the same time, when war-torn Sri Lanka looked up to ‘masculine’ role models who could demonstrate valor in the battle field and mental versatility off the field, we have a male who is challenged in both those aspects in Sam. In other words, as far as war-torn Sri Lanka is concerned Sam is a non-masculine-entity, a condition which he transcends in his immediate sphere of control where he is the multi-skilled breadwinner, a typical gender-specific role reserved for males. Thus in war-torn Sri Lanka, away from the dangerous battle fields in unknown spaces in the North and the East, Sam is what I would call a ‘hometown hero’ -- male who fights his own individual battle with a society considers him ‘abnormal.’ In that sense, Sam is symbolic of the oppressed and voiceless people of Sri Lanka—and perhaps the world.

Playing pillow politics at MGK

In Medawattegedara's *Playing Pillow Politics at MGK*, the narrator Deshan who is also marginalized by doctors as a mere ‘vegetable,’ proves that he is anything but so, by highlighting the issues of post war Sri Lanka with sensitivity. Here William Hay's perception of deformity being an advantage is true in Deshan's case as well. Hay says that, “the more a

man is inactive in his person, the more his mind will be at work: and the time which others spend in action, he will pass in study and contemplation: by these he may acquire wisdom and by wisdom fame.” (Hay 1754, p.69) Here, Hay’s description of a physically deformed person’s mind appropriately describes Deshan’s mental strength, as he comprehends things like an adult as a result of his psychic powers. Thus, it is clear that Deshan transcends his ‘disability’ when his physically inactive body facilitates the development of his ability to read people’s minds, as his ‘disability’ gives him ample time to enhance his intellectual capacity. This makes Deshan capable, as he is more mentally empowered than the rest of the squatter community, as he has transformed his ‘disability’ into a positive aspect of his life. Deshan’s perceived disability frees him from identity crisis that plagues the other shanty dwellers of Maha Geeni Kanda, as they attempt to come to terms their social outcaste status. His uninhibited display of love between Deshan and Tandoori nanda in the luxurious boutique hotel Cassia Palace is one instance, which contrasts with Vicoria mali’s behavior of being reluctant to be seen in public with people of his own class. Thus, like Sam, Deshan too has transcended his disability by making it a positive aspect of his life. More importantly, he only uses his psychic powers to help people to protect themselves. An example of this is: “I used my horror howl to warn people who had inner conflicts.” (Medawattegedara, 2013, p.70) Thus, as he does not use his psychic powers for the benefit of those in power, instead he helps the underdogs. This is complemented by the fact that like Sam, Deshan too is aware of what ails post-war Sri Lanka, when he identifies that those in power suppresses the minorities in the guise of piety. Deshan says with the confidence of a mature politically-savvy adult that: “Sujata Meniyo was yet to realize the subtle ways with which businessmen manipulated their wives and religion to promote their own interests.” (Medawattegedara, 2013, p.179). Furthermore, Deshan is also a conscientious narrator as he makes a deliberate decision not to reveal the passionate lesbian relationship between SujathaManiyo and Ramani Nangi. This act is significant as it depicts that Deshan is aware of the legal system and social norms of Sri Lanka which are prejudiced against same sex relationships. As this too is a sign of sensitivity which is facilitated by his disability, here, too he transcends it by making it a positive aspect of his life by his mental empowerment. He is mentally empowered as does not suppress people by suppressing their sexuality. Moreover, similar to Sam Deshan too, was the cornerstone that enabled his family to gain better prospects: his medical condition which brought severe financial constraints on his family compelled his parents to seek greener pastures in the desert. Deshan, like Sam, symbolizes ‘disabled’ narrators of Sri Lanka/the world whose stories are seldom heard or told. Deshan’s ‘difference’ makes him a non-entity in a time/dimension saturated by Bollywood heroes, dashing and handsome rugby players and men who wore crew-cuts. Yet, Deshan outperforms all of them by being the sole –and therefore ‘sacred’ – narrator of the tragedy of people and the mountain called Maha Geeni Kanda which is invaded by a western business interests. At the same time, Deshan, who enters the novel as a boy whose death is imminent, outsmarts death and survives the vicious purge of Maha Geeni Kanda with the help of intransigent Tandoori Nanda and a most unlikely ally—the government of Saudi Arabia.

CONCLUSION / RECOMENDATIONS

In conclusion, it is clear that both Sam and Deshan are powerful symbols with which the authors attempt to communicate the potential power of the oppressed—no matter what label society places on them. Oppression, which is encapsulated in disability in the novels, is transformed in to sites of counter resistance by the two narrators as they take on forces which are bigger than them. Interestingly, they do not meet those forces head-on, rather they meet them in the most unlikely sites—in the human psyche. Thus, both narrators and the novels offer us an ironic suggestion: wh is actually ‘disabled’ – us or them?

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CUSTOMER ORIENTATION AND GENDER

N. Abeyssekera^{1} and D. Samarasinghe²*

¹*Department of Management Studies, Open University of Sri Lanka*

²*Department of Management Technology, University of Moratuwa*

INTRODUCTION

Salespeople who are customer-oriented take action aimed at increasing long-term customer satisfaction and avoid behaviors that may lead to customer dissatisfaction. They avoid actions that increase the probability of an immediate sale at the expense of sacrificing customer interests (Saxe and Weitz 1982). They suggested that selling behaviors of salesperson fall somewhere between high customer orientation (i.e., customer-oriented selling) and low customer orientation (i.e., selling orientation). Salespeople who are highly customer-oriented have high concern for others and themselves, whereas salespeople with low customer orientation show low concern for others and high concern for themselves. The study of Saxe and Weitz (1982) highlights the fact that long term satisfaction of the customer can be considered an important factor in customer orientation of salespeople. Customer-oriented selling is a viable option for organizations seeking to improve long-term customer relationships. By definition, customer-oriented selling is the use of the marketing concept within the salesperson-customer relationship. This implementation is designed to enhance the customer satisfaction attributable individually to salespeople and overall to sales departments (Saxe and Weitz 1982). Further Thurau and Thurau (2003) have argued that customer orientation as a core element of the marketing concept and is especially crucial to the concept of Relationship Marketing. They claimed customer orientation as a main condition for the better relationship marketing.

Sigauw and Honeycutt (1995) study highlighted the significant difference between the level of customer orientation of male and female sales representatives. Accordingly, Saleswomen reported to engage in a significantly higher level of customer-oriented selling than men. In Sri Lankan context the customer orientation with gender perspective has been not discussed in terms of services sector and this study is investigating customer orientation of gender in Sri Lankan banking sector.

METHODOLOGY

As the sample, two state banks and four major private banks were selected. The reason for selecting two state banks was due to their contribution to the banking sector in Sri Lanka. The Bank of Ceylon (BoC) has a stable capital base of over Rs. 24 billion with a 14.9 percent Capital Adequacy Ratio and asset base of Rs. 611 billion which is the largest in the Sri Lankan banking system (Ministry of Finance and Planning, 2010). Interestingly the other state bank, People's Bank is the second-largest Licensed Commercial Bank (LCB) in Sri Lanka, accounting for 18.44% of the industry's assets as at end December 2010 (RAM ratings, 2011). Four major private banks were selected to make the sample representative and also because of the growing competition in the sector. Furthermore, according to special report on Fitch Rating (2011) the six largest local LCBs identified as being systemically important – Bank of Ceylon (BOC), People's Bank (PB), Commercial Bank of Ceylon Plc

* Corresponding author: Email - nabey@ou.ac.lk

(CB), Hatton National Bank Plc (HNB), Sampath Bank Plc (SAMB) and Seylan Bank Plc (SEYB) – accounted for 64% of sector assets, 74% of sector loans and 68% of sector deposits at end 2010. It is important to understand the regional distribution of LCBs as well. According to Central Bank (2011) out of 1700 branches of commercial banks operated, 746 branches operated in the Western Province (44%). And out of 746 branches, 294 branches represented by two state banks (39%). In the Western Province, Colombo has many branches 475 (64%) followed by Gampaha 176 (24%) and Kaluthara 95 (12%). Hence, the stratified random sample method has been adopted in the study. A stratified random sampling technique could thus claim to be more representative of the population than a survey of simple random sampling or systematic sampling. The branch of the bank was considered as unit of analysis in this study.

From these eight banks, a random sample of 200 respondents was and Questionnaires have been administered with the help of research assistants. But only 130 Customer Relationship Officers (CROs) were selected due to incompleteness of some questionnaires (See Table 1).

Table 1. Selected Sample Profile

Western province	CRO
Colombo (62%)	81
Gampaha (23%)	30
Kalutara (15%)	19

Source: Researcher's construction

Definition of Concepts and Operationalization

Customer orientation of salespeople refers to the degree to which salespeople practice the marketing concept by trying to help their customers make purchase decisions that will satisfy customer needs (Saxe and Weitz, 1982). Modified SOCO (Selling Orientation-Customer Orientation) scale of Thomas et al (2001) has used to operationalize the Customer Orientation among salesperson .

Table 2. Operationalization of Selling Orientation and Customer Orientation

Concept	Variable	Indicators
Selling Orientation and Customer Orientation (SOCO)	Customer Orientation	1) Try to figure out what customer needs are 2) A good employee has to have the customer's best interest in mind. 3) Try to bring a customer with a problem together with a product/service that helps solve that problem 4) Offer the product/service that is best suited to the customer's problem 5) Try to find out what kind of products/services will be most helpful to a customer
		1) Try to sell as much as I can rather than to satisfy a customer 2) It is necessary to stretch the truth in describing a product to a customer 3) Try to sell a customer all can convince them to buy, even if think it is more than a wise customer would buy

		4) Paint too rosy a picture of my product/service to make them sound as good as possible
		5) Decide what product/service to offer on the basis of what can convince customers to accept, not on the basis of what will satisfy them in the long run

Source : Author constructed from Literature

RESULTS AND DISCUSSION

According to Table one (below) it can be observed that there is significant difference of customer orientation and gender in the banking context can be observed as well. An independent sample T-test was performed to measure the level of significance. Hence it can be argued that the more female salespeople are customer oriented than their male counterparts.

Table 3.

Male		Female		Independent Sample T-Test and P Value
Mean	Std. Dev.*	Mean	Std. Dev.*	
3.93	0.422	3.61	0.530	-9.980**(0.000)

Std. Dev.* - Standard deviation

**significance at 0.05 level

Source: Survey Data

Table 1. Customer orientation and gender

CONCLUSION

There is a significant difference observed between customer orientation and gender in the banking context. The customer orientation was tested by using two variables of selling orientation and customer orientation. It was found that female salespeople are more customer orientated than male salespeople. This also can be supported by the literature as Jolson and Comer (1992) suggested the expressive or feminine traits for which women are more renowned which contributed the most towards saleswomen's effectiveness "in retaining customers and performing non-selling activities". Furthermore, Sigauw and Honeycutt (1995) study highlighted the significant difference between the level of customer orientation of male and female sales representatives. Accordingly, Saleswomen reported to engage in a significantly higher level of customer-oriented selling than men. This has supported by Berrio and Henderson (1998) as that study concluded that "females had a higher customer orientation than males". Franke and Park (2006) highlighted that the role of saleswomen is higher in customer orientation than men in their study as well. Thus, it can be confirmed that females are similarly more customer orientated in the context of banking sector in Sri Lanka as well.

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QUALITATIVE APPROACH FOR EVALUATING THE EFFECTIVENESS OF STRATEGIC DECISIONS: A CASE STUDY OF NATIONAL FILM CORPORATION FOR FILM DISTRIBUTION IN SRI LANKA

J. Nanayakkara^{1} and M. W. A. P. Jayatilaka¹*

¹*Department of Agriculture Extension, Postgraduate Institute of Agriculture, University of Peradeniya*

INTRODUCTION

The National Film Corporation (NFC) was established by the Parliament Act No: 47 of 1971. The NFC was made the sole distributor of films in Sri Lanka. But early in 2001 as stipulated by the national film policy and guidelines provided by the Government Treasury Department, the NFC allocated film distribution to the private sector. Accordingly four private film distributors were recognized. The NFC made a strategic decision to have its own distribution unit named Rithma Enterprise and also remained as the regulatory body for film distribution. The NFC holds responsibility for strategic decisions for the betterment of the film industry. The NFC has controlled private film distributors with regulatory and decision making power, making strategic decisions. Films are major entertainment products, used in the creative economy (Bakker, 2008). The NFC could enhance the competitiveness of business opportunities to the film industry to strengthen the creative economy from Sri Lankan films. This study is to evaluate the strategic decisions for film distribution in Sri Lanka for the period 2002 to 2012. The research question explores, “Have the NFC’s strategic decisions ensured competitive advantage for key players?” The objective is to determine the effectiveness of the NFC’s strategic decisions for film distribution from 2002 to 2012. The NFC must have appropriateness of its strategic decisions for film distribution as the regulatory body of the film industry. The study approach is qualitative, based on responses from the relevant authority personals of the film industry. Besides, the study effort is based on tacit knowledge of qualitative facts. Key players of the film industry are film producers, distributors and exhibitors. Their experiences and perceptions were used in this study to make useful recommendations for the NFC.

METHODOLOGY

This is a case study adopting a Grounded theory approach to develop explanations. Grounded theory refers to a set of systematic inductive methods for conducting qualitative research aimed toward theory development (Charmaz, 2009). Qualitative in-depth interviews were carried out with officials of the NFC, film producers, distributors and exhibitors. The face to face interviews were undertaken. Some of the exhibitors in rural areas were interviewed using the telephone mode. The duration of the interviews varied between 30 to 90 minutes. The interviews were recorded with the consent of the interviewee. Total 50 respondents granted time for the in-depth interviews, face to face as well as via phone and summarized in Table 1.

Table 1. Sample of respondents who provided qualitative facts at the in-depth interviews

Category of Interviewee	Representation of Sample size	
The NFC Officials	7	Top, Middle, Operational Level of the staff
Film producers	10	Art House, Commercial, Blockbuster
Distributors	17	Top, Middle, Operational Level of the staff
Exhibitors	10	9 provinces and addition 1 from Western province
Industry Experts	6	First/Former NFC chairman, Well-versed actors

* Corresponding author: Email - janan@ou.ac.lk

Besides the interviews, documents were used to supplement the evidence. The main documents used were official circulars, legislation acts, organizational documents from film distributors, regulations and guideline documents of the NFC. Then the interview transcripts were analyzed manually for contents in the interview guide using thematic analysis. Based on the grounded theory approach, qualitative hypotheses were induced from the research and continued to analyze concepts and insights of the key players.

The main research question explored is;

Have the NFC's strategic decisions enabled to ensure competitive advantages for key players? The objective is to determine the effectiveness of the NFC's strategic decisions. To meet the effectiveness, the NFC's strategic decisions should provide competitive environment for key players. With respect to the objective of the study and insight of the NFC, hypothesis 1(H₁) was developed.

H₁: The NFC's Strategic decisions have enabled to ensure competitive advantage for key players

The null hypothesis was developed based on "Key players" perspectives, and it is;

H₀₁: The NFC's Strategic decisions have not enabled to ensure competitive advantage for key players

RESULTS AND DISCUSSION

The NFC has played a dual role as a governance body and the distribution circuit at the same context. There are conflicts with strategic decisions made by the NFC. To perform this analysis and evaluation, hypothesis 1 is utilized. Question: Have the NFC's strategic decisions ensured competitive advantage for key players? Two key conflicts, having negative effects on the industry emerged as foci during the discussions and they are as follows;

I. The NFC's strategic decisions vs. key players

Many leading film producers do not agree with recent decision to limit copies of films to 35. The NFC has used the regulatory power to limit film distribution as a solution to the deficiency of exhibition halls in the island. As a result, blockbuster films faced restrictions of film copies during 2011-2013. Film producers and distributors took their grievance to court. Case 1: Film, *Sri Siddhartha Gotham Vs NFC* (2013), Case 2: Film, *Sri Parakum Vs NFC* (2014) can be considered as practical implications. "The root cause of the conflicts is the strategic decisions made on privatization" foremost chairman (NFC) highlighted. "Before privatization, the NFC had a mechanism to prioritize films and the lineup of film distribution as per film genre", Assistant General Manager (AGM, NFC) explained. There were five distribution circuits under the NFC monopoly, which distributed different genres of films prior to privatization. The foremost mistake was the transferring of five distribution circuits under the NFC to private distributors and allocated cinema halls to them to make distribution circuits. Reduction of cinema halls were evident in 2001, the NFC could decide to privatize two or three distribution circuits. Most of the key players expressed that the NFC's governance had made strategic decisions based on personal interests.

II. The NFC's business operational strategies vs. key players

Making a remarkable change in the film industry during the first ten years after privatization remained a major challenge. Most of the film producers believe that profits are the primary motive of the film industry. Key players are facing difficulty to maintain the film distribution as a business at the operational level. Having identified the two major conflicts, the four main strategies of the NFC were examined. They are; a) Pricing strategy, b) Profit sharing strategy, c) Merging practice and d) Film removal strategy.

a) Pricing strategy

The key determinant of revenue in film industry is the pricing strategy. As explained by former Manager (MPI, NFC), he introduced the ‘pricing strategy’ to the NFC in 1981. Most of the leading film producers argued that, the pricing strategy had no meaningful benefits to the key players after privatization. The reason is the ticket price. It grows with inflation as per the ‘pricing strategy’. Film distributors/exhibitors justify their need and request to enhance ticket price in exhibition halls. If film distributor requests to enhance ticket price, the NFC has to provide written permission to distributor to enhance ticket prices. When ticket price is high cinemagoers have difficulty to watch films. Most of the key players highlighted the argument and explained in Table 2.

$$\text{Film exhibition hire} = \text{Ticket price} - (\text{Levy} + \text{Entertainment Tax share})$$

Table 2. Example of comparing ticket price for NFC’s Pricing strategy

1977 ticket price of Rs.8.00	2010 ticket price of Rs.600.00
Ticket price: Rs. 8.00/=	Ticket price: Rs. 600.00/=
First share: The NFC Levy Rs.6.50/=	First share: The NFC Levy Rs.6.50/=
Ticket price–Levy =Rs(8.00-6.50) = Rs.1.50	Ticket price – Levy = Rs (600.00-6.50) =
Second share: Entertainment Tax ratio: 7.5%	Rs.593.50/=
(Rs.1.50x7.5) /107.5= Rs.0.10/=	Second share: Entertainment Tax ratio: 7.5%
= Rs 8.00- (6.50 +0.1)	(Rs.593.50x7.5) /107.5= Rs.41.41/=
Film exhibition hire = Rs.1.40/=	= Rs.600.00- (6.50 +41.41)
	Film exhibition hire = Rs.552.09/=

However, former Manger (MPI, NFC) concluded that ‘pricing strategy’ should be streamlined after privatization. The strategy provided is tactless for key players. The ‘Levy’ is counted at first, from the ticket price. Then the entertainment tax ratio is exempted from the ticket price. The last share is film exhibition hire, which is used for profit sharing for key players.

b) Profit sharing strategy

Profit sharing strategy is the share of revenue, from film exhibition hire (Circular Act GM/GEN/01, 2002). However, profit share comes after tax and levy collection by the government. Both exhibitor and producer directly pay taxes to the government upon publicity/promotions through municipal councils. The ratio of the publicity campaign tax varies from (10-15) % depending on the divisional secretaries. Most of the key players have to pay direct and indirect taxes in the film distribution process. It creates dissatisfaction with the profit sharing strategy. Distributors take (5-10) % of the ‘profit share’ without committing to the tax involved in promotional campaigns. As a result, some of the producers and exhibitors have decided to leave the film industry. Leading film producers and exhibitors shared their experiences and views. Film producers expect more than 45% from the profit share. They maintain the argument to expect (45-50) % for satisfying their investment. All the produces agreed and pointed that distributor’s share could be reduced as distributors had no taxes for promotional activities.

c) Merging practice

AGM (NFC) expressed that the NFC wanted a temporary solution to the lack of exhibition halls in the island. Thus, the NFC did not regulate ‘merging practice’ in film distribution process. The NFC expects to satisfy the key players to generate more film exhibition revenue. As a result, AGM (NFC) agrees that ‘merging practice’ is used by all the distributors. Sometimes, they use it as a competitive strategy to gain competitive advantage. For example, the box office revenue generated film ‘Kusapaba’ (2012) was exhibited via EAP, hiring other exhibition halls from LFD, MPI distribution circuits. Some distributors use ‘merging’ as a ‘collaboration strategy’ to gain competitive advantage in the film industry. For instance, the

NFC exhibited 'Vijaya Kuvani' (2012) hiring other exhibition halls from LFD, MPI and CEL distribution circuits. Therefore, they should make sure that 'merging practice' provides win-win situation to all the key players in the agreement. Distributors should have mutual understanding of agreement on profit sharing to avoid conflicts with exhibitors. Most of the film exhibitors shared their views. However, Chief Executive Officer (CEO) of EAP, CEO of LFD and Manger of Rithma (NFC) agree that their prime objective is to facilitate cinemagoers, providing the expected level of coverage of film exhibition requested by the producer. Conflicts are created among exhibitors to merge with preferred distributors for popular films. No exhibitor can decide on the film or distribution circuits. These conflicts are created due to desire to achieve expected revenue. All the key players interviewed, expressed "merging practice is an attempt we use to survive in the film industry."

d) Film removal strategy

The major victim is the producer due to the "Film removal strategy" (Circular Act OD/GEN/187, 1997), where the NFC stipulates a minimum 25% seating capacity to continue screening films. If not, the films are withdrawn. "The film removal strategy has not been adjusted for today's needs of film distribution", most of the key players revealed. Most producers who make "art house films" are victimized. Leading film producers of blockbuster films believes that art house producers cannot expect the number of cinemagoers within a certain time period compared to commercial or popular films. The reason is high utility expenditure. As a result, no exhibitors would like extension of exhibition period of art house films. CEO (LFD) argues that 'Seating capacity' is not a reliable measure on deciding the film removal. Most film distributors do not consider the genre of the film. "There should be a justification for film removal strategy for art house films; or else no art house film producers will remain in future", leading film producer (Art house films) explained.

CONCLUSIONS/RECOMMENDATIONS

Analyzing "key players" experiences, it is clear that the NFC's strategic decisions have not met their expectations. Hence, H_{01} cannot be rejected. The merging practice can give a temporary competitive advantage to the distribution circuits. In addition, it gives a threshold limit for both distributors and exhibitors to exist in the industry. Unfortunately, there is a pattern of merging which depends on the rapport of distributors, while no exhibitors can be proactive in mergers of their choice. On the other hand, the NFC has no obligation to this practice and allows as a temporary solution to the insufficiency of cinema halls. However, cinemagoers can benefit from the merging practice. At least, it would facilitate a popular film to be exhibited for cinemagoers in many exhibition halls. Also, it is evident that an exhibition hall with 800 seats cannot justify the art house film to be removed by 25% of filling seating capacity. The reason is art house film demand is different from commercial films. If the art house film is screened in an exhibition hall with 250 seats, then the decision can be changed. Therefore film removal strategy should be streamlined for film genre.

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**“THE MUSLIM GIANT”: ANALYSIS OF THE WORLDVIEW REPRESENTED IN A
SELECTION OF FOLKTALES ATTRIBUTED TO THE MUSLIM ETHNIC
COMMUNITY IN SRI LANKA**

L. Medawattegedara^{1}*

Department of Language Studies, The Open University of Sri Lanka

INTRODUCTION

Though folktales in Sri Lanka have a history dating back to the 3rd Century ACE, and were introduced as part of the religious dissemination endeavors of the Asokan Buddhist mission (Ratnapala 1991), they have not been the subject of scholarly studies either for their achieved form or conditions of existence. This could be attributed to the uncritical view that folktales are the lot of “Illiterate, Rural, Lower stratum” (Dundes 2007). However, folkloric texts, according to folklorists, are not as dilettantish as scholars grant them to be—they carry, according to Bronner (2009), biases, prejudices, belief and values through time and space, often “unconsciously or unselfconsciously” (2009). At the same time, majority of the folktale collections published in Sri Lanka, since the appearance of the first collection by the British colonial officer Henry Parker in 1910, are folktales told by/of the major ethnic group, the Sinhalese. Gunasekera Gunasoma, a passionate folktale collector, in 2011 added an interesting dimension to the folktales of Sri Lanka by collecting and publishing a selection of 17 folktales attributed to the Muslim ethnic group living in the Eastern Province of Sri Lanka. This study is a close reading of those folktales for their “world view,” which is defined by Bronner as the “general outlook, values and belief that drive human action and inform ethical judgment” (Bronner 2009). At a time when the discourse of ethnic reconciliation has attracted the attention of both the bureaucrats, non-governmental participants and even the literary community of Sri Lanka (as apparent from at least two Write to Reconcile creative writing programs in operation at present) this study, which is a preliminary study of a larger study of folktales of the minority communities of Sri Lanka, intends to compliment and add to that discourse.

METHODOLOGY

Gunasoma’s collection and classification of 17 folktales from the villages of Eastern province under the category “Muslim folktales” (*Muslim Janakatha*), lends itself for a parallel analysis of these folktales tale. Thus this study would engage these tales in a qualitative reading. In that reading it would use the literary critic Macherey’s assumptions that all speech “envelopes in the unspoken in order to reach utterance” (Macherey 2006) and this ‘unspoken,’ which he also terms as “silence” (Macherey 2006), informs us of the “precise conditions for the appearance of an utterance,...its limits...real significance” (Macherey 2006). These silences that envelope the values and beliefs of the tales will be put under scrutiny in this study to understand what they say about the subjective world experience of the Muslim ethnic community.

RESULTS AND DISCUSSION

Spirituality is one of the most valorized traditions across the folktales. Like myths that resist rationale discourse (Coupe), spirituality--or ‘purity’--in the tales negates mundane material realities, including the (British) colonial authority. Thus, in one tale, the graveyard of a sacred religious figure disrupts the journey of a train built over it by the British colonials, thus derailing the colonial power discourse. Here the contending powers are the ‘sacred’ and the ‘colonial.’ The graveyard becomes a sacred space; and the train, a symbol of colonial economic power; one serving the needs of the body, the other, the soul. The body/soul dichotomy collides head on in this strange event of the mysteriously halted train. In another

*Corresponding author: Email - lalmedawattegedara@gmail.com

tale, a man who was robbed and critically wounded by a gang of thieves survives his ordeal by reciting religious stanzas—religion assumes the role of life-saving medication here. Just as much as thieves can harm one's body, the 'sacred' can heal it. Two lamps lit alongside the grave of a sacred man burns all night in another tale, thus converting the idea of 'scared' into a force that defies the laws of physics. One is discouraged from uttering untruths in a sacred space. An illegitimate love affair between a man and a woman is taken to the mosque for a settlement as a last resort--the 'sacred' meets 'desire.' The male vehemently denies his participation in this questionable alliance, whereby he is asked to swear his innocence. His eye balls pop out as he leaves this religious space owing to the fact that his act of swearing was false. This tale valorizes monogamy, suggests moderation of one's desires and promotes cultural ritual over uncontrolled desires. In another tale, a Sinhala man who disrupted the building of a mosque dies in an accident, thus converting the 'sacred' into a force that (violently) exerts itself into the material sphere of mundane existence.

The world of the female, as shown in two tales told by females, is different to that of males. She seemingly exercise agency and valorizes her daughters over sons. Thus, in one tale, an angry mother poisons her son who had allegedly slapped his sister. Though the claimed attack never took place, the mother is quick to accept the word of her daughter over her son's. This tale suggests females as sacrosanct subjects whose bodies should be respected by males. In another tale, a greedy son-in-law's nocturnal foray into the kitchen to lick the left-over meat-curry-spice-mixture off a *wangediya* becomes a tragedy as his head gets stuck in that container. The mother-in-law demands that the *wangediya*, which comes to her from her family, be saved at any cost. Thus, the males in the house end up beheading the hapless son-in-law. This tale offers, while offering the implication of feminine agency (she had the final say in this issue), also suggests that females' sphere of influence was largely the space called the kitchen.

There are stories that recount the heroic acts of men with powerful physical attributes. Adam Lebbe, is capable of outrunning elephants, slapping a Leopard, and overcoming a Bear with his bare hands. There is also a 'Muslim Giant' who is capable of Herculean tasks like carrying two large tree trunks a long distance to build a well. He eats four-five measures of rice per meal and his venerated grave yard is 60 feet long. Tales with similar episodics are also found among the Sinhala ethnic group; the exaggerations are possibly a narrative strategy to communicate the intensity of the strength of the hero. The presence of the giants is a suggestion of the valorizing of masculine valor and strength within the community, which could be extended to suggest that the community under focus here is patriarchal.

The relationship with the Sinhala ethnic community is captured in at least two tales. In one, a romantic alliance between the two communities is explored. An attractive Sinhala female from a land-owning cultivating family runs away with a handsome Muslim male of equal wealth and means. The villagers' agitation over this issue is amicably settled by the intervention of the eloping partners who express their lifelong commitment to each other. The class attributes of the couple is equal—they are both wealthy; but their ethnicity is not, which is settled through discussion. The Sinhala folk act of soothsaying (*pena balanawa*) is ridiculed by a Muslim man who becomes a successful soothsayer in a Sinhala village by a shrewd method: he uses informants to find out details about the individual prior to the act of soothsaying. This tale rather than an act of ridicule, seems to be a warning to the listeners who might subscribe to the 'pleasures' of clairvoyance owing to the popularity of the concept.

The relationship between the Muslim ethnic community and the nation is also explored in two tales where the Sinhala kings (two are not identified by name, one identified as the *King Senarath*) are projected as having cordial relationship with this community. The kings have regular contact with the people and one king is particularly touched by the gesture of a *Lebbe* of a mosque, who presented the king with a king coconut while he was on his way to worship the *Dighavapiya*. The tales are not islands, they align themselves to national politics, where diplomatic and friendly relations with the political centre are encouraged.

Dreams have a special place in the stories in the sense that they are interpreted literally. Thus, a man whose fishing boat was destroyed in the sea responds to a dream which asks him to swim, and he ends up being carried home by a large wave. Another man initiates the building of a mosque at a location which was pinpointed by a dream. It is possible to assume that the tale creators/tellers/listeners believed that dreams are part of the 'sacred' and its dictums are to be carried out literally.

CONCLUSIONS/RECOMMENDATIONS

A close reading of these tales demonstrates the beliefs that inspire ethical judgments of the characters of the tales, which could have been a reflection of the affairs in the material sphere. The 'sacred,' which can be interpreted as 'pure,'—and since anything considered 'pure' resists questioning they are robed as 'myth'^{*} according to the literary critic Barthes (2009)—is the most significant value that drives the tale episodics. The 'sacred' occupies an overwhelming and inescapable 'presence' in the tales trampling and transcending objects or concerns in the material sphere. Thus the 'sacred' is valorized over worldliness. By invoking other ethnic groups into the tales, they tell us more about the subjectivity of the Muslim ethnic group: that they prefer to retain their independence, or core values, in their dealings with other ethnic groups. In the sphere of politics, the Muslim ethnic group was largely supportive of the powers that be; this connection to the centre was looked upon with much pride and joy. The attention of the king, or the political centre, was seriously appreciated by this community. Females enjoy agency and autonomy, with a hierarchy of values in their world, and in this ordering they have located the male gender below the *wangediya*. At the same time, this could also indicate that the females were static in their worlds, with the kitchen and household duties being their primary responsibilities. The 'world view' espoused in these tales show a community who are attempting to come to terms with their material surroundings while adhering to their individuality. Their identity hinges on the 'sacred' and strict adherence to its tenants, with tales disempowering people who defy and negate this idea of the sacred. The community found in the tales is not claustrophobic—they explore the world outside, they engage with other ethnic groups. Such engagements necessarily require maintaining a core identity, or a subjectivity, that they define as 'Muslim.'

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^{*}The word 'myth' is used here according to the concepts of Barthes who posits it as a semiological system involving interplay between the signifier, signified and the sign. See Barthes's *Mythologies* (2009) for more

FORECASTING TOURIST ARRIVALS TO SRI LANKA FROM WESTERN EUROPE

K. M. U. B. Konarasinghe^{1}*

¹ *Institute of Mathematics & Management, Nugegoda, Sri Lanka*

INTRODUCTION

Sri Lanka was re-emerging after defeating terrorism, ending Sri Lanka's 30-year conflict, investing in infrastructure and emphasizing its natural beauty. Over the past years international tourism in Sri Lanka has shown growth in two ways; volume and value. This study concerns about the growth of volume. The Sri Lankan tourism market consist all regions in the world. The Western Europe is one of the highest tourist producers to Sri Lankan tourist market. Tourist arrivals from Western Europe have increased from 105748 in second half of 2009 to 278402 in second half of 2014 (SLTDA, 2014). The boom is clearly shown by Figure 1.

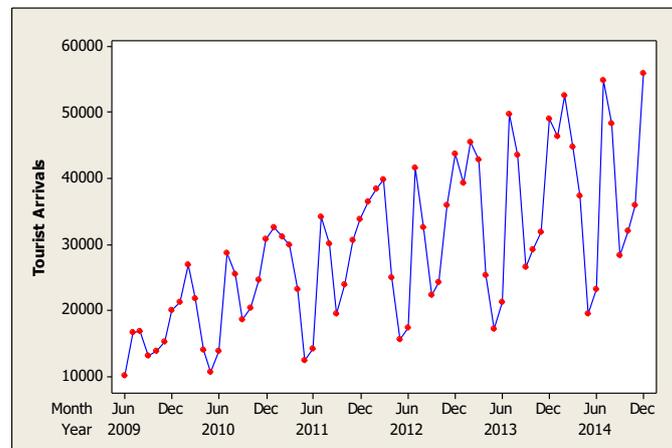


Figure 1. Time Series Plot of arrivals from Western Europe

Research Problem

Forecasting is an essential planning tool that helps any industry to cope with the uncertainty of the future. Finding appropriate forecasting techniques is essential for planning at all levels in any organization (Witt and Witt, 1995); (Song and Li, 2008); (Song and Witt, 2006). With the increasing of tourist arrivals from Western Europe, it is important to find a suitable method of forecasting tourist arrivals. It has been observed that rare attempts were made to forecast tourist arrivals from Western Europe to Sri Lanka. Therefore, the current study was focused on identifying the suitable, statistical model for forecasting tourist arrivals from Western Europe to Sri Lanka.

METHODOLOGY

Yi-Yi (2010) and Chau, (1970) have applied the Auto Distributed Lag Model (ADLM) approach for forecasting tourism income and employment. Konarasinghe (2015) has used the same technique for forecasting tourism income of Sri Lanka. The objective of the study is to fit a suitable forecasting technique. The study concerned ADLM on transformed data. The tested model is;

^{*}*Corresponding author: Email - udaya35@yahoo.co.uk*

$$\ln Y_t = \alpha + \beta_1 \ln Y_{t-1} + \varepsilon_t \quad (1)$$

Monthly tourist arrival data from Western Europe from the year 2009 to 2014 were obtained from statistical reports of 2009 and 2014, Sri Lanka Tourism Development Authority (SLTDA). The study concerned the period of post-war, which is after June; 2009. One way Analysis of Variance (ANOVA) technique was used for overall model testing and t-test was used for individual parameter testing. The residual plots, Anderson-Darling, and Durbin-Watson tests used to test the independence and normality of residuals in model validation criterion. Forecasting ability of the models was assessed by Mean Absolute Percentage Error (MAPE), Mean Square Error (MSE) and Mean Absolute Deviation (MAD). Three measurements of errors as follows;

$$MAPE = \frac{1}{n} \sum \left| \left(\frac{Y_t - F_t}{Y_t} \right) \cdot 100 \right| \quad (2)$$

$$MAD = \frac{1}{n} \sum | (Y_t - F_t) | \quad (3)$$

$$MSE = \frac{1}{n} \sum (Y_t - F_t)^2 \quad (4)$$

Where; Y_t = Observed value of time t, F_t = Forecasted value of time t

RESULTS AND DISCUSSION

Box and whisker plot showed no outliers. A number of lags for the model were decided with the help of, Auto Correlation Function (ACF). The ACF confirmed that only one lag is significant. Then the model tested with one lag, as follows:

$$\ln Y_t = \alpha + \beta_1 \ln Y_{t-1} + \varepsilon \quad (5)$$

The ANOVA output of the above model presented in Table 1.

Table 1. ANOVA table for model

Source	DF	SS	MS	F	P
Regression	1	2.8343	2.8343	27.35	0.000
Residual Error	47	4.8703	0.1036		
Total	48	7.7046			

P value of ANOVA (0.000) is less than the significance level ($\alpha = 0.05$). It clearly showed that there is a linear relationship between the variables $\ln Y_{t-1}$, with $\ln Y_t$. The next step of the study was to test the individual regression coefficient. The results available in table 2.

Table 2. Summary table for regression Coefficients

Predictor	Coef	SE Coef	T	P
Constant	3.862	1.187	3.25	0.002
$\ln Y_{t-1}$	0.6143	0.1175	5.23	0.000

The results of table 2 revealed that variable with lag one was significant. The residual plot shows the independence of residuals. The Durbin-Watson test also supported the same. The Anderson-Darling test results were $P = 0.156$. It confirmed the normality of residuals. It is clear that the model completed all validation criterions. The fitted model is;

$$\ln Y_t = 3.86 + 0.614 \ln Y_{t-1} \tag{6}$$

Table 3 gives the summary outputs of the model. According to the results, the MAPE of the model was 2.6% in fitting and 2.7% in verification. The MAD and MSE also very small. But the Adjusted R^2 value is not satisfactory.

Table 3. Summary outputs of model fittings and model verifications

Model	Model Fitting		Model Verification	
$\ln Y_t = 3.86 + 0.614 \ln Y_{t-1}$	R-Sq(adj)	35.4%		
	MAPE	2.64	MAPE	2.73
	MAD	0.263708	MAD	0.289752
	MSE	0.0993932	MSE	0.130226
	Normality	0.156		
	Independence	Yes		

Figure 2 shows that actual arrivals and fits are closer to each other. Figure 3 shows the same in actual and forecast.

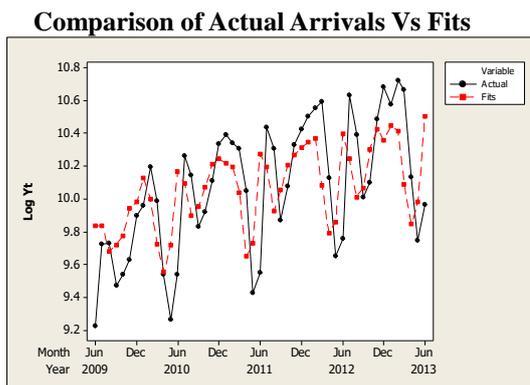


Figure 2. Actual Arrivals Vs Fits

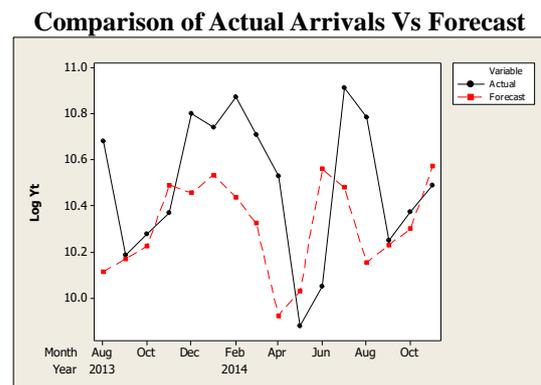


Figure 3. Actual Arrivals Vs Forecast

CONCLUSIONS / RECOMMENDATIONS

This study was focused on fitting a suitable model on forecasting tourist arrivals from Western Europe to Sri Lanka. The ADLM was tested with log transformation for the post-war period in Sri Lanka. The model with lag one completed all model validation criterions. The MAPE is below 3% other measurements of errors also shown small deviations. The study concluded that ADLM with log transformation with lag one is suitable in forecasting tourist

arrivals from Western Europe in Sri Lanka. Further, it is recommended to test the Circular Model in order to capture the seasonal or cyclical patterns, if any.

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SUSTAINING MICRO ENTERPRISES OF WOMEN ENTREPRENEURS THROUGH FINANCIAL LITERACY

W. A. R. Senevirathne^{1*} L. P. S. Gamini² and W. A. D. K. Jayendrika³

^{1,2} Department of Management Studies, Faculty of Humanities and Social Sciences,
Open University of Sri Lanka

³ Department of Accountancy, Faculty of Business Studies and Finance,
Wayamba University of Sri Lanka.

INTRODUCTION

Sri Lanka is sailing towards fast-track development after emerging from a 30-year civil war. The country's financial system has been upgraded from many aspects utilizing modern technology as a means for facilitating to on-going development. The asset base of the country's banking system by end of year 2015 is 8.1 trillion (Central Bank of Sri Lanka, 2015). The knowledge level of the members of a financial system is very important for its development (World Bank, 2014). The financial literacy level of Sri Lankan is such a mandatory requirement for proper management of financial institution, financial market, financial instruments and financial infrastructure in Sri Lanka. In shouldering the development pace of the country, active labour force and their level of skills are significant factors. One of an existing issues here is that low level of female participation, when compared to males, in decision making. See the following figure 01.

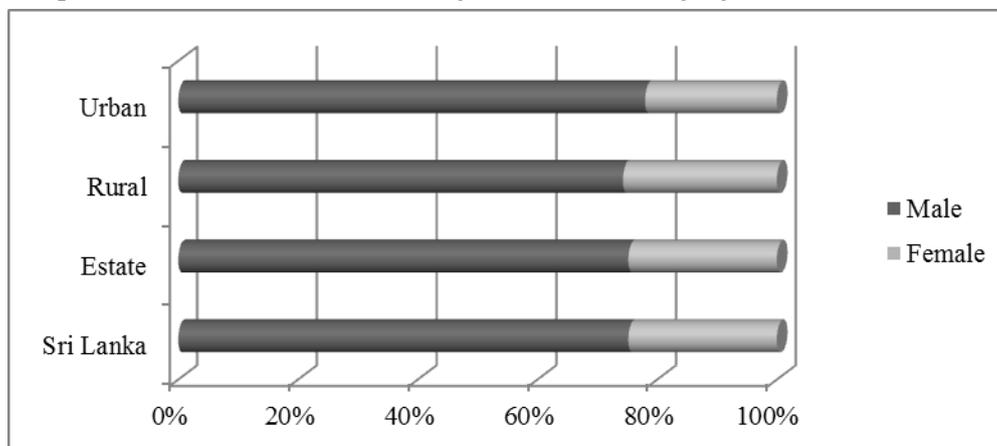


Figure 1. Percentage of Gender of Entrepreneurs
Source: Department of Census and Statistics, 2014

Women's entrepreneurship and women's participation in the capacity of decision making in the business entities have been recognized during the last few decades as an important untapped source of economic growth. Undoubtedly, economic impact of women is substantial, and therefore, number of women entrepreneurs and women decision makers in an economy is an important indicator for economic policy making (Department of Census and Statistics, 2014).

Women play many key roles just like men in contemporary society, even though the rate of their participation in the capacity of decision making in the business entities is low. According to Cowling (2010), Women make decisions regarding health care providers, personal banking relationships, dining habits, school choices, personal family time and more; they are likely to engage in businesses--especially informal ones. However, women are likely

* Corresponding author: Email - asankaousl@gmail.com

to be more vulnerable than men in their financial behavior (OECD, 2012). Therefore Women's economic empowerment is a prerequisite for sustainable development and pro-poor growth.

Research gap and research problem

Issues and challenges faced by entrepreneurs have been investigated by many researchers in Sri Lanka and other countries. But the concept of financial literacy of owners as a root cause for issues in the micro business has not been widely researched. Financial literacy level is a measure of the degree to which one understands key concepts and possesses the ability and confidence to manage personal finances through appropriate, short-term decision-making and sound, long-range financial planning, while being mindful of life events and changing economic conditions (Remund, 2010). The first objective of the research is to measure the level of financial literacy possess by women entrepreneurs of micro enterprises. The second objective is to investigate the association between financial literacy and sustainability of micro business run by women entrepreneurs. The third and the final objective is to assess the sustainability of business and analyze issues, intricate financial literacy and business sustainability. Sustainable position of the business is the ability to run a business in the foreseeable future with greater proportion of net assets relative to liabilities of the business. The Organization for Economic Corporation and Development (OECD) and its International Network on Financial Education (INFE) have defined financial literacy as a combination of awareness, knowledge, skill, attitude and behavior necessary to make sound financial decisions and ultimately achieve individual financial well-being.

The Research model

The tested research model is based on the five financial literacy benchmarks of an individual introduced by the Institute for Financial Literacy, USA. The researchers tried to survey significant association between five financial literacy benchmarks of Money Management, Debt Management, Credit Management, Risk Management and Investment Retirement Planning with Business Sustainability.

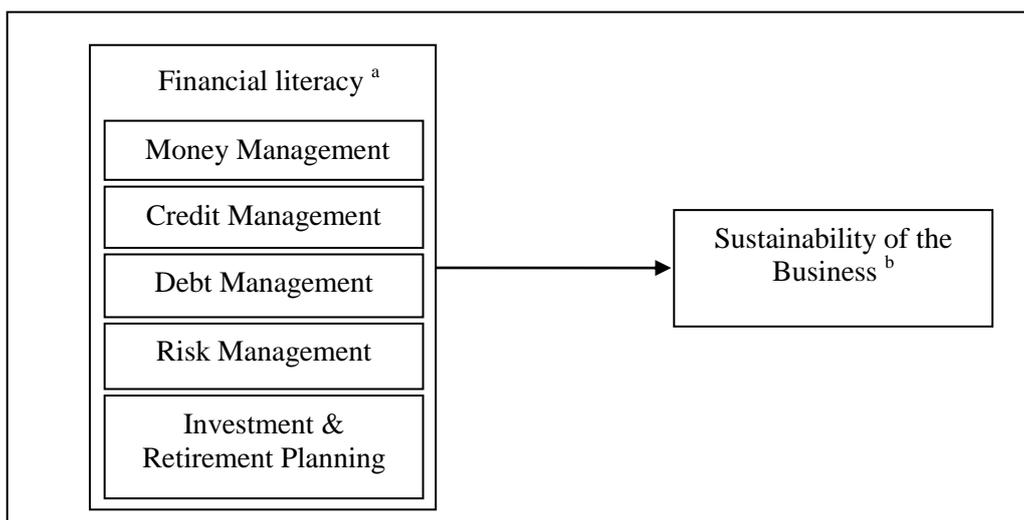


Figure 2. Tested Research model

Sources:

- a. Five financial literacy benchmarks of an individual defined by, The Institute for Financial Literacy, (IFL), USA, 2012
- b. Seven Basic Financial Ratios to measure Business Sustainability, Farries et.al, 2010

Five hypotheses were developed to test the above research model. It was assumed that each of the independent variables has a positive relationship with business sustainability.

METHODOLOGY

Primary data were gathered through a structured questionnaire from women entrepreneurs of Micro Size Enterprises (MSEs) from July 28, 2015 to October 23, 2015. The research was conducted from a simple random sample of micro enterprises in the Western Province in Sri Lanka. 122 Members of Small Enterprise Development Division (SEDD) were selected for the research. A pilot study was conducted by administering the initial structured questionnaire developed by the researcher. The SPSS 20.0 statistical software was used to analyze the data. Quantitative analysis were conducted so as to ensure the validity of the evidences of the findings. The reliability of the measure was established by testing for both consistency and stability. Pilot survey Cronbach values were higher than 0.7 and final survey values were higher than 0.8. Reliability statistics indicated that overall Cronbach’s Alpha is more than 0.8. This is a clear indicator of internal consistency, Walsh (1980).

RESULTS AND DISCUSSION

Table 1. Results of descriptive statistics

Independent/ Dependent Variables	Respondents	Minimum	Maximum	Mean	Std. Deviation
Money Management	122	1.40	5.00	3.9877	± .61866
Credit Management	122	1.82	5.00	4.0306	± .70936
Debt Management	122	2.00	5.00	4.0779	± .70130
Risk Management	122	1.00	5.00	3.7992	± .73009
Invest & retire plan	122	1.50	5.00	3.7992	± .69207
Sustainability of the businesses	122	1.00	5.00	3.6541	± .76311

Note. Survey Data 2015

In order to calculate the association between financial literacy and sustainability position of the businesses, average values and dispersion of the data were calculated. Mean values of all the independent variables are greater than three (03). This indicates that a moderate level of financial literacy exists among women entrepreneurs. The sustainability position of the businesses also shows a mean value of 3.6541, and standard deviation of ±.76311. This signposts potentiality of business sustainability.

Table 2. Results of Pearson Correlation Test

	MMgt	CMgt	DMgt	RMgt	Inv plan	BS
MMgt		.520**	.482**	.498**	.565**	.435**
CMgt	.520**		.634**	.496**	.505**	.407**
DMgt	.482**	.634**		.624**	.575**	.432**
RMgt	.498**	.496**	.624**		.742**	.442**
Inv plan	.565**	.505**	.575**	.742**		.613**
BS	.435**	.407**	.432**	.442**	.613**	

** . Correlation is significant at the 0.01 level (2-tailed).

Note. Survey Data 2015

According to the above table all the independent variables are significantly correlated with the dependent variable. It can be seen that investment and retirement planning skills of the women entrepreneurs have highest correlation coefficient value with the sustainability of the business. (r = 0.613, p<0.0005) Credit management shows the lowest correlation coefficient of 0.405 However, all variables are significantly correlated to each other. These results are

consistent with findings of (Lusardi & Mitchell, 2007) and (Huston, 2012). However the results of this study are inconsistent with the findings of (Raath, 2013). In addition to the correlation analysis, multiple regression analysis also has been carried out to analyze the association between factors of financial literacy and the business sustainability. Because, in multiple linear regressions two or more independent variables are used to predict the value of a dependent variable. The model summary gives us the R value as 63.3% for assessing the overall fit of the model. The adjusted R square value in this case is 0.375. It reflects that five IVs in the research model account for 37.5% variation in the DV- business sustainability. According to the results investment and retirement planning is the only significant factor that influences on sustainability of the business.

Table 3. Results of the Regression Analysis

Hypothesis	Variables	Standardized Coefficients β	P value
Hypothesis 1	Money Mgt vs a.	.096	.301
Hypothesis 2	Credit Mgt vs a.	.077	.439
Hypothesis 3	Debt Mgt vs a.	.088	.408
Hypothesis 4	Risk Mgt vs a.	-.105	.365
Hypothesis 5	Inv,ret Plan vs a.	.547	.000

*p<0.01 Two-tailed test

a. Dependent Variable: Business Sustainability

Note. Survey Data 2015

CONCLUSION AND RECOMMENDATION

From the above analysis, first objective was achieved by concluding that moderate level of financial literacy existed among the women entrepreneurs. As an attempt to achieve the second objective the researcher tried to find out the association between money management, debt management, credit management, risk management, investment and retirement planning with business sustainability. As the results of correlation, it shows the positive and significant association between financial literacy of women entrepreneurs and sustainability of their business. Then, it can be concluded that micro business sustainability has been influenced by financial literacy of women entrepreneurs. However, contradictory results were generated in multiple regression analysis when it was done in order to achieve the third objective. The regression outcome revealed that sustainability of micro enterprises has not been influenced by all the factors of financial literacy of women entrepreneurs. Only the investment and retirement planning have significant association to the sustainability of business. Then it can be concluded that sustainability of micro enterprises has not been achieved by the existing level of financial literacy of women entrepreneurs. Extending the research to a larger sample could be desirable in order to enhance the generalizability of the findings. Because the researcher believes that the area of study is important and may yield important findings. Study suggests enhancing existing level of financial literacy among the women entrepreneurs. It is recommended that women entrepreneurs should regularly review their financial records in order to measure operational performances and financial position of their enterprises. In addition to that financial experts and consultants, service can be obtained to enable women entrepreneurs to choose and access appropriate financial services and products. Thereby increase women's entrepreneurial participation to the valid and solid business decision making in order to achieve sustainability for the micro enterprises.

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COMMUNITY UNIONISM AND CHANGING ROLE OF TRADE UNIONS IN NEW HUMAN RIGHTS ERA

*K. N. Liyanapathirana**

Department of Law, University of Peradeniya

INTRODUCTION

Traditionally Trade Unions focused on protecting the employment/labour rights of its membership. As primarily members-based organizations, they are characterized by literature and case law alike as engaging quid pro quo in collective bargaining. While trade unions can also engage in other activities, the *raison d'être* of their activity is in providing a sense of job (or employment) security and negotiating wages, fringe benefits, delayed compensation plans, and pension guarantees. (Mundlak, 2012) According to Webb and Webb's definition, a trade union is a continuous association of wage-earners for the purpose of maintaining or improving their conditions for employment and it implies that trade unions are bread-and-butter organizations, safeguarding their members' wages and working conditions, but having none or little function beyond this. (Thomassen, 2015)

However, within the last few decades there has been a significant change in the role of trade unions in response to popular political and cultural perceptions of Trade Unions being corrupt or self-serving organizations that work in the interest of their own members rather than for the greater good. (K.Kolben, 2009-2010) This negative perception of unions has compelled the labor movement to attempt to redefine itself within a framework that has obtained widespread intellectual, cultural, moral, and political support: human rights. (K.Kolben, 2009-2010) According to Howard Gospel, three different ideal types of unions emerged in this context: (1). the market-orientated unions where unions are essentially economic actors pursuing economic goals. (...) (2). the class-orientated unions which are deemed vehicles of class struggle (...) (3). Society-orientated unions which may be seen essentially as social actors or social partners, engaged in social dialogue and operation in a social democratic context. (K.Kolben, 2009-2010)

These new roles are termed Community Unionism (Wills, 2001) (Jane, 2015), The Union Learning Representative (ULR) role (Moore, 2010), Social movement unionism (Witharana, 2015) and Democratic role (Thomassen, 2015) depending on the context in which a union might operate. Their roles were re-couched in Human Rights terms with trade unions advocating the adoption of human rights analyses and arguments in their work, and human rights organizations including workers' rights in their mandates. (Compa, 2008)

This changing role of the trade unions has supported trade unions to bring new workers into trade unions, also to increase the public profile of the labour movement, and they have moved the focus of trade unionism beyond the workplace. Anyhow this new paradigm-shift poses significant challenges to prevailing concentrations of power in the trade union movement and it has opened a heated academic debate over the theme.

METHODOLOGY

A combination of primary as well as secondary qualitative research method was used. The research began by planning a comprehensive domestic and international literature review.

* Corresponding author: Email - kanchanaliyanapathirana@yahoo.com

Three Trade Unions were selected from United Kingdom as a case study. The Case study involved a series of interviews with trade union leaders and in depth analyses of the media releases. Based on this review and the data obtained through the case study method, the research identified the changed role of Trade Unions and analyzed the impact of these changes.

RESULTS AND DISCUSSION

The International Labour Organization (ILO) defines a trade union organization as: “An organization of employees usually associated beyond the confines of one enterprise, established for protecting or improving through collective action, the economic and social status of its members.” ((CSTS), 2015). Some authors discuss about the traditional role of trade unions as 1. Protecting the interests of the whole country, but at the same time safe guarding the legitimate rights and interests of the workers; 2. Helping their members participate in the management of their own work units; 3. Mobilizing the labour force to raise productivity and the economy’s performance; 4. Educating the workers to be better members of society (Daniel Z.Ding, 2002)

The labour movement is in desperate crisis and in countries such as Australia, Canada, the Netherlands, the USA, New Zealand and the UK. There is a strong impetus propelling the search for new methods of securing union growth and renewal. Some unions are developing new models of organizing which look beyond the workplace to forge links and develop shared agendas with the wider community. (Wills, 2001)

Among several changing roles the ‘community unionism’ has become a more popular topic among the academic and trade union specialists. Community unionism is about finding common cause between unions and those groups cemented around affiliations of religion, race, gender, disability and sexuality, with those providing a particular community service and with those fighting for a particular political cause. (Wills, 2001) In other words “it means making the union into a vehicle through which its members can not only address their bargaining demands but actively lead the fight for everything that affects working people in their communities and the country. Movement unionism includes the shape of bargaining demands, the scope of union activities, the approach to issues of change, and above all, that sense of commitment to a larger movement that might suffer defeats, but can’t be destroyed”.(Fairbrother, 2008)

As it has been noted by a number of writers, trade unions’ organizing in the community is not new .The history of trade union formation in the UK is inextricably linked to the places and spaces in which people lived and worked. (Jane, 2015) And its rather than being based *in* communities, or acting *for* communities, it make the argument that unions are well placed to develop reciprocal community unionism in which unions work *with* communities for social change. (Simms, 2004)

According to the Wills (2001) by forging common-cause alliances with community groups and political campaigns, trade unions aim to do (at least) four things. Firstly, by increasing the scale and thus the influence and power of organizing activity, community-union initiatives are able to tackle questions of economic justice that stretch beyond any particular workplace; Secondly, by organizing with community groups, trade unions are able to reach non-union workers who have been traditionally marginalized from trade unions; Thirdly, as increasing numbers of workers are concentrated in low paid, contingent, manufacturing and service employment, often in small workplaces, it has often proved very difficult to reach them

through traditional union organizing strategies which focus on workplaces and employers; And finally, the community might also prove invaluable in defending traditional workplace trade union organization.

Social movement unionism has become part of the lexicon about trade unionism over the last two decades. Social movement unionism has four key aspects to it 1. Locally focused and based, often referred to as rank and file mobilization, or variants thereof

2. Experimenting with collective actions, that go beyond the strike, or workplace limited activities 3. Building alliances, coalition building, and extending into the community and beyond 4. Embracing emancipatory politics, framing demands politically, and formulating (Fairbrother, 2008)

As Holgate (2015) mentioned, this approach is largely motivated by three things: the success of the broad-based community organization, London Citizens and its high profile campaign for a living wage (Wills, 2004, 2009a); local and national politicians noticing how this organization is able to mobilize local people around community activity; and third, unions and political parties waking up to the potential for growth within their own organizations.

CONCLUSIONS/RECOMMENDATIONS

This changing role of Trade Unions as community unions has become success stories in several trade unions such as the case of the Iron and Steel Trades Confederation (ISTC) Battersea and Wandsworth Trades Union Council (BWTUC). Also with Unite's new 'community membership' and the Transport Salaried Staff Association (TSSA).

This new role has brought new workers into trade unions, they have increased the public profile of the labour movement, and they have moved the focus of trade unionism beyond the workplace. As we have seen, this poses significant challenges to prevailing concentrations of power in the trade union movement. Re-inventing community unionism is still in its early stages and there is a lot of work to be done convincing those with power that it represents one part of the future of trade unionism in the UK. (Wills, 2001)

So this new mechanism can be used as a good role model for Sri Lankan trade unionism to overcome several barriers which have been experiencing for the last decades. This will build up a link between the community and the trade unions and it will give a chance to play an active role for the trade unions beyond their workplace.

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SEXISM IN TEXTBOOKS: A CASE STUDY OF G.C.E. O/L TEXTBOOKS

*L. M. S. Wijetunga**

¹*Department Language Studies, The Open University of Sri Lanka*

INTRODUCTION

When perceiving language in the light of Sapir-Whorf hypothesis which states that language determines thought, use of language as a means of establishing and sustaining relationships within a speech community becomes a significant phenomenon. If Sapir-Whorf hypothesis is accepted to be valid, then learning a second language not only improves the ability of an individual to communicate with another but also introduces the learner to a whole new dimension of perceiving the world. However, if a language is with prejudice, i.e. if the use of language is prejudiced, then according to Sapir-Whorf, the users of the said language also become prejudiced as language determines thought. Thus, if the learner of a language is exposed to its use in a prejudiced manner, it can be declared that the perception of the world by the learner would also adjust to align with the prejudices learnt through language.

Among numerous possible language based prejudices such as race and religion, sex is an important aspect in that it is universally applicable to all nations across the world. When investigating language related sexism, this paper seeks to analyze ESL textbooks in Sri Lanka, which plays a central role in language learning in the classroom. Textbooks have a central role to play in education in that it is one of the cheapest and most effective ways of transforming knowledge and values. (Esen Y., 2007) Therein lies the significance of portraying equality or lack thereof pertaining to gender roles in textbooks. In the context of Sri Lanka, school is more often than not the only place where the average child is exposed to English. Therefore, the child's associations with the language are heavily dependent upon the teacher, teaching atmosphere, and most importantly, teaching the material. Being a compulsory subject from grade 3 to grade 13, English is imparted to the majority of the children through the government provided textbooks. It is necessary that Sri Lanka is examined for its use of language due to the dire implications a sexist language would pose to a young learner. Therefore, this research seeks to investigate if the text provided for ESL textbooks for the GCE O/L is sexist.

METHODOLOGY

English language textbooks of grades 9, 10 and 11 were analyzed as per the criteria introduced by Hartman and Judd in the first sexism in textbooks study of 1978. These criteria include, gender visibility and firstness (whether male or female is mentioned first in instances where both sexes are mentioned); occupational and family roles present in the text as well as occupations assigned to each gender; character attributions such as hobbies; and linguistic occurrences such as masculine generic constructions and marked language for females.

Quantitative Analysis

The texts were analyzed for gender visibility and firstness in expression. First, the frequency of occurrence of female and male characters in illustrations was tabulated, as well as the number of times each sex was mentioned in the text. Gender visibility was also calculated in terms of the presence of male and female figures from history, mentioned in the text. Second, the firstness, i.e. the number of times females and males were mentioned first in the text, in instances where both the sexes are mentioned, was calculated. Visibility of each gender is important in that presence of each gender and their importance is acknowledged, while which gender is mentioned first provides an indication as to superiority awarded for a particular gender, if that is always mentioned first. Historical figures were also tabulated to observe if

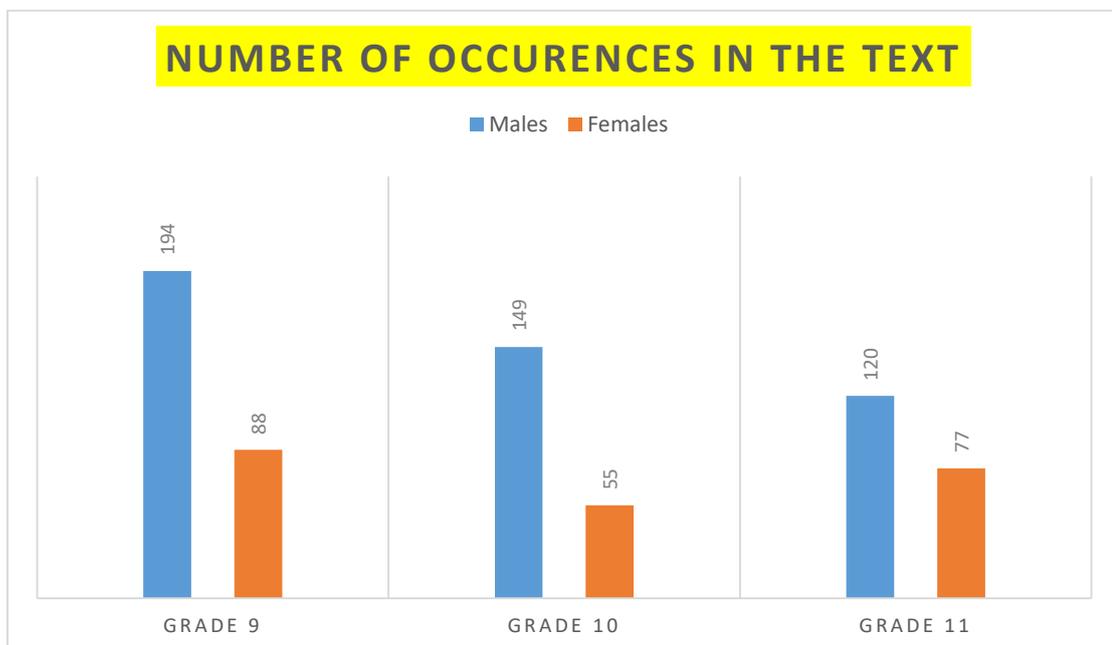
*Corresponding author: Email - minoli.wijetunga@gmail.com

both the sexes have been mentioned equally in this aspect, as historical figures are the role models for learners.

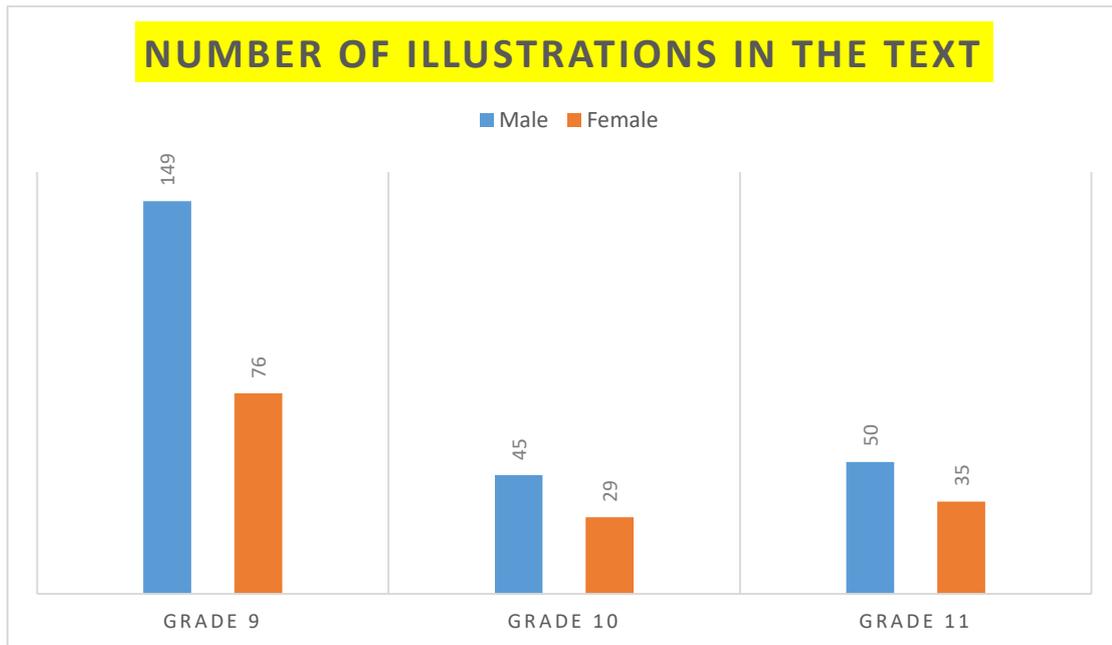
Qualitative Analysis

Occupational roles of characters, family roles of characters and character attributions of males and females in the text were investigated. This provided an insight into the presence of stereotyping each gender, and if the text reflected cultural norms and not the practical world. Features of each gender in illustrations present in the textbooks were also analyzed in this category to determine whether gender stereotyping was present. Finally, the text was studied for linguistic occurrences of usage of masculine generic constructions and for marked language for females. Masculine generic constructions such as “man” to represent humans would mark the language used as sexist in that men were assumed to be the umbrella term while presence of marked language for females indicated that females were purposefully set apart, and would often carry negative connotations, as with the use of the word “mistress”, to indicate owner of a house.

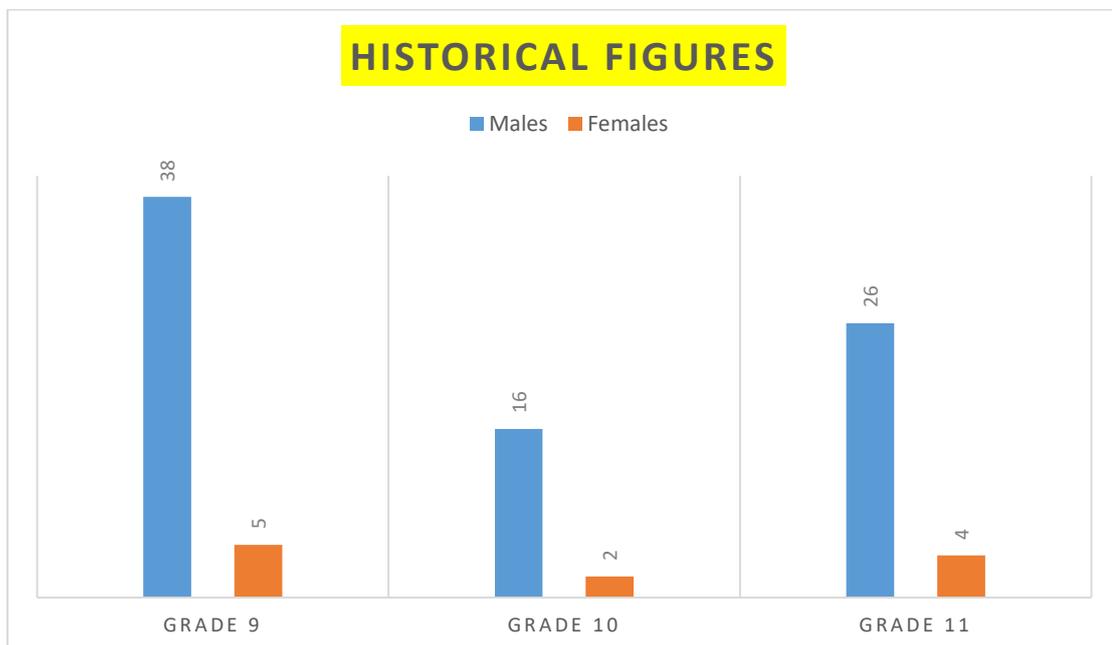
RESULTS AND DISCUSSION



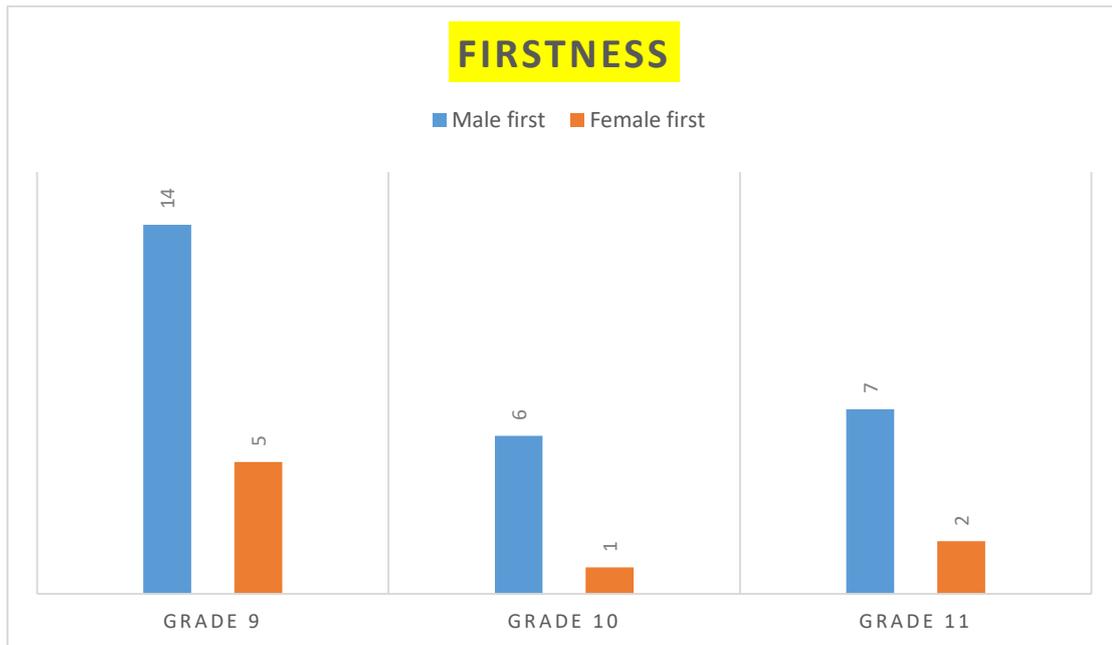
It was discovered that all three textbooks had a large number of male characters, while female characters were often few. It was interesting to note that units that focused on travelling and outdoor activities had barely any female characters, implying that outdoor activities are the male realm, and not for the female to enjoy.



The trend of occurrences was reflected in the illustrations as well. Apart from the sheer lack of female representation, the instances where females were portrayed showed them engaging in stereotypical work of sweeping, cleaning or decorating while males were illustrated in a wide range of areas.



More than the clear difference between the number of historical figures who would serve as role models for the learner, the lack of modernization in the characters was significant. Centuries after initial recognition, the main female historical figure was still Marie Curie, although other prominent female figures such as Malala Yousafzai have been out and about in the modern society. This, in contrast to the mentioning of Usain Bolt and Michael Jordan for male figures, was a clear indication of inequality.



Males were almost always mentioned first in the texts. In instances where females were mentioned first, it was in instances such as “mother and father” or “bride and groom”, once again reducing females to a stereotypical construction.

When analyzing the occupational roles of the characters, all three textbooks contained more occupational roles for men as opposed to women. It was noted that teachers of English were commonly assumed to be female, while those of science were clearly defined as male. The family was clearly divided into the father providing financial support while the mother was a figure to provide refreshment. All knowledge imparted in the dialogues were uttered by males, while females played a supportive role. Females were also portrayed to be dissatisfied with their appearance, often making remarks on their insecurities. The emotional range of each gender was clearly stereotyped, with males having a wide range of emotions against females who were limited to confident, sensible and shy. However, males are displayed as loving husbands in the text who lay the table for dinner while the mother prepares the meals. In contrast, no activity or trait has been attributed to females which are stereotypically considered male.

CONCLUSIONS/RECOMMENDATIONS

Sri Lankan ESL textbooks ascribe agency to males, particularly in the sphere of economics and knowledge. The male is the financial center and female is the dependent. Firstly, the dependent role of the female might not be accurate in the material sphere, considering that there is a powerful female presence in the labor market according to a survey done by Sri Lanka Labor Force Survey 2014. Secondly, this might not impart a sense of motivation for a female learner in that she would be given the idea that females are to play only a family role. In this light, the ESL textbooks of grades 9, 10 and 11 were found to be sexist in their use of language, thus promoting prejudices against females and contributing to causing a wider rift in the already existent gender disparity of the Sri Lankan society.

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**PUBLIC SPENDINGS AND ECONOMIC PROSPERITY
SPECIAL REFERENCE TO POST INDEPENDENCE SRI LANKA**

*A. Koswatta**

Department of Social Studies, The Open University of Sri Lanka

INTRODUCTION

Abstract:

This paper empirically investigates the relationship between expenditure and taxation policies and economic growth in Sri Lanka. The country's overall level of taxes and government spending are substantially lower compared to the advanced economies. Therefore, this study is launched to identify the impact of fiscal policy changes on economic growth in Sri Lanka under different political regimes. Estimated results demonstrate that even though the Fiscal significance influence on Sri Lanka's economic growth in the short run, but in the long run the impact is considerable. To identify this impact in the short run the study employs the error correction mechanism, for the long run the study employs the Engle Granger Technique. The Granger Causality test suggests that the Fiscal Policy does cause the Economic Growth. The Study also examines the external shocks to the fiscal variables in Sri Lanka and its impact on Economic Growth.

Introduction:

In every country the fiscal policy plays a significant role in economic growth. In the short term, In the short run, fiscal expansion can help aggregate demand and growth to improve during cyclical downturns. Conversely, contractionary fiscal policy can stabilize an economy that is growing at an unsustainable pace and thus faces the risk of overheating. Developing Economies like Sri Lanka in particular have a long history of using taxes and larger government spending to improve the economy by smoothing the business cycle. And also, fiscal policy can also have a major impact on medium and long term economic growth. This is especially true in Sri Lanka where the private sector is relatively weak and underdeveloped. Public spending on physical infrastructure, such as roads, ports, and highways, affects the productivity of all types of industries, and the entire economy. Likewise, public spending on education and research and development fosters human capital, a vital ingredient to long-term growth. Therefore, it is essential to improve the fiscal policy in order to improve the economic growth strategically.

Literature:

Comparing various taxes, Skinner found that personal income and corporate tax rates had a negative direct effect on output growth, trade taxes had little direct effect, and sales and excise taxes were neutral with respect to both output growth and investment. King and Rebelo (1990) showed that tax policy can have a potentially large impact on long-term growth. Public policies can exert a significant influence on economic growth rates by affecting private incentives for accumulating physical and human capital. Even relatively small changes in tax rates can lead countries to stagnate or even regress if these policies eliminate incentives for growth.

* Corresponding author: Email - achinthyatharangani@gmail.com

Objectives:

The objectives of the study can be broken down into main objective and specific objectives based on the contribution to this study.

Main objective

The main objective is to investigate the impact Fiscal policy basically taxation and expenditure, changes on economic growth of Sri Lanka.

Specific objectives

- To analyze the time series properties of the variables used in this study.
- To understand the behavior of the fiscal policy tools known as taxation and expenditure in Sri Lanka.
- To analyze the short run and long run effect of fiscal policy changes on Economic growth.
- To suggest policy implications.

METHODOLOGY

This section summarizes the main variables, the frequency of data, the source of data study period, and the analytical methods.

i. Method of Data Collection

Time series data from 1956 to 2014 of the related variables will be collected from the Central Bank of Sri Lanka. The variables are real gross domestic product, Direct taxes, Indirect taxes, Government recurrent expenditure, Government capital expenditure non-oil taxes and total debts of the government of Sri Lanka

ii. The model

The model specification will be based on the growth theory that fiscal policy impact on the economic growth of Sri Lanka stated by Appah (2010) but with modifications. Consequently, the functional form of the model specification will be:

$$RGDP = f(NTR, REX, CEX, TD)$$

Explicitly, equation 1 can be written as: in statistical form

$$RGDP = \beta_0 + \beta_1 NTR + \beta_2 REX + \beta_3 CEX + \beta_4 TD + U$$

Where:

RGDP = Real Gross Domestic Product (proxy for economic growth);

NTR = Non-oil Taxes;

REX = Recurrent expenditure;

CEX = Capital expenditure;

TD = Total debt defined as domestic and foreign borrowings.

Where β_0 = Y-intercept term. This gives the mean or average value of RGDP when all the explanatory variables included in the model put at zero.

And $\beta_1, \beta_2, \beta_3, \beta_4$, are parameters known as partial regression coefficient or partial slope coefficients (Gujarati & Porter, 2009; Gujarati, 2006; Osuala, 2010).

U = the stochastic term or the unexplained variation in RGDP. Sweeney et al. (2006) stated that it accounts for the variability in the dependent variable that cannot be explained by the linear effect of all the independent variables in the model.

iii. Econometric tools

The variables have been described by the graphical methods and summary statistics. To identify the order of time series properties of this study unit root test is employed. To test the stationary of the time series this is basically used. This study employs Johansen’s cointegration method to investigate both long-run and short-run relationship between the tax policy changes and expenditure policy changes on economic growth in Sri Lanka. The granger causality test is used to determine whether one time series is useful in forecasting another. To identify the causal impact of fiscal policy and economic growth, the granger causality test has been applied. The impulse response function is used to determine the effects of external shocks to the variables used in this study.

RESULTS AND DISCUSSION

Government expenditure has consistently exceeded revenue, often by a considerable margin. From 1960 to 1977, expenditure was about 28 percent of GDP. After 1977 it increased, mainly as a result of investment in infrastructure. Between 1978 and 1987, the government spent around 38 percent of GDP. Of the nearly Rs.70 billion spent in 1986, about half was identified as recurrent expenditure, and fifty percent goes as capital expenditure.

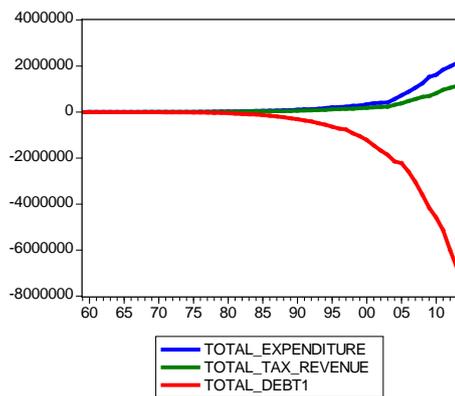


Figure 1. Total Expenditure , Total Tax Revenue and Total Debt in Sri Lanka

According to figure 1, the total expenditure always exceeds country’s total revenue. Therefore, the total debt amount continues to expand.

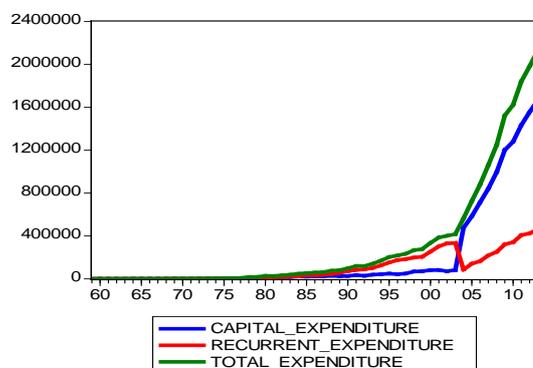


Figure 2. Capital Expenditure, Recurrent Expenditure and Total Expenditure in Sri Lanka

Figure 2 shows the composition of the total expenditure of Sri Lanka. According to the statistics the highest amount records by capital expenditure due to the investment

programmes hold in the last few years.

The effectiveness of growth-friendly fiscal policy is enhanced when reforms reinforce each other and are accompanied by complementary structural reforms. Combining fiscal reforms (e.g., scaling up infrastructure investment while improving the public investment process) increases their effectiveness.

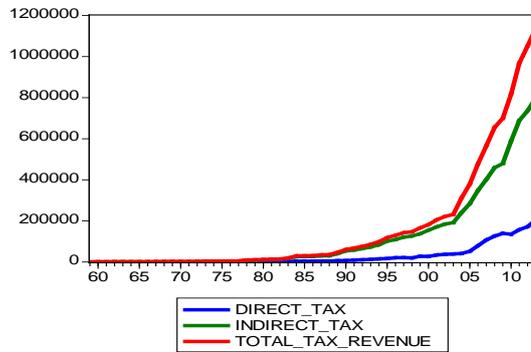


Figure 3. Direct Taxes, Indirect Taxes and Total Tax Revenue in Sri Lanka

In a healthy economy, the direct taxes should always greater than indirect taxes. But according to figure 3, Sri Lanka’s highest income was recorded by indirect taxes. Higher indirect taxes leads to higher income disparities, poverty and inequality. But the government is purposely doing this in order to collect the revenue smoothly. Appropriately this is a chronic failure most of the developing countries face.

Policy design and social consensus matter for the successful implementation of reforms. Therefore, designed fiscal reforms can serve both growth and equity objectives. A proper decision can be taken based on the real values of an economy since the real values exclude the inflationary impact. The following figure summarizes the real GDP behavior over time.

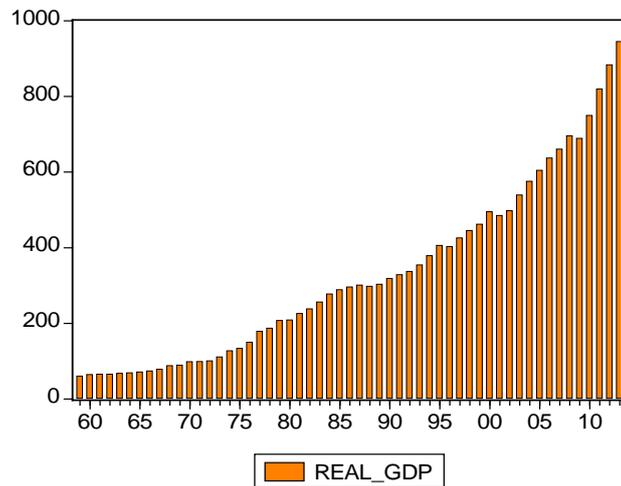


Figure 4. Real GDP Growth in Sri Lanka.

According to the results given in the long run relationship the total expenditure increases economic growth by 66% in Sri Lanka while the taxation reduces the economic growth by 19%.

Table 1. Long Run Relationship among the variables
Included observations: 220

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DIRECT TAX	-0.16 (16%)	0.094573	-1.742958	0.0482
INDIRECT TAX	-0.19(19%)	0.133979	1.453456	0.0330
TOTAL EXPENDITURE	0.66(66%)	0.254929	-2.597275	0.0127
RECURRENT EXPENDITURE	0.28 (28%)	0.090960	3.125530	0.0031
CAPITAL EXPENDITURE	0.32 (32%)	0.093456	3.504511	0.0010
DEBT TO GDP RATIO	-0.366028	0.100041	-3.658768	0.0007
FOREIGN DEBT	0.500508	0.079623	6.285993	0.0000
TOTAL DEBT	-0.68 (68%)	0.263315	-2.604222	0.0124
TOTAL DOMESTIC DEBT	0.538839	0.147774	3.646362	0.0007
C	4.182901	0.457987	9.133239	0.0000

Table 2 presents results from the pair wise Granger- causality tests which were obtained with two lag for each variable.

Table 2. Causal Relationship among the variables

Null Hypothesis:	Obs	F-Statistic	Probability
LTOTALTAX does not Granger Cause LREALGDP	220	1.16908	0.01934
LTOTALEXP does not Granger Cause LREALGDP		5.88657	0.00517

According to the figure 5, when the total expenditure is affected by an external shock, the effect will not makes a significance impact on economic growth in the first two years just after the policy change then the impact will decay slowly.

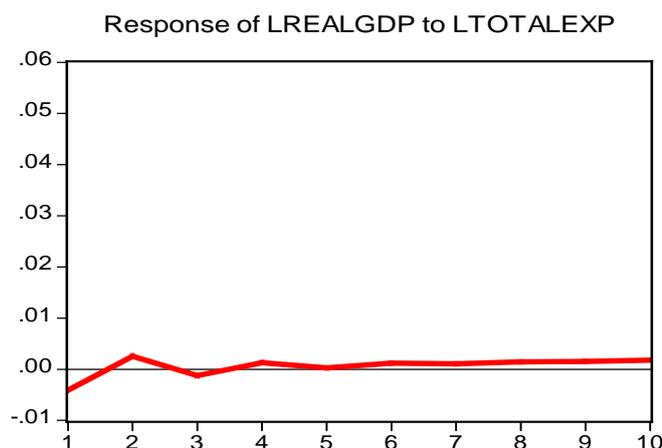


Figure 5: Direction of Economic Growth due to external shocks

CONCLUSIONS/RECOMMENDATIONS

Fiscal policy can help Sri Lanka to meet the challenges in Economic Growth. Therefore, a strong fiscal policy can improve the economic growth effectively in the past, present and the future. This analysis indicates that in Sri Lanka, the composition of taxes and government spending matters for economic growth. According the outcomes of the study, public spending and taxation also has a significant effect on economic growth. This study proves that there is a considerable long run relationship between taxation and expenditure policies and the economic growth in Sri Lanka. And this growth can be improved using fiscal policy tools such as growth oriented taxation and expenditure policies.

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APPLICABILITY OF INTERNATIONAL HUMANITARIAN LAW IN A CONTEXT OF NON-INTERNATIONAL ARMED CONFLICTS: AN OVERVIEW

W. A. S. S. Wijesinghe^{1*} and B. A. R. R. Ariyaratna¹

¹Department of Legal Studies, The Open University of Sri Lanka

INTRODUCTION

“The law of armed conflict regulates aspects of a struggle for life and death between contestants who operate on the basis of formal equality.” (T. Meron, 2000). Accordingly, it is apparent that the law has to play a significant role in the sphere of an armed conflict to harmonize the conflicting interests of all parties. Historically, after many disastrous and painful experiences, the International Humanitarian Law (IHL) has been developed to protect persons who are not or no longer participating in the hostilities and restrict the means and methods of warfare. In the sense, it is noteworthy that, the ultimate aim of the IHL is to strike a balance between humanitarian needs and military necessity.

Nonetheless, IHL recognizes a distinction between international and non-international armed conflicts. International Armed Conflicts (IACs) are those in which at least two States are involved. As well, Non International Armed Conflicts (NIACs) are those restricted to the territory of a single state, involving either regular armed forces fighting groups of armed dissidents, or armed groups fighting each other. (C. Harland, 2012). However, it is notable that the IHL principles governing IACs and NIACs, afford different kind of protection in its application. Even though, IACs are subjected to plethora of IHL rules, the protections given for NIAC's are only embodied in the Common Article 3 of the 1949 four Geneva Conventions and Additional Protocol II of 1977.

However, as an emerging trend, the differences between IACs and NIACs are gradually blurring and in reality, it way forward for a nature of ‘mixed’ conflicts. Therefore, as Sivakumaran (2011) correctly opined, even if NIACs represent the vast majority of armed conflicts in the world today, they are suffering the lack of regulation to challenge the complex nature of warfare. Moreover, this study intends to examine the applicability of IHL rules in this mixed nature of conflicts and further, it discusses the root causes that still preserve the difference between IACs and NIACs. Finally, this paper attempts to analyze the changing nature of armed conflicts and its impact on demarcation between IACs and NIACs.

METHODOLOGY

This study is a normative research. Fundamentally, it is based on an extensive review of literature. Thus both primary and secondary sources are used to carry out the research. International conventions, statues and decisions on international tribunals are thoroughly used as primary data. Particularly, 1949 four Geneva Conventions and its Additional Protocols (APs) in 1977 are used to emphasize the IHL rules governing in IACs and NIACs. As well, text books, journal articles and case studies conducted by International Red Cross Society are used to enrich the research as secondary data.

RESULTS AND DISCUSSION

IHL distinguishes two types of armed conflicts; namely, IACs and NIACs. Though this dichotomy has been widely criticized by some scholars on the basis of humanity and moral concerns, the distinction is still firmly placed in the sphere of IHL. (J. Stewart, 2003). As Ditter (2002) pointed out, ‘it is difficult to lay down legitimate criteria to distinguish international wars and internal wars and it must be undesirable to have discriminatory regulations of the Law of War for the two types of conflict.’

*Corresponding author: Email - sanathwijesinghe@gmail.com

In contrast to that argument it may be worthwhile to recall that the primary difference between an international and an internal armed conflict is the actors taking part in them and the involvement of differing actors in the two types of armed conflict suggest that, at the very least, certain legal norms cannot be transposed directly from IACs to NIACs without some modifications. (S. Sivakumaran, 2011). Thus, before it reaches the discussion of emerging trends, it is worthwhile to unpack the legal definition of IAC and NIAC embedded in the Geneva Conventions and Additional Protocols.

According to the Common Article 2 of the Geneva Conventions ‘even if the state of war is not recognized by one of them, all cases of declared war or of any other armed conflict which may arise between two or more of the High Contracting Parties’ an IACs occurs. Even if one of the parties denies the existence of a state of war and without considering the intensity or the duration, such an armed conflict can be categorized as an IAC. Also, AP I expand the scope of the IACs into the armed conflicts against colonial domination, alien occupation, racist regimes, as well as wars of national liberation by virtue of Article 1(4). Thus, it is amply clear that the IACs are clearly defined in the IHL paradigm.

On contrast, the importance of rules pertaining to NIACs are overwhelmingly discussing in modern context due to the uprising conflicts of non-international character in all over the world. As professor Cassese (1981) vigilantly pointed out; “ [First], internal wars are increasingly common all over the world, in particular in Third World countries....large and medium sized powers either restrain from settling disputes by armed forces of fights their wars by proxy, in the territories of other States.”

The modern definition of NIACs is lying beneath two main legal sources of IHL; namely, Common Article 3 to the Geneva Conventions and Article 1 of the AP II. The Common Article 3, applies to the armed conflicts/hostilities that may occur between governmental armed forces and non-governmental armed groups or between such groups in the territory of the ‘High Contracting Parties’. Since Common Article 3 does not define ‘conflicts not of an international character’ governments can easily contest its applicability. Furthermore, the definition embedded in Article 1 of the Additional Protocol II introduces a very high threshold on NIACs than Common Article 3. Thereby, the protocol applies only in the ‘situations at or near the level of a full-scale civil war’ or belligerency. Thus, it is evident that the internal conflicts that occurred in developing countries; for example the CPN-M initiatives in Nepal, the RUF activities in Sierra Leone, the LTTE insurgents in Sri Lanka and the Revolutionary Armed Forces of Colombia (FARC) considered as act of intervention of the internal affairs and the matters ended up internally.

Though, the four Geneva Conventions and two Additional Protocols embedded with hundreds of rules pertaining to armed conflicts, only a few rules are applied on NIACs. Nonetheless, one can argue that the entire corpus of the IHL is heavily tilted on the IACs rather than NIACs. It is amply clear that the distinction would cause to cast two tiers of protection on the subjects of IACs and NIACs accordingly. Furthermore, high thresholds provide by the Geneva Conventions and the Additional Protocols create a restrictive approach of the applicability of IHL into NIACs. As Sivakumaran pointed out, ‘the idea of combatant immunity and prisoners of war regimes are only bound up with IACs and no treaty provisions envisage in NIACs in this regard.’ It is apparent that several attempts to incorporate those rules in the context of NICAs have failed.

Inevitably, not only by the parameters embedded in conventions but also several other reasons can be identified which supports to the existence of the demarcation between IACs and NIACs. This demarcation may be fertilized by political, economic and social ideologies, as well as international relations of a particular State. Furthermore, the States are unwilling to apply the laws of war into NIACs on the sole ground that this may have the effect of legitimizing rebels, terrorists and other armed groups.(J.Odrnatt,2016) Ultimately, applying of IHL principles onto all NICAs would give cause to recognize the non-governmental party

to an internal conflict, as an entity which is subjected to international law.

However, this distinction is being blurred in the modern context on the following ground reasons. Firstly, applicability of the IHL depending on whether an armed conflict is international or internal in nature is no longer acceptable in the modern context. A resent and welcome trend is blurring the different thresholds of applicability. Thereby, it can be argued that this third category of conflicts, which can be named as ‘internationalized’ (H. Gasser, 1983) or ‘mixed conflicts’ render some difficulties to the traditional approach of the applicability of rules of IHL. As Meron argued; ‘the ICTY appeal chamber has encouraged the blurring of the distinction between international and non-international conflicts’ (T. Meron, 2000) Ultimately, the ‘internationalized’ armed conflict would be eligible to apply Grave Breaches provisions envisaged in the Geneva Conventions pertaining to IACs. (*Prosecutor v. Dusko Tadić*, [1999]) Thus, it can be pointed out that the ‘mixed conflicts’ would pave the way for applying the most important rules of IHL in NIACs. Thereby, it is evident that the emerging trends have caused to dilute the traditional demarcation between IACs and NIACs.

Secondly, the distinction between IAC and NIAC is being ‘blurred’ by the development of customary law principles of IHL. The rules pursuant to IACs are being generalized and made feasible to be adopted in all armed conflict by the intervention of customary law principles of IHL. As noted in the *Tadić* judgment, some rules pertaining to IACs such as protection of civilians from hostilities, in particular from indiscriminate attacks, protection of civilian objects, in particular cultural property and protection of all those who do not (or no longer) take active part in hostilities etc. are applicable to all forms of armed conflicts without considering the distinction.

Thirdly, the intersection of International Human rights Law (IHRL) into IHL has unanimously contributed to soften the distinction between IACs and NIACs. As Meron correctly pointed out, ‘the reason may be the shifting of the traditional focus of State sovereignty towards a human rights approach to international problems.’ In the light of this argument we can reach a conclusion that the applying IHRL would be more fruitful to serve humanity where the States and rebels alike have determined that they are not bound by IHL. Before summing up the passage of the influence of IHRL on IHL and its impact on the distinction between IACs and NIACs, it is worthwhile to note here a dictum pronounced by International criminal tribunal for former Yugoslavia, in *Tadić* (1994) judgment;

“Why protect civilians from belligerent violence, or ban rape, torture or the wanton destruction hospitals, churches, museums or private property, as well as proscribe weapons causing unnecessary suffering when two sovereign states are engaged in war, and yet refrain from enacting the same bans or providing the same protection when armed violence has erupted ‘only’ within the territory of a single state? If international laws, while of course duly safeguarding the legitimate interests of states, must gradually turn the protection of human beings, it is only natural that the aforementioned dichotomy should gradually lose its weight.”

Thus, it is clear that the changing nature of the conflicts, intersection of IHRL into IHL and the codification of customary law principles of IHL and its wide acceptance has caused to dilute the demarcation between IACs and NIACs.

CONCLUSIONS/RECOMMENDATIONS

As per the extensive discussion the writers had on the above passages, the followings facts can be summed up accordingly. Although, the distinction between IACs and NIACs are highly criticized by the scholars and other stakeholders dealing with IHL, the State parties are still willing to accept the demarcation of IACs and NIACs envisaged in basic IHL treaties. Thus, the traditional approach does not give a room to the whole corpus of IHL to be applied to the NIACs. However, this restrictive approach has lost its value by the intervention of

customary law principles of IHL and IHRL in the realm of IHL. Finally it can be concluded that though the distinction still retains, a considerable amount of rules that would be useful to mitigate the echo of any kind of war are applicable to the IACs and NIACs alike.

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A MATHEMATICAL MODEL TO CALCULATE THE SAFE DISTANCE BETWEEN PROGRESSIVE VEHICLES TO AVOID REAR END COLLISIONS

I. A. Premaratne^{1} and T. S. Ravindra²*

¹*Department of Electrical and Computer Engineering, Open University of Sri Lanka*
²*Repair Centre – Maradana, Sri Lanka Telecom (PLC)*

INTRODUCTION

Road accidents which are caused by rear-end collisions are now increasing in numbers. Reason for most of such accidents is the driver's negligence that they do not keep a safe distance between the front vehicles. According to the census records of the Traffic Division of Sri Lanka Police, the 12.9 percent of the fatal accidents are caused by rear-end collisions. Out of these accidents 39.2 percent are injury free.

Therefore it is clear that a considerable amount of damages can be avoided by reducing rear end collisions of vehicles. To achieve that, it is required to maintain a safer distance between vehicles. Experienced drivers may have an idea about the gap between vehicles to avoid accidents, but it cannot be applied to all drivers and all types of vehicles. Therefore it is required to alert the driver from a system installed in the vehicle to avoid being too close to the front vehicle. This research has been conducted to develop a mathematical model to calculate the safe distance between vehicles by considering the relative motion, road condition, traffic on the road.

METHODOLOGY

Construction of mathematical model

When developing the mathematical model, three parameters have been identified as the key factors governing the alert time while driving. Those are,

1. Reaction time of the driver
2. Speed of the vehicle
3. Distance between the vehicles.

Derivation of safe distance between vehicles

To determine the safe distance we define two vehicles A and B running in the same direction one after the other at velocities of V and U respectively. Assume that A is leading. Since we are concerned of the rear vehicle the relative velocity with reference to the vehicle B can be given by equation (1).

$$V_{(A,B)} = V - U \quad (1)$$

A collision is possible only if U is greater than V . This could be caused by either acceleration of vehicle B or deceleration of vehicle A. In case where vehicle A starts to decelerate at $t = t_1$ and stops at $t = t_4$. Assuming vehicle B detects the front vehicle deceleration and starts decelerating at $t = t_2$ and stops at $t = t_3$. The deceleration rates of vehicle A and B can be given by following equation (2) and (3) respectively. The deceleration rate is assumed to be constant over the time.

$$\frac{V - 0}{t_4 - t_1} = a \quad (2)$$

* Corresponding author: Email - iapre@ou.ac.lk

$$\frac{U - 0}{t_3 - t_2} = b \quad (3)$$

The safe distance (d) can be defined as,

(Travel distance of vehicle B from $t = 0$ to $t = t_4$) – (Travel distance of vehicle A from $t = 0$ to $t = t_3$)

$$d = \left[Vt_2 + \frac{1}{2} \frac{U}{(t_3 - t_2)} (t_3 - t_2)^2 \right] - \left[Vt_1 + \frac{1}{2} \frac{V}{(t_4 - t_1)} (t_4 - t_1)^2 \right]$$

$$d = \frac{(t_2 + t_3)U}{2} - \frac{(t_1 + t_4)V}{2} \quad (4)$$

Substituting (2) and (3) in (4) gives,

$$d = 0.5 \left(\frac{U^2}{b} - \frac{V^2}{a} \right) + Ut_2 - Vt_1 \quad (5)$$

Since the vehicle B can only measure the relative velocity and its own velocity the equation (5) can be written in terms of U and $V_{(A,B)}$. Using (1) and (5),

$$d = 0.5 \left(\frac{U^2}{b} - \frac{(U + V_{(A,B)})^2}{a} \right) + U(t_2 - t_1) + V_{(A,B)}t_1 \quad (6)$$

Relative velocity calculation can be expressed in terms of time and distance measurements. The distance sensors of the rear vehicle measure and the distance to the forward vehicle at two consecutive instances. The relative velocity will be the ratio of distance travelled during the two time instances to the time elapsed. This process is continuously done in order to detect the relative velocity change which indicates a possibility of a collision.

Setting parameters of the safe distance formula

The time taken to apply brakes after hearing the alert is the reaction time of the driver and it is used as 1.5 s (National Highway Traffic Safety Administration (NHTSA), 1998). Most researches state that 90 percent of the drivers are decelerating the vehicles at a rate of 3.4 ms^{-2} (Officials, 2001). Also it is acceptable that the rate of deceleration is comfortable for the drivers to stay within the driving lane and maintain the steering control on a wet surface also. For design purpose we assume the forward vehicle deceleration as 4.5 ms^{-2} which is higher than that of normal value. Therefore testing parameters for the model are listed as follows,

$a = 3.4 \text{ ms}^{-2}$, $b = 4.5 \text{ ms}^{-2}$, $(t_2 - t_1) = 1.5 \text{ s}$, $t_1 = 1.5 \text{ s}$, initial distance travelled $d_0 = 5 \text{ m}$

RESULTS AND DISCUSSION

The model itself gives the safe distance at any given speed of the vehicle. The parameters have been set to meet the critical condition by considering the extreme values. This model has been tested using a simulation tool by manually applying distance values and time values as given by the sensors in the real situation. Table 1 shows the data set used to test the model. The data set includes four consecutive distance measurements. The velocity of the vehicle is assumed to be at $18 \text{ ms}^{-1} = 64.8 \text{ kmh}^{-1}$.

Table 1. Sample data set for testing the model

Test case \ Data	U (ms ⁻¹)	d1 (m)	d2 (m)	d3 (m)	d4 (m)
Vre1 < Vre2	18	101	102	101	103
Current D > Safe D	18	102	103.6	103.8	104.8
Current D < Safe D	18	102	103.6	99.8	100
Current D > Critical D	18	29.4	32	33	34
Current D < Critical D	18	19	21	22	23

When the data is applied to the model the safe distance is calculated and it can be given to generate an alert by the system. Table 2 shows the calculated values for the given data.

Table 2. Test results

Result \ Test Case	Vre1	Vre2	d4 measurement	Warning Alarm Distance	Calculated critical distance	Critical Distance	Critical Alarm
Vre1 < Vre2	5	10	0	0	7.536	0	No
Current D > Safe D	8	5	104.8	0	28.37	0	No
Current D < Safe D	8	1	100	100	41.04	41.04	No
Current D > Critical D	13	5	34	34	28.37	28.37	No
Current D < Critical D	10	5	23	23	28.37	28.37	Yes

It is clear that the warning alert will be activated when the distance is less than the safe distance and the critical alarm will be activated when the distance is less than the critical distance. According to the safe distance defined by NHTSA the test results gives a valid warning to prevent collisions. Table 3 gives the recommended safe distance data.

Table 3. Recommended safe distances by NHTSA (National Highway Traffic Safety Administration (NHTSA), 1998)

Speed (km/h)	Thinking Distance (m)	Braking Distance (m)	Safe distance (m)
40	27.8	18.4	46.2
50	34.8	28.7	63.5
60	41.7	41.3	83
70	48.7	56.2	104.9
80	55.6	73.4	129
90	62.6	92.9	155.5

CONCLUSIONS/RECOMMENDATIONS

The tested mathematical model gives the correct indication of alerts when the vehicles are running too close to each other. Therefore this model can be used to warn the drivers at correct times to prevent rear-end collisions. Important point of this model is it can update the safe distance by considering the current vehicle speed. Therefore it is suitable for any driving condition. As an example the safe distance would be very small during a town run and will be higher during a long distance journeys.

In order to test the model in real time, it is required to implement the model in an embedded system. Then it can be supplied with real sensor data and speed transducer data. After verifying the model in an embedded system it can be fitted to a real vehicle and test for accuracy. In the next phase of this research the model will be tested using real sensor data.

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AUTOMATED NOTES TO COIN EXCHANGER

S. M. A. J. B. Abeysekara² and W. D. S. S. Bandara^{1†}

^{1,2}*Department of Electrical and Computer Engineering, The Open University of Sri Lanka*

INTRODUCTION

Image processing has become an important incitement for increasing the degree of automation in production processes. It is now indispensable in quality control and product identification as well as in process management and monitoring. Only with the help of modern image processing systems it is possible to realize today's requirements in terms of traceability, quality, cycle time and safety.

The idea of notes to coins exchanger based on image processing emerged to give a solution to the problems facing by vendors and customers in daily transactions at places like buses, railway stations and shops. The major problem to be handled by implementing this automated system is reduce the chaos without coins. The objectives of the project are to develop an accurate note recognition system using image processing techniques, build up an algorithm and to build a mechanical coin dispensing unit.

Though there are systems to identify currency notes like automated cash depositing machines and coin dispensers in coin operated vending machines and public phones the newly designed system provides much better convenience by integrating note identification and coin dispensing.

With implementing this system different types of image processing techniques which are used for Sri Lankan banknotes identification were tested using Matlab® image processing environment. Plenty of deviations observed in banknotes with their circulation and some of them were difficult to recognize due to their distortions and unnecessary damages made to notes. Optimal results were obtained based on the neural network based algorithm.

METHODOLOGY

The designed system comprise of following sub units.

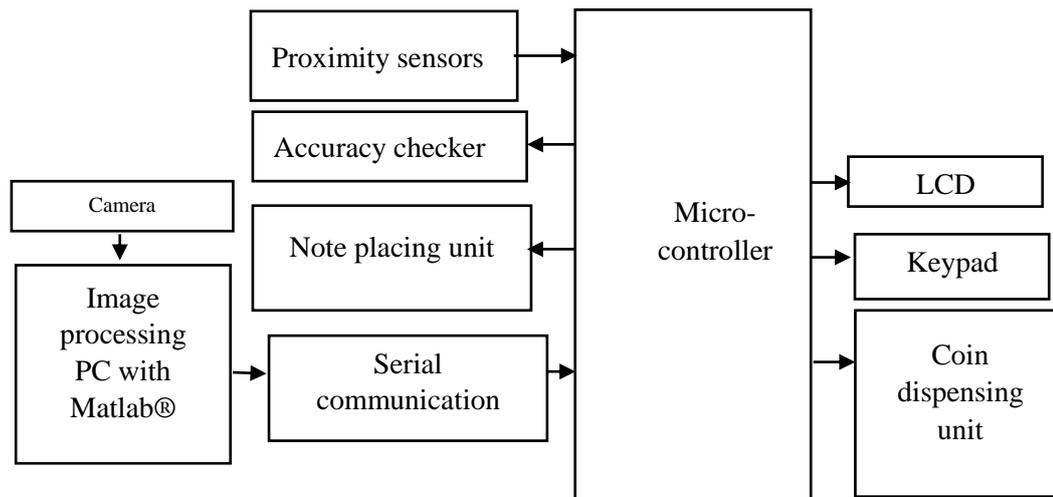


Figure 1. System block diagram

[†] Corresponding author: Email - wdban@ou.ac.lk

The process of the system is describe in the following Figure 02.

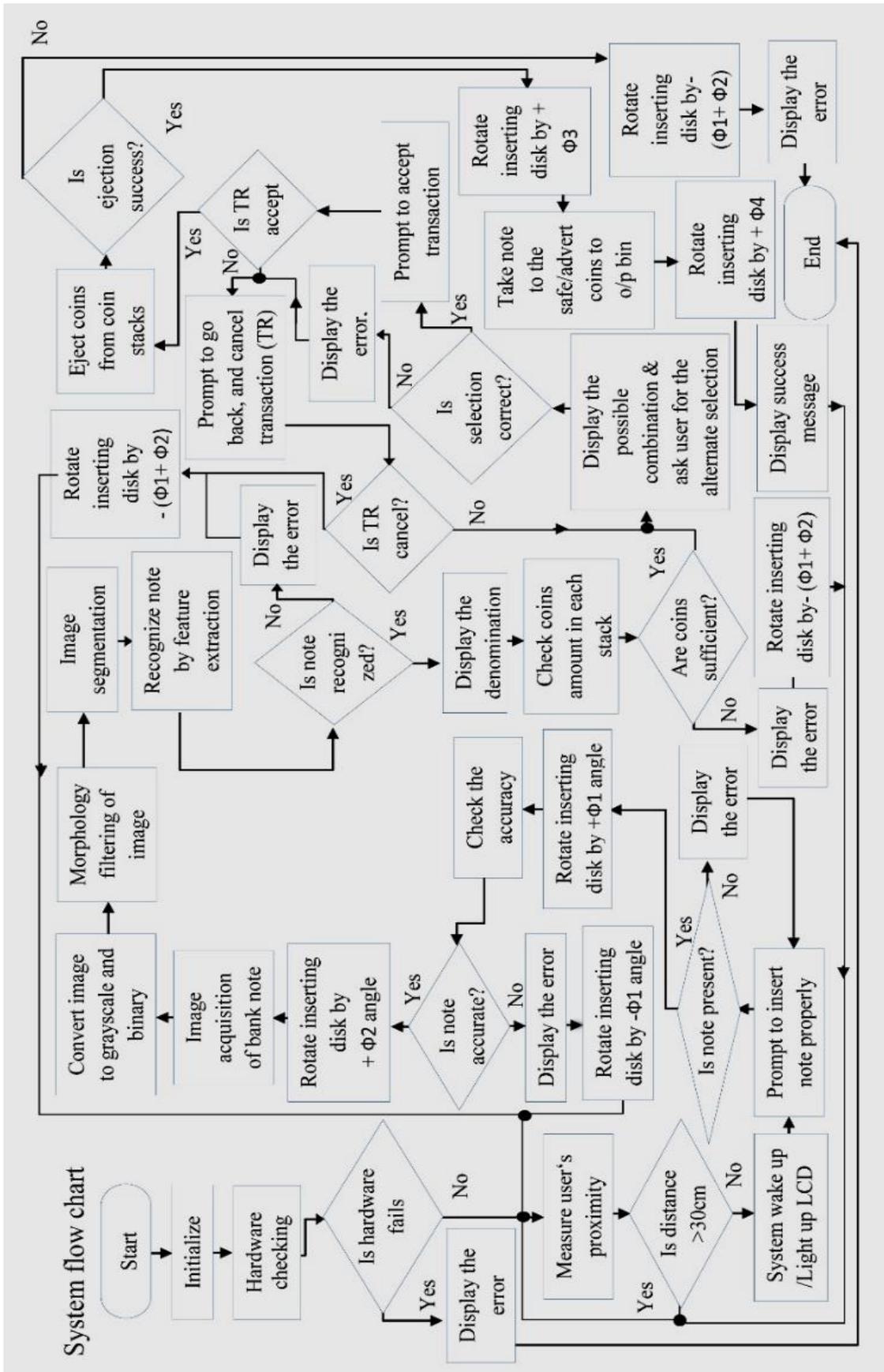


Figure 2. System flowchart

The notes inserting unit consists of a stepper motor, IR proximity sensor, UV ray sensor for note detection and HD camera and note collecting bin. Note identification unit consists with a computer with image acquiring and processing system which is based on a Matlab® algorithm and a neural network based character recognition system to identify Sri Lankan bank notes. The coins dispensing unit which has four stepper motors for rotating coin ejecting disks and four coins stacks to store Rs.1, Rs.2, Rs.5 and Rs.10 coins. Further it has a LCD display to see the transaction process progress and DTMF keypad for acquiring information from the consumer.

OPERATION OF THE SYSTEM

Outlined operation of this system initiated with placing any Rs20, Rs50, Rs100 Sri Lankan bank notes properly in the note placing bin. Then the system will check it and then it will be subjected to a fake note checking process. After that image processing will be done in the same position and if the recognition process is success, denomination of the note will be sent to the PIC microcontroller and dispense the particular amount of coins accordingly and prepare for the next transaction.

Here the machine accepts note and checks whether a note is fake or real. This can be done by analyzing the UV absorption characteristics of currency notes. Fake note detection unit consist of UV LED, photodiode, amplifier and comparator. If the case is counterfeit, it is rejected out else, a note is real, camera takes picture of note and with help of computer having MATLAB® program checks the value of the note by series of techniques and accurate value will be sent to the microcontroller, thereby using LCD display user will be notified the denomination of the note and will be asked for the coin selection. Once the user gives the choice, system will check the amount of coins that system currently having and if the user's selection is possible again gives a notification via display that transaction can be completed and ask for confirmation. After confirmation system will issue coins by activating the coin dispenser unit. When user go away from the machine system will automatically check this using proximity sensors and go back to the low power state.

FINAL PRODUCT

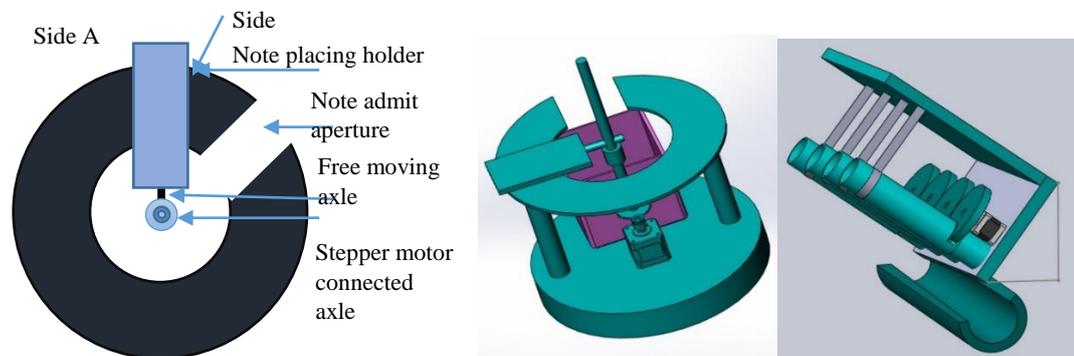


Figure 3. The designed note inserting unit and coin dispensing unit



Figure 4. Note inserting unit and coin dispensing unit

RESULTS AND DISCUSSION

The system was tested for several Sri Lankan currency notes. The percentage error in detecting the note is listed in the following table. For the accuracy testing 100 notes of each type is used.

Table 1. Test results for samples bank notes

Note type	Tested no of notes	Correctly recognized	Incorrectly recognized	Error percentage
Rs 100	100	96	4	4%
Rs 50	100	89	11	11%
Rs 20	100	86	14	14%

With the above test results the error percentage is below 14 %. To increase the accuracy the lighting condition inside the note identification unit must be kept constant.

CONCLUSION

As in the Sri Lankan market there is no any available similar systems the design is unique. Further it is totally designed to match with Sri Lankan currency notes.

Note to coins exchange system can be used to assist people to minimize the lack of coins problem. Hence for saving significant amount of money and time of the consumers. The emergence of new system like this makes the transaction processes faster and efficient. Clear banknote recognition was successful and relevant combination of coins were obtained as per the selection. This accommodate an excellent learning experience and it was discovered that this type of project would be a useful and important, valuable design for students interested in both electronic and mechanical applications.

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COMPARATIVE STUDY OF WIND CODES TO BE USED FOR TALL BUILDINGS IN SRI LANKA

J. L. N. Chaturanga¹, W. A. B. De Costa¹, T. N. Igalawithana¹, L. S. S. Wijewardena^{1} and P. A. K. Karunananda¹*

¹*Department of Civil Engineering, The Open University of Sri Lanka*

INTRODUCTION

Iconic tall buildings are coming up in and around the city of Colombo undergoing rapid changes after a thirty year civil war showcasing the development process. This has forced structural design engineers to pay more attention regarding the effects of wind forces on tall buildings which received less attention earlier. As a result of the cyclone which severely affected eastern and north eastern coastal areas in 1978, Sri Lankan Government introduced “Design of Buildings for High Winds, Sri Lanka” (1980) to be followed when designing buildings for high winds. This was based on CP-3 Chapter-V, part-2:1972 and the document is more suitable to be applied for design of low rise buildings. However, following factors were not addressed by this document.

- Change of wind pressure with the altitude
- Deflection
- Human comfort
- Feasibility of environmental impact

Sri Lankan structural design engineers use various international wind codes when designing tall buildings to address the above issues. This study was carried out as a comparative study to identify the most appropriate wind design code to be used when designing tall buildings by Sri Lankan structural design engineers emphasizing the safety and comfort of the occupants.

METHODOLOGY

Wind Codes

In this study, four different wind codes, namely CP3 Chapter-V Part-2:1972, BS 6399.2:1997, AS/NZS 1170.2:2011 and BS EN 1991-1-4:2005 are compared with respect to CP3 Chapter-V Part-2:1972. Two different configurations of buildings; 30m x 40m x 54m high located in wind zone 3 and 40m x 60m x 180m high located in wind zone 1 were analyzed applying the wind loads recommended in the four different design codes using a structural design software.

Basic Wind Speeds

Selected wind codes use different average times to calculate wind loads. CP3 Chapter-V Part-2:1972 has sub divided Sri Lanka into three different zones as shown in Figure 1 and three second wind gust speeds are available for these zones. Wind speeds used for the three zones to determine the wind loads based on different average times recommended in each wind code are tabulated in Table 1.

Structural Analysis of Selected Buildings

The buildings were designed as typical column - beam frame structures of reinforced concrete. Structural analysis was done using a structural design software assuming typical details for structural element sizes and shear cores. The structures were analyzed for each wind code mentioned above, with the completed data of the wind load calculations and structures were modeled for each wind code. The models were analyzed for the ultimate limit state load combinations. Wind drift caused by the wind loads recommended by each wind

*Corresponding author: Email - lswij@ou.ac.lk

code was also determined.

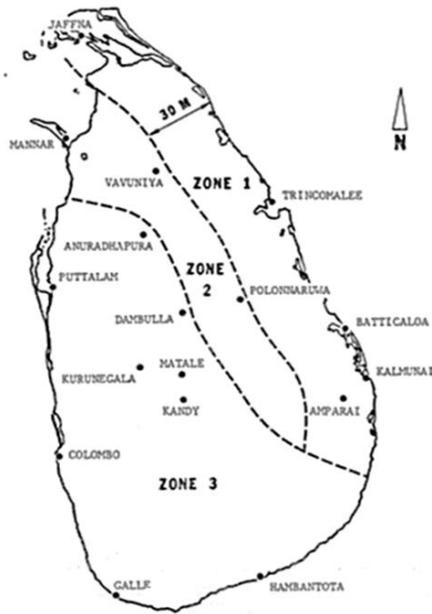


Figure 1. Wind loading zones in Sri Lanka

A methodology to carry out wind induced accelerations is provided only by the wind codes AS/NZS 1170.2:2011 and BS EN 1991-1-4:2005. Out of these two codes, AS/NZS 1170.2:2011 facilitates calculation of acceleration on cross wind direction in addition to the along wind direction. Wind induced accelerations for both building models were carried out according to the guidelines given in these two wind codes.

Table 1. Basic wind speeds with different average times used with different wind codes

	Zone 1		Zone 2		Zone 3	
	Normal Structure	Post Disaster Structure	Normal Structure	Post Disaster Structure	Normal Structure	Post Disaster Structure
3 second gust wind speeds for CP3: Ch.V Part-2:1972	49	54	43	47	33	38
Mean hourly wind speeds for BS 6399.2:1997	27	30	24	26	18	21
3 second gust wind speeds for AS/NZS 1170.2:2011	49	54	43	47	33	38
Ten minute mean wind speeds for BS EN 1991-1-4:2005	28	32	25	28	19	22

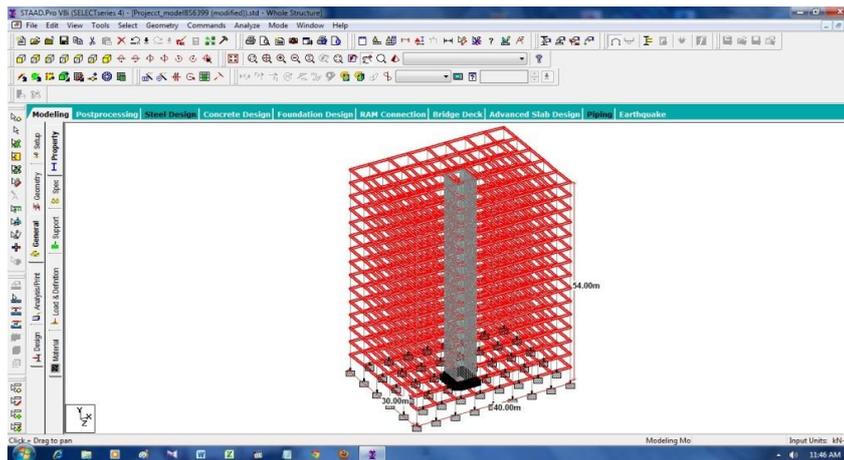


Figure 2. Model prepared using the structural design software for 30m x 40m x 54m Building

RESULTS AND DISCUSSION

Drift Index

Wind drift of the buildings need to be maintained at lower values: to prevent damages to cladding, partitions and interior finishes; to reduce the effect of motion of perceptibility etc. BS8110: Part 2, 1985 recommends a maximum allowable deflection of (1/500). The calculated values for the two cases are summarized in Table 2. BS EN 1991-1-4:2005 produced the highest wind induced drift according to the result.

Table 2. Drift index for different wind codes

Wind code	30m x 40m x 54m Building in Zone 3	40m x 60m x 180m Building in Zone 1
CP3: Ch.V Part-2:1972	1/2235	1/1050
BS 6399.2:1997	1/2162	1/1072
AS/NZS 1170.2:2011	1/1906	1/876
BS EN 1991-1-4:2005	1/1847	1/718

Column Loads

BS EN 1991-1-4:2005 produced the highest axial forces, shear forces and bending moments in ground floor columns.

Bending Moments

BS EN 1991-1-4:2005 produced the highest bending moments in first floor beams.

Shear Forces

BS EN 1991-1-4:2005 produced the highest shear forces in first floor beams.

Wind Induced Acceleration

AS/NZS 1170.2:2011 wind code produced the higher values for wind induced acceleration than BS EN 1991-1-4:2005 code. However, all the values are lower than the recommended peak acceleration, 0.200 ms⁻², at the design wind speeds.

Table 3. Wind induced accelerations

Wind code	Accelerations (ms^{-2})							
	30m x 40m x 54m Building				40m x 60m x 180m Building			
	Wind normal to 40m side		Wind normal to 30m side		Wind normal to 60m side		Wind normal to 40m side	
	Along wind	Cross wind	Along wind	Cross wind	Along wind	Cross wind	Along wind	Cross wind
BS EN 1991-1-4:2005	.012	-	.008	-	.030	-	.018	-
AS/NZS 1170.2:2011	.019	.065	.016	.049	.057	.127	.042	.119

CONCLUSIONS/RECOMMENDATIONS

Based on the outcomes of this comparative study it can be concluded that Euro code BS EN 1991-1-4:2005 produces the highest levels of stresses and deflections in both building models used for the analysis. Considering the huge investment one has to make to construct a tall building it can be concluded that the Euro Code BS EN 1991-1-4:2005 would ensure the safety and comfort of the occupants of tall buildings when used to model the wind effects on the building.

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APPROPRIATENESS OF CRUSHED CONSTRUCTION WASTE IN CONCRETE AND MOTAR PRODUCTION

*D. A. T. H. Deiyagala¹, M. A. N. Perera¹, P. G. N. Priyadarshani¹, T. M. Pallewatta²,
M. N. C. Samarawickrama² and D. P. M. B. Thibbotuwawa^{2*}*

^{1,2}*Department of Civil Engineering, The Open University of Sri Lanka*

INTRODUCTION

The demand for construction aggregates exceeds 26.8 billion tons per year globally (Ashraf *et al.*, 2013) and there is a significant increase in the use of Natural Aggregates (NA) in Sri Lanka due to recent infrastructure development projects. Usage of mineral aggregate such as broken natural rock else, coarse aggregate for concrete and river sand or fine aggregate for both concrete and mortar creates to degradation of environmental at an alarming rate.

Also, the annual amount of construction and demolished waste generate in Sri Lanka is about 4.0 million tons, while the current ways of managing such amount of waste is becoming an environmental problem (Ramezden, 2006). Moreover, the operation associated with aggregate extraction and processing creates further damage to the environment. As an alternative solution to this, Crushed construction waste like Demolished Concrete Aggregate (DCA), Demolished Block Fine Aggregate (DBFA) and Ceramic Tile Coarse Aggregate (CTCA) has been identified as potential alternative partial substitutions for river sand and mineral rock aggregate in preparation of mortar and concrete mixes. Therefore, it was intended in this study to examine how to manage and reuse of demolished crushed construction waste in order reduces their negative impact on the environment.

The aim of this study was to investigate the suitability of crushed construction waste (demolished concrete, ceramic tile and demolished cement blocks) as a raw material for the preparation of concrete and mortar in construction purpose. The following aspects were investigated in this respect.

- Comparative study of physical properties of demolished-crushed construction material and natural aggregates.
- Most appropriate mixed proportions of demolished construction material that can be replaced with natural aggregates in producing concrete and mortar.
- Cost effectiveness of producing concrete and mortar using such demolished construction materials.

METHODOLOGY

Sample Preparation

In the process of sample preparation, demolished concrete, ceramic tile and demolished block waste were collected from three different sites. Ceramic tile cut pieces gathered during the construction of new buildings at respective sites were used for the study. Collected demolished material was manually broken into smaller size aggregates by hammer crushing, and this was in order to make identical size material to match the natural aggregates. The comminuted products were sieved to separate fine and coarse fractions using (6 mm mesh size) sieve to make Demolished Concrete Coarse Aggregate (DCCA), Demolished Concrete Fine Aggregate (DCFA), CTCA, and DBFA in adequate quantities to proceed with the study.

*Corresponding author: Email – dpthi@ou.ac.lk

Material Testing

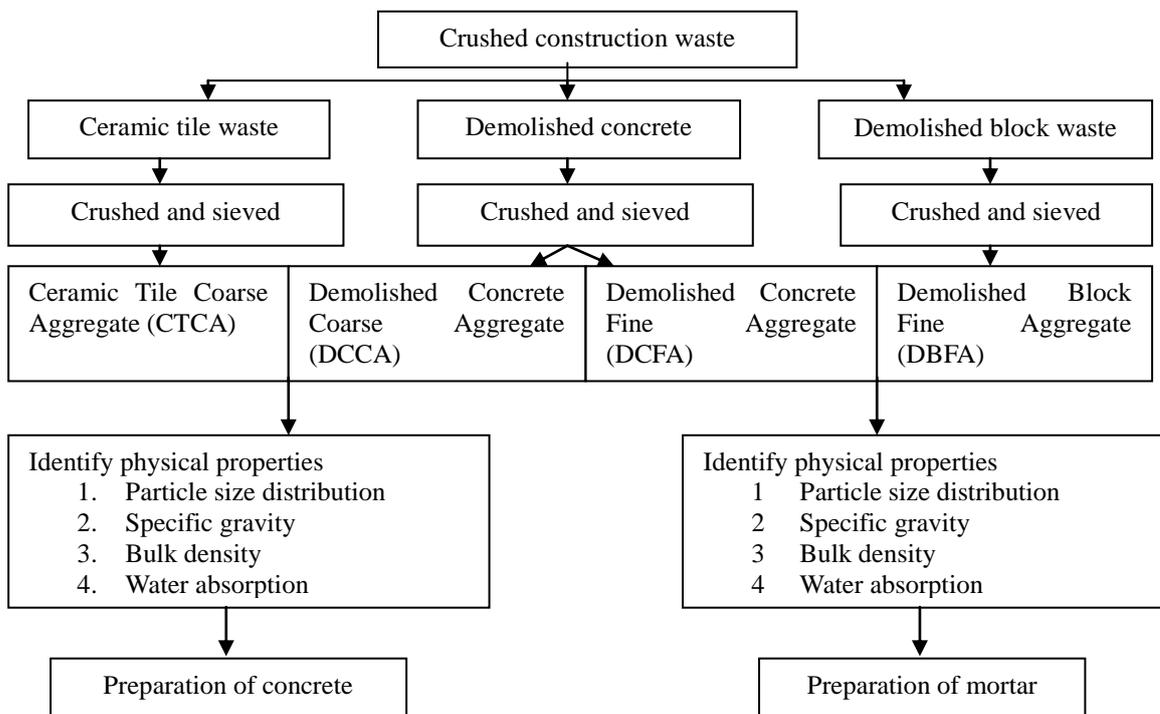
In order to compare the physical properties of above with Natural Aggregates (NA), tests such as Sieve Analysis, Specific Gravity, Bulk Density and Water Absorption were performed in the laboratory. These tests were carried out according to the standard method described in BS 812, BS 882 and BS 1881. To study the engineering properties of concrete tests such as slump test, unconfined compressive strength, tensile splitting strength, flexural strength and Brazilian disc test were performed according to the BS 1881. Batching of concrete was done by weighing the constituent materials based on the adopted mix ratio of 1:1 1/2: 3. The materials were mixed manually. Two types (DCA and CTCA based) of concrete were produced during the study. DCA based concrete specimens were cast replacing coarse and fine aggregates by 0 %, 30%, 60 % and 100 % with DCCA and DCFA. CTCA based concrete specimens were cast replacing only coarse aggregates by 0 %, 30 %, 60 % and 100 % with CTCA. The water/cement ratio was maintained depending on the workability of concrete such that to produce a slump of 100 mm ± 25 mm.

Engineering properties of different mortars were investigated through tests such as unconfined compressive strength, flexural strength, water absorption and cracking susceptibility conducted according to the BS EN 1015. The mortar samples were prepared in this study using Ordinary Portland cement, river sand, DCFA and DBFA. The batching of mortar was done by weighing the constituent materials based on the adopted mix ratio of 1:5.

Cost Analysis

Cost analysis was performed for the best-selected replacement ratio of recycled aggregate concrete and mortar. Price rates for this analysis was obtained from construction demolishing contractors and crusher plants and analysis was performed according to the BSR norms. Eventually, production cost per cube for both concrete and mortar that were made out from processed aggregates was compared with the similar products made with natural aggregates.

Figure 1. Indicate the flow chart for the whole process.



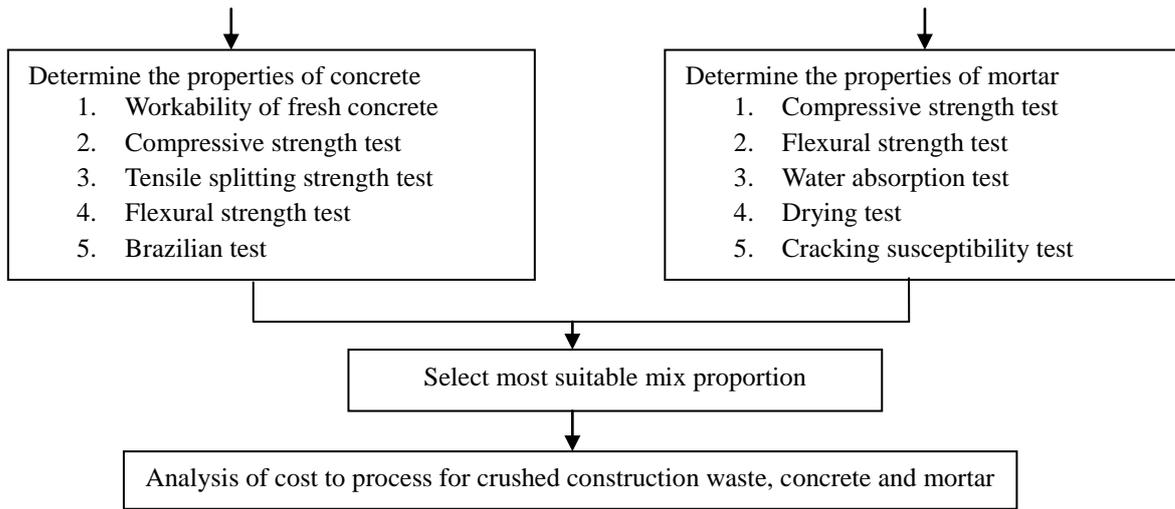


Figure 1. Flow chart of the whole process

RESULTS AND DISCUSSION

Sieve analysis test results for NA, and demolished aggregates

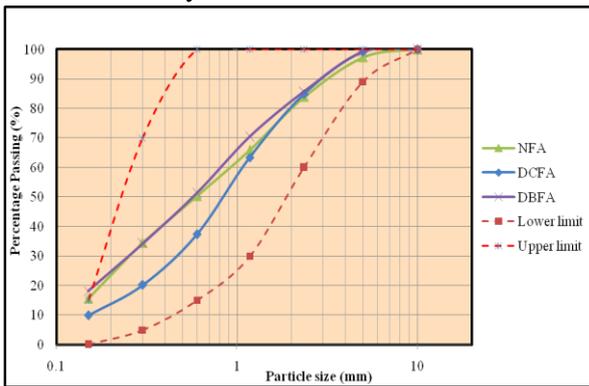


Figure 2. Particle size distribution of NFA, DCFA and DBFA

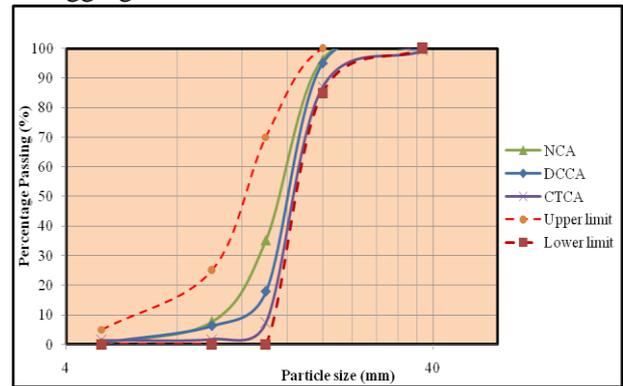


Figure 3. Particle size distribution of NCA, DCCA and CTCA

Table 1. Cost comparison with natural product

Type		Production cost (Rs. /cube*)	Profit Margin %
Type of coarse aggregates	NCA	6500.00	-
	DCCA	2625.00	60%
	CTCA	2778.00	57%
Type of fine aggregates	NFA	9000.00	-
	DCFA	2625.00	71%
	DBFA	3309.00	63%
Type of concrete	NA based concrete	37095.00	-
	DCA based concrete	35297.00	5 %
	CTCA based concrete	35271.00	5 %
Type of mortar	NA based mortar	4788.00	-
	DCFA based mortar	4596.00	5 %
	DBFA based mortar	4617.00	4 %

* Cube = 100 ft³

The results demonstrated that the engineering properties (Particle size distribution, bulk density, specific gravity and water absorption) of demolished concrete have made a positive impact on using them as a partial replacement for NA. In production of concrete, results indicate that the DCA up to 30% and CTCA up to 60% can be effectively replaced with NA in 1:1½: 3 concrete mix of grade 25. Furthermore, the results regarding the properties of mortar testing have confirmed that DCFA and DBFA up to 30% were acceptable to be replaced with sand in production of mortar mix in 1:5. Also, the cracking susceptibility test was done on several samples at 30% replacement of alternative with sand and there was no surface cracking in any sample within 55 days of observation after 28 days curing.

The cost analysis results point out that the use of DCCA, CTCA, DCFA, and DBFA in production of concrete and mortar were more economical when NA were replaced with 60%, 57%, 71% and 63% respectively (Table 1.). In accordance with the results of cost analysis, to prepare concrete and mortar mixes by partial replacing demolished construction waste were more economical than using NA only by 5%.

CONCLUSIONS/RECOMMENDATIONS

Physical properties such as particle size distribution, specific gravity, bulk density and water absorption in DCCA, DCFA, CTCA and DBFA are almost similar the properties of Natural Aggregates.

Therefore, the study indicates that DCA and CTCA are suitable as a partial replacement of natural coarse aggregate in production of concrete and DCFA and DBFA are suitable as a partial replacement of natural fine aggregate in production in mortar.

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PROSTHETIC FINGER DESIGN WITH REDUCED DOF TO SYNONYM HUMAN FINGER

L. R. K. Withana^{1}, R. J. Wimalasiri² and J. W. K. K. Jayasundara³*

¹*Department of Electrical and Computer Engineering, The Open University of Sri Lanka*

²*Department of Mechanical Engineering, The Open University of Sri Lanka*

³*Department of Electronic and Telecommunication Engineering, University of Morotuwa*

INTRODUCTION

The human finger has three distinct sections which hinged in three joints. Different sections of the finger are Distal Phalanx (DP), Middle Phalanx (MP), Proximal Phalanx (PP) and the joints are Distal Inter-phalangeal (DIP) joint, Proximal Inter-phalangeal (PIP) joint, Metacarpal phalangeal (MCP) joint.

As per the day to day requirements, humans do not use the PIP and DIP motions separately. Most people cannot control them separately even desired, as it was not required and thereby not practiced by human beings. Therefore, the actual human finger operation is only two DOF using three separate inputs where the PIP and DIP works in combination.

This phenomenon has opened an opportunity to reduce the DOF to two in designing prosthetic arms and reduce the sEMG or similar input requirements from the user, while keeping the motion of the fingers close to natural movements. By allowing a reduced DOF, it enables the prosthetic arm to use lesser number of sEMG inputs. Also this will be more similar to the commands given to the actual arm by brain. As a result, it will be easy for the people who lost an arm after their birth to practice with the replaced prosthetic arm.

This paper discusses about a novel way of combining the PIP joint and MCP joint such that the two movements are combined to a single movement pattern similar to the actual human finger movement.

PIP joint and MCP joint were connected by a swing arm mechanism that combines their motions, and the torque input operating the PIP joint operates the MCP joint too. A detailed analysis of the actual arm and its dynamic analysis was used to design the joints mechanism of prosthetic arm. After the design, the actual arm and prosthetic arm motions were simulated and compared to check the similarity of the two motions.

[Gizmodo et. el] discusses about a similar approach in his research the PIP joint and DIP joint movements are combined and how they can achieve a human like motion pattern. The paper has a crank slider and the generalized dynamic motion data. But the paper lacks motion comparison with the actual finger and talks about a different mechanical model than discussed within this paper. Also it relies on the linear motion mechanism which can be bulky and expensive to implement.

Most of the prosthetic finger designs and publications talk about separate actuator for DIP joint or no controlled motion. This paper distinguishes among them in that it achieves the human like motion without extra actuator at DIP which compares well with the human finger motion pattern and customizable according to the individual's exact finger motion pattern.

The contribution of this paper is a novel and customizable DIP and MCP joint interface with a similar motion pattern to the actual human finger to reduce the DOF of prosthetic fingers and hence reduce the learning curve of the users.

METHODOLOGY

Human Finger Movement Analysis

The human fingers can move directions defined as abduction and adduction, flexion and

*Corresponding author: Email - lrkwithana@gmail.com

extension as shown in Figure 1. Usually humans do not use Active and Passive extension, and also barely uses Adduction and Abduction in day to day life. Hence the prosthetic fingers do not require motions such as Active/Passive extension and Adduction/Abduction.

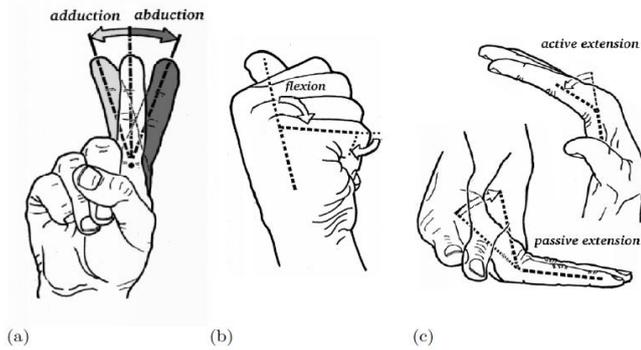


Figure 1. (a) Adduction/Abduction, (b) Flexion, and (c) Active/Passive extension of human fingers [Kamper]

The Human index finger consists of the joints and distinct section as shown in Figure 2.

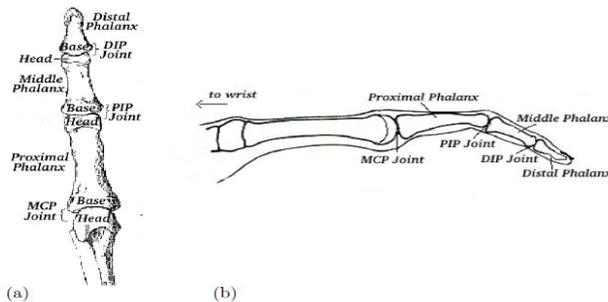


Figure 2. (a) Palmar and (b) Lateral views of the bones and joints of the human index finger [Kamper]

Kamper [1] discusses about a detailed analysis of human finger motions in actual scenarios. They have used motion capture system in Qualisys Track Manager Software (QTM) to individually measure the joint movements. The captured data includes real time monitor and record of position, angle, velocity and acceleration of each data point. The Motion Capture System (MOCAP) was used to animate the recorded motion and test the skeletal parameters. Notable usage of MOCAP is in the study of skeletal parameter by Kirk [6].

These data have been used to measure the fingertip motion profile and plot the motion (Figure 4). Also the same system was used to measure the angles of PIP joint vs. MCP joint and angles of DIP joint vs. PIP joint angles. This analysis offers the very important relationship between these joints in actual motions. As clearly seen in Figure 4 (b), the relationship between MCP and PIP is not clear and consistent, making them two independent joints. But the relationship between PIP and DIP joints is clear and follows the same line, making them highly correlated.

Therefore, the argument of this paper is that these joints can be combined yet having a same kind of human-like motion is well proven with this analysis.

When analyzing the finger motion, the start (initial) position was considered to be the maximum open position where the DP, MP and PP parts are kept in a single line. Then all the angles measured are towards the finger bending direction.

The captured fingertip movement trajectory for a finger motion while engaged in general activities is mapped and plotted in Figure 3 [1]. This motion is a collaborative motion of all the three joints, where the captured collaboration of the joints is shown in Figure 4.

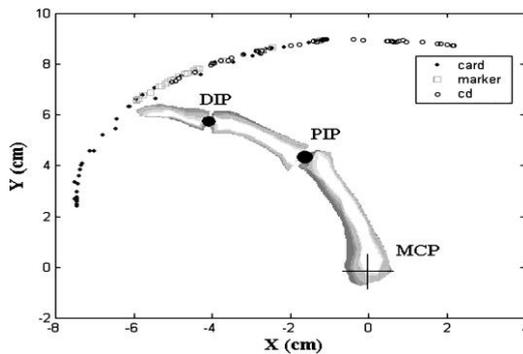


Figure 3. Trajectory of tip of index finger in the x - y plane for 3 different trials: grasping the marker, the CD, or the playing card [1].

Figure 4. shows the relationship plot between DIP vs PIP joints (A) and PIP vs. MCP joints (B). These relationships were captured using 50Hz sampling of finger movement at general daily activities a Cyber Glove [7]. (Immersion Corp., San Jose, CA).

The results obtained by Kamper et. al. [5] is very important for this paper as it offers a baseline of biodynamic data of actual finger movements and joint's relationships. Therefore, the research data [1] was used to this study as a reference baseline to match the designed prosthetic finger.

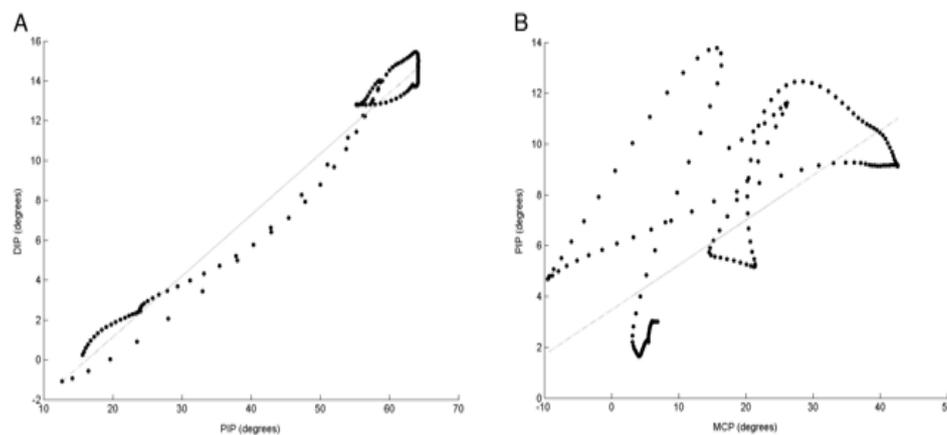


Figure 4. Relation between PIP and DIP joints (A) and relation between PIP and MCP joints (B) in actual human motion [5].

Designed Model and Development of PP and DP joint relationship

The finger model was analyzed, designed, simulated and implemented to synthesize the actual finger movement. To achieve this task, first the general kinematics was used to determine the required motion and DOF. Then an easy-to-manufacture swing arm design was suggested to join the PIP and DIP joint motions. Equations were built using trigonometry to calculate the relationship between PIP and DIP joints using the developed model. These equations were fed to MatLab along with the extracted data from [1] to optimize the design parameters and make the design finger movements as equal as possible to the actual finger. Then, the designed and optimized model was ported to SolidWorks to simulate the motion. Finally, a model finger was designed and manufactured to test the actual finger movement and test the simulation results.

Kinematics and dynamics

As shown in Figure 5, finger kinematic model can be divided into three joints as Metacarpophalangeal joint (MCP) with two DOF along X and Y axis, proximal Interphalangeal (PIP) joint with one DOF and distal Interphalangeal (DIP) joint with one DOF. But for the scope of this research, Y axis motion of MCP joint was neglected and was not implemented in designed models. But some of these joints work in conjunction in the

actual human behavior [8]. Especially for the DIP and PIP joints, the relationship between the two joints can be approximated as $\theta_{DIP} = (2/3) \theta_{PIP}$ [8]. But as proven before [1], this approximation is a little shifted from the actual scenario when the actual finger movements were measured in real life situations.

Based on the biodynamic analysis on the actual finger [1], motion angles of each joint were limited to the following values.

$$0^{\circ} \leq \theta_{PIP_FLEXION} \leq (90^{\circ} \sim 100^{\circ}), 0^{\circ} \leq \theta_{DIP_FLEXION} \leq 90^{\circ}, 0^{\circ} \leq \theta_{MCP_FLEXION} \leq 90^{\circ}$$

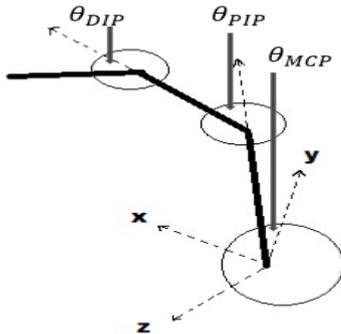


Figure 5. Kinematic model of human index finger.

Figure 6 shows the mechanism used to join the PIP and DIP joint motions by using a swing arm to connect the DP and MP arms. This will interlink the motion between PP and DP arms. Therefore, the DIP joint can automatically be driven from the PIP joint using a single actuator. This mechanism has five variables that can be adjusted to obtain the required relationship between PIP and PIP joints. These variables are shown in Figure 7 and Equation 4. By adjusting these variables individually or using simulation software to optimize the variables to the required PIP vs. DIP graph, the actual finger motion can be duplicated with one lesser actuator and DOF. The result of this implementation is shown in Figure 10, it shows the comparison of the actual finger movement and designed prosthetic finger movement.

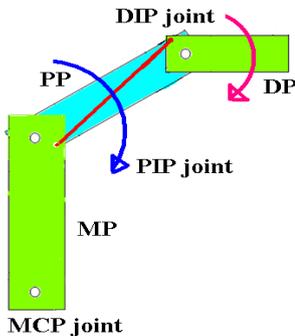


Figure 6. Finger movement PP and DP joints.

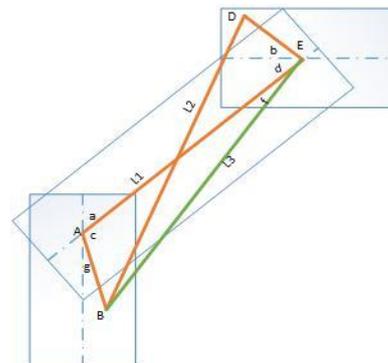


Figure 7. Finger movements PP and DP relationship.

The figure 7 shows the triangle model of the PP and DP joints that are used for building the equations. This model was used with equations (1), (2), (3) and (4) to build the mathematical relationship between the PP joint angle (a) and DP joint angle (d).

In figure 7, L_1 is the PIP joint length, L_2 is the swing arm length, x_1 is AB length (from PP joint to swing arm mounting length), x_2 is DE length (from DP joint to swing arm mounting length), 'a' is the PP joint angle, 'd' is the DP joint angle, 'g' is the swing arm mounting angle at PP joint and 'b' is the swing arm mounting angle at DP joint.

Using the general trigonometry for triangle ABE,

$$L_3^2 = X_1^2 + L_1^2 - 2X_1L_1\cos(c) \tag{1}$$

And from triangle ABE,

$$f = \cos^{-1}[(L_1^2 + L_3^2 - X_1^2) / 2L_1L_3] \quad (2)$$

From triangle BDE,

$$L_2^2 = X_2^2 + L_3^2 - 2X_2L_3\cos(b + d + f) \quad (3)$$

Therefore, using equations (1),(2) and (3), the DP joint angle ‘d’ can be calculated using DP joint angle ‘a’ and other fixed values x1, x2, L1, L2, b as,

$$d = \cos^{-1}[(X_2^2 + L_3^2 - L_2^2) / 2X_2L_3] - b - f \quad (4)$$

These resultant equations and the relationship between ‘a’ & ‘d’ were used for simulation of finger movements, optimization of input variables for finger-like movement and finally to build the optimized models.

SIMULATION, IMPLIMENTATION, TESTING AND COMPARISION RESULTS

With the development of mathematical model, a 3D CAD design was done to check the movement of fingers using Solidworks CAD software. This model offered a secondary method to prove the design by actually simulating the model and observing the finer-like motion. This CAD simulation results are shown in Figure 8.



Figure 8. CAD Design and simulation of Finger movements



Figure 9. Implemented finger and its PP & DP joint movements

Figure 9 shows the first finger prototype built to prove the functionality of the calculated and simulated model. The values calculated using MATLAB for optimize the finger movements and the values were used for build the prototype. The fabricated prototype was moved along with the actual fingers to check the accuracy and tolerances between the actual finger movements.

Actual test data from the biodynamic models [5] and equations (1),(2),(4) from the designed prosthetic finger were implemented in MatLab and the output plots were shown in Figure 10 to compare the relations between PP and DP joints. Using MatLab simulator, the design parameters of prosthetic finger were optimized to match the DP and PP relationship with the actual finger. Final result of DP and PP joint relationship was achieved by changing the design parameters as shown in Figure 10. These graphs show similar movements and relationships between PP and DP joints, and prove the concept of ability to reduce one DOF from fingers without restricting the motion of fingers.

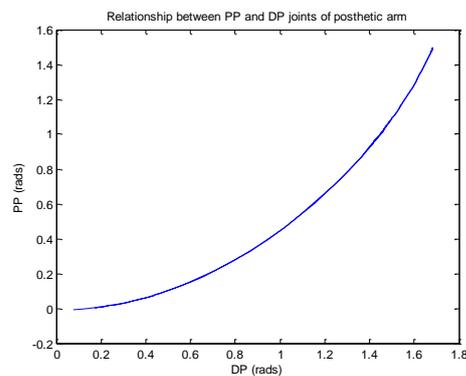
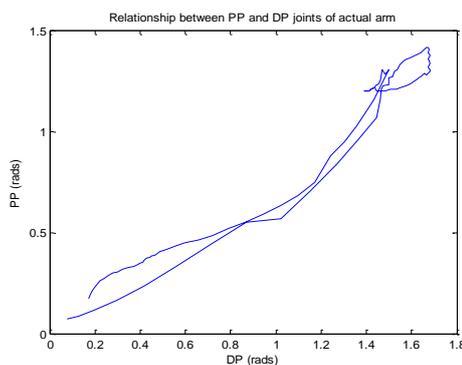


Figure 10. Plot of measured PP vs DP angles [5] and calculated PP vs DP angles as per equations (1), (2), (4) for $x_1 = 1$, $x_2 = 0.5$, $L_1 = 5$, $L_2 = 6$, $b = 2.45$ rads.

CONCLUSION AND FUTURE WORKS

In this paper, a new method of combining PIP and DIP joints to achieve human finger –like motion without an extra DOF is discussed. The proposed mechanism of swing arm, developed equations, simulations to optimize the parameters and actual prototyped finger was demonstrated.

A comparison between actual finger motion and designed finger model is performed. This research achieved a significantly similar motion to the actual finger using a very simple and low cost swing arm based solution. Also the equations (1) to (4) enable changing the parameters and achieving the required motion profile for any given finger.

As the future developments, the following tasks and researches can be conducted.

- Have a detailed analysis of biological finger movement considering gender and ethnicity to validate the consistency of reference input.
- Increase the similarity of the actual and designed finger motions by using simulation software to optimize the parameters.
- Implement the same system to individual fingers, but with different parameters making an arm with individually operating fingers to achieve much similar results.
- Test the designed fingers in prosthetic arms with a fair sample of individuals to test the user experience about the similarity of finger movement to the actual fingers (specially DIP and PIP joints).

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A STUDY ON THE FASHION PREFERENCE OF EXECUTIVE GRADE STAFF: AGE OF 20 TO 30, LADIES FROM THE WESTERN PROVINCE, SRI LANKA

*P. V. M. R. Perera, D. S. Wijerathne**

Department of Textile & Apparel Technology, The Open University of Sri Lanka

INTRODUCTION

Fashion is a distinctive and often habitual trend with current styles in human clothing. It is considered as a prevailing style in human behavior and newest creations in designs. Fashion exists in the society to project human personalities prevailing as non-verbal communication. Fashion comes out as directly made comfort in clothing while setting with the society and the environment. Fashion comes out as business which spread all around the world and earns huge profits with its flexibility to make changes and the process of getting influences on new technology and upcoming sources. Fashion change based on recent fashion trends which were being set by the fashion capitals mainly in Paris, Milan, New York, and London.

After the industrial revolution and world war influences in the 19th and 20th century, fashion and apparel industry gradually began to open up a new chapter in the western society especially with the mass productions. It was made available for buying different stylistic and fashionable clothing. It shows comparatively a low price. Mass productions made different fashionable garments available at lower prices. Fashion came out to be a widely spreading business to cater different life styles of people in all around the world.

As a result of the globalization and the open economic concepts, Sri Lanka opened up doors to go along with the world fashion movements. Sri Lanka is not only followed the fashion trends in the western world but also it contributes to the garment production sector and also began to contribute to the fashion designing aspects of the industry in the 21st century.

The ladies' office wear category was developed mainly to fulfill western social requirements which came out with the Industrial Revolution in 19th and 20th century. As a result of the World war, lack of resources, the Industrial revolution and women's liberation concepts, women's participation in the workforce was substantially increased. Subsequently, a demand for suitable dress codes for ladies was gradually emerged. Thus, ladies office wear category began to develop as mass productions and showed a rapid development and presently it is available with three main sub categories as office formal wears, office executive wears and office casual wears.

Generally, the office wears are designed with limited colour combinations related to the neutral colour schemes, limited and less detail decorations, clear and bold cuts lines (Tate, 2004), less aesthetically decorative accessories and body adornments. Hair normally set in tight or short hair styles and studs or small ear ornaments without hanging decorations are practiced. Foot wears are used to fully cover or half cover the toe areas. Well groomed, sophisticated, elegance and professional look are the main concepts of creating the overall appearance of the dress code. Office formal wear clothing category highly followed the rules and office casual wear clothing category showed more flexibility to add personal preferences on clothing through setting more space to select colours, garment accessories and jewelries.

Features of the fashion trends in office wear clothing category in Spring & Summer 2015 show more tendency to add textural fabric effects and long covered silhouette types. Hourglass looking silhouette type is commonly used in designs to enhance body rhythm and shape. Neck shapes with less deep cuts, long sleeves, high waist tight skirts with long slits, long trouser pants, pleating and patchworks techniques are commonly used to make details (Bichu, 2014). Thick heavy looking materials, neutral and dark color ranges are in common practice.

Ladies office wear collections are one of the leading garment categories that show a tendency to follow western fashion trends in Sri Lankan fashion market. Women workforce in Sri Lanka

contributes with high demand to uplift the economic level in the country. Market research was done using gathered information in retail shops specially related to the Mondy fashion brand available in Sri Lanka. According to the analysis of data, it shows that there is comparatively higher demand for office wear garments in Colombo, Gamphaha and Kaluthra districts.

METHODOLOGY

The study on office wear garment category related to the dress code, colour, and designs were done through the secondary data gatherings through the books, journals and online study materials. Office wear fashion trends in 2015 were identified referring to the available websites and online resources.

The study on present fashion preferences related to ladies executive staff belonging to the age group between 20 to 30 years was done through the survey by administering a questionnaire. Twenty five questions were developed in the questionnaire in order to identify preferences on office wear designs and to understand their awareness on new fashion trends of 2015. The questionnaire was focused on identifying fashion concerns of lady executives of Sri Lanka specially related to the Gamphaha, Colombo and Kaluthara districts. Information regarding office wears, dress codes or designs related to organizations was excluded in this study.

Pilot run was conducted among twenty ladies who were in the executive grades in the Western Province of Sri Lanka taking nine from Colombo, six from Gampha and five from Kaluthara districts. Final distribution of the questionnaire was conducted among fifty of Lady Executives that comprised twenty-one from Colombo District, fifteen from Gampha District and fourteen from Kaluthara district. Questionnaires were analyzed in terms of their preferences on designs of office wear category and their likeness to be with new fashion trends.

RESULTS AND DISCUSSION

Questionnaires were analyzed for five main areas as to know preferred silhouette type for office wear designs, style of the design details related to the sleeve type , front look of the bodies and collar types, colour selection, material preferences and their relevant features to select a clothing for office wears.

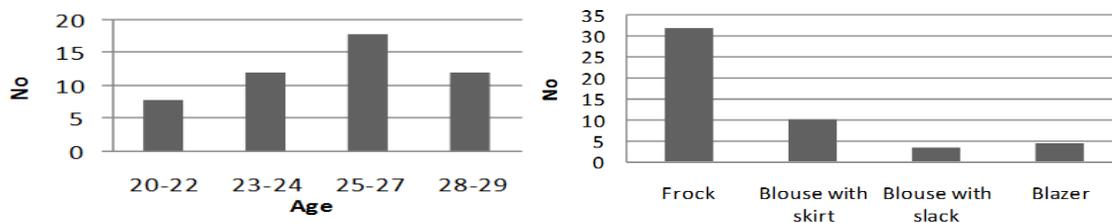


Figure 1: Number of participants related to age **Figure 2:** Preferences on silhouette type for office wears

Figure 1. Shows the breakdown of their preferences according to the survey. Frock and blouse with skirt are the most preferred garment category for office wear designs as the results shown in figure 02. It expresses that their likenesses to present themselves in rectangular, invert triangular or hourglass silhouette types. Round shaped or balloon shaped silhouette types are commonly not used for the office wear garment designs (Gehlhar, 2008).

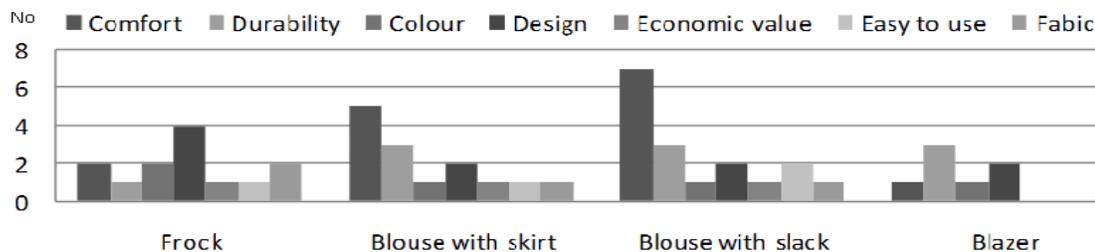


Figure 03 shows the preferences of selecting the office wear garments related to comfort, durability, colour, designs, economic values, easy to wear and fabric type. According to the analysis, preference is given to design of the frock as their first choice and comfort, colour and fabric type as their second preference in selecting a frock for office wear.

When selecting a blouse and skirt for office wears, comfort ability is considered as first preference. Durability and design are considered as second and third. Colour, economic value of the garment, practicality and the fabric type are lower level concerns when selecting a blouse and skirt.

Comfort is the main concern for selecting blouse with slack for office wears. Durability, design and practicality are their second concerns. Colour, economic value and fabric type are lower level concerns. Blaze designs are selected considering durability and the design of the item.

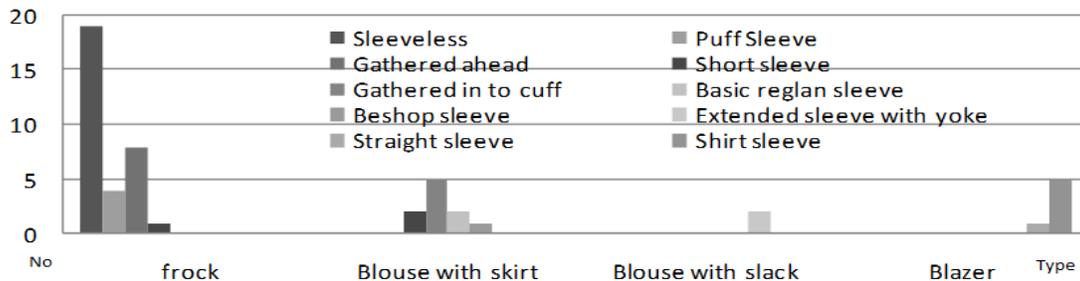


Figure 4: Preferences on sleeve types related to the silhouette type

Figure 04 present the preferences on sleeve types related to the silhouette type. Sleeveless designs are highly preferred for frocks and sleeves with gathered ahead are the second choice. Puff sleeves and short sleeves are only preferred as next. Gathered sleeves are main preference on blouse with skirt and shirt sleeve is mainly selected for blazer designs. The selection shows the tendency to take more ease for hand movements.

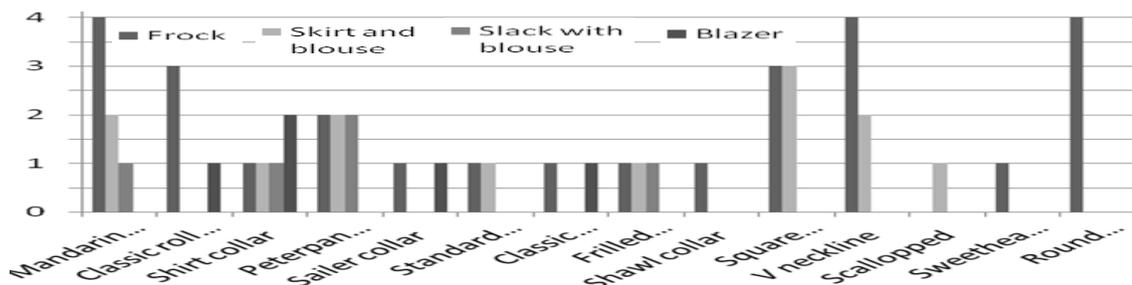


Figure 5: Preferences on collar types and neck lines

Figure 05 shows the preferred collar type and neck lines according to the silhouette category. Mandarin collar, Classic roll collar and Shirt collar shows high demand for frock styles. Mandarin collars and Peterpan collars are more preferred on blouses with skirt or pants. When it comes to the neck lines, V neck and round neck styles got more demand for frock styles and square and V neck line lines are more preferred on blouse styles. According to the survey selected collar styles and neck lines show simple design details and add more attraction and professional look to the appearance.

Figure 06 shows the front detail appearance of the bodice pattern related the silhouette type. Double breasted front and plain front are most preferred style features for frock styles and standard button lines and asymmetrical front lines and shows high demand for top and blouse styles. Figure 07 shows the colour preferences of selective group on office wear collections. Colours for office wear categories are selected mainly related to neutral colour range like black, white and grey and dark colour range related to navy blue, dark green and dark red and light and soft colour range like pink and yellow are selectively used in questionnaires. Black and white got comparatively high demand. Figure 08 shows the preferred fabric material type related to the silhouette category. Cotton is the most preferable fabric type for all garment categories and the

linen shows the second preference.

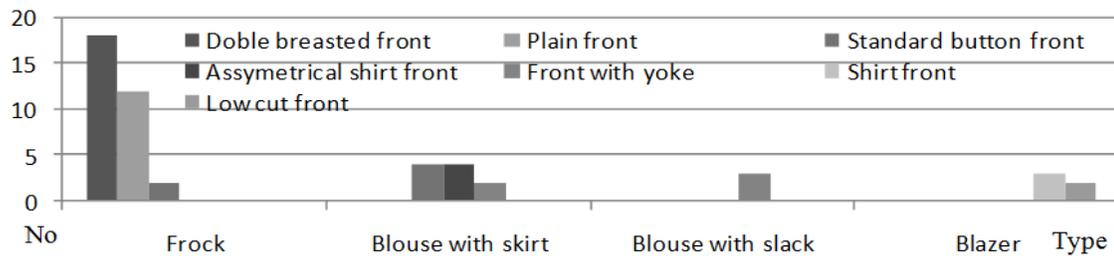


Figure 06: Favorite front styles in bodice

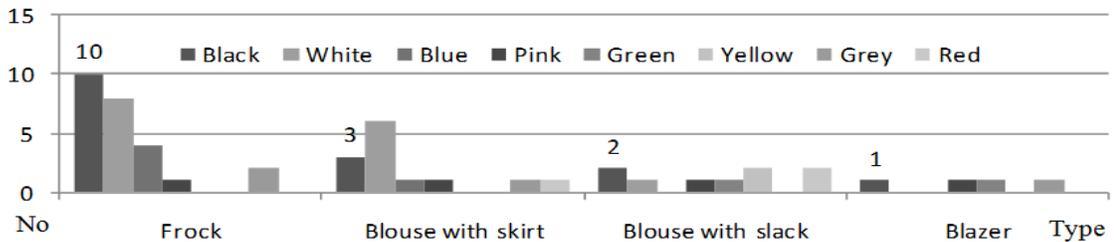


Figure 07: Colour preferences

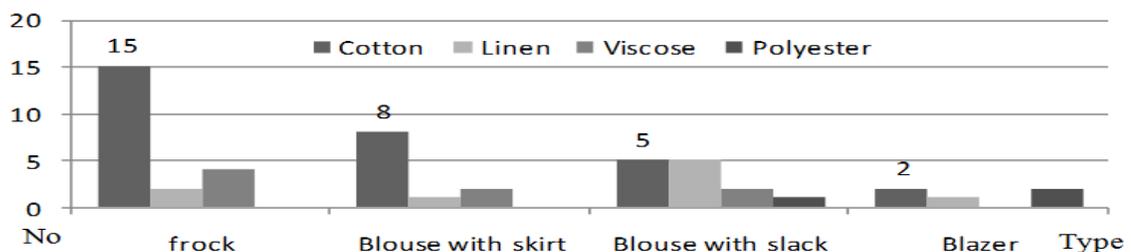


Figure 08: Material preferences

CONCLUSIONS/RECOMMENDATIONS

According to the analysis of the survey results, ladies who work in the executives' grade in Sri Lanka are concerned about comfortable designs and fabric types related to the environmental conditions and practicability. Frock is most preferred with sleek, elegant and sophisticated look. It is required more freedom for hand movements. Collar Selection, neck line selection and front style feature selection not directly goes with western fashion trends come out in 2015 spring and summer collections in office wear designs. Black and white colour range is the most preferable for office wear designs and the colour selection goes with the colour trends for 2015 office wear collections.

Ladies who work in executive grades, Western province in Sri Lanka show good sense in fashion selection considering their practicality of the work place and new fashion trends come out in global fashion world. They show more tendencies to be with new designs considering the suitability of the garment. With that office wear garment category has adequate market in the Western Province in Sri Lanka.

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THE EFFECT OF DETERGENTS ON COLOUR DETERIORATION OF WHITE SCHOOL UNIFORM SHIRTING MATERIALS USED IN SRI LANKA

S. Balakrishnan¹ and M. E. R. Perera¹

¹The Department of Textile and Apparel Technology, The Open University of Sri Lanka

INTRODUCTION

Colour fastness is one of the most important factors of buyers' demand. Colour fastness refers to the resistance of colour to fade or bleed of a dyed or printed textile materials to various types of influences e.g. water, light, rubbing, washing, perspiration etc. (Lawal and Nnadiwa, 2014). As per the standard "Boys' shirting and Girls' dress fabrics" developed by the Sri Lanka Standards Institution, the white colour school uniform shirting materials can be tested for colour fastness. The white is also considered as a colour agreed between the purchaser and the supplier (SLS 1060 part I, 1995).

White school uniform shirting materials are used by most of the school children in Sri Lanka. Most of the school children have only 2-3 uniforms at a time, so that they have to wash them once or twice a week. One of the major complaints is that the deterioration of color of the uniforms with the usage. People in Sri Lanka use different types of detergents for washing. They also employ different washing conditions. There may be large number of possible reasons for the deterioration of colour during the usage of the white school uniforms. One of the major factors could be the detergents used in washing. The main objective of this research is to investigate the effects of detergent types on colour deterioration of white school uniform shirting material. ISO 105 C06 testing standard was used to investigate and for comparison purposes of the above mentioned aspect. The Delta E values were used to determine the degree of colour deterioration. The recent studies have proposed that when Delta E value exceeds 2.3, the change of colour is noticeable to the human eye (Mahy et al, 1994).

METHODOLOGY

The study was carried out as mentioned below.

1. A literature survey was carried out to identify the factors, which may influence the colour deterioration of textile materials.
2. The testing standard, white school uniform shirting materials, machines and equipment for testing were selected and the most frequently used three (03) detergent types for washing of school uniforms were identified.
3. Fabric samples for washing were prepared.
4. The samples were washed as per the standard using three detergents using only water. They were tested for colour deterioration using the "Data Color Machine 600" and the necessary data was collected and analyzed to determine whether the used detergent types have an impact on the deterioration of colour of white school uniform shirting materials.

*Corresponding author: Email- meper@ou.ac.lk

EXPERIMENTAL DESIGN

The composition of white school uniform shirting material, details about the machines, equipment and the testing standard used are shown in the Table 1.

Table 1. Selected conditions for the experiment

Selected conditions for the experiment	
Fabric	Fibre content: 65% Polyester and 35% Cotton, Fabric structure: Plain weave, Weight: 101 g/m ² , Warp yarn count: 13.1 tex, Weft yarn count: 13.1 tex, Ends per inch: 116, Picks per inch: 78
Washing Fastness Tester	Washing Fastness Tester (B-Test) , which confirms with the international standard ISO 105-C06
Color Assessing Machine	Data Color Machine 600
Testing Standard	ISO105-C06
Water	Grade 3 water as per the standard ISO 3696
Bath conditions	MLR: 1:50, Temperature: 40 ^o C, Detergent concentration: 4g/l
Duration of Testing	30 minutes

The Table 2 shows the details about the detergents used in this experiment. This is the only variable parameter of the experiment. Water without any detergent was used for comparison purposes.

Table 2. Selected detergents for the experiment

Detergent type	Chemical composition
Detergent type A	Sodium metasilicate, Sodium carbonate, Sodium chloride, Alcohol ethoxylate and Water
Detergent type B	Sodium carbonate, Sodium aluminosilicate, Sodium alkylbenzene sulfonate, Alcohol ethoxylate , Sodium perborate monohydrate
Detergent type C	Oxygen cleaner, Simple green cleaner, Water, Softening powder

PREPARATION AND TESTING OF SAMPLES

Twelve panels from the white school uniform shirting material were cut. The dimensions of a cut panel were 4 cm x 10 cm. Each cut panel was kept between a 100% polyester cut panel and a 100% cotton cut panel of the same size and stitched loosely along one of the shorter edges by using a single needle lock stitch machine. With each detergent type three samples were washed. The other three samples were washed with water. Then the samples were rinsed and dried. After that the outer materials were removed and by using the Data Color Machine 600 Delta E values were obtained.

The washing procedure was repeated 20 times with fresh washing solution each time for the same white uniform shirting materials stitched with new 100% polyester and cotton cut panels. The samples used for comparison were also washed 20 times only with fresh water. The average Delta E values of the three samples washed with each detergent and water were calculated individually after each washing cycle.

RESULTS AND DISCUSSION

Table 3 gives the average Delta E values of the three samples washed by using three types of detergents and water. The values are given for 20 washing cycles.

Table 1. Average Delta E values of the four washing experiments against washing cycles

Washing cycles	Washed with detergent A	Washed with detergent B	Washed with detergent C	Washed with water
1	0.39	0.73	0.53	0.23
2	0.41	0.80	0.84	0.32
3	0.49	1.24	0.98	0.37
4	0.83	1.31	1.00	0.50
5	0.93	1.43	1.09	0.51
6	1.06	1.63	1.07	0.53
7	1.32	1.73	1.17	0.54
8	1.36	1.69	1.27	0.62
9	1.38	1.81	1.38	0.66
10	1.62	1.92	1.84	0.70
11	1.83	1.90	2.65	0.74
12	1.92	2.05	2.69	0.74
13	2.01	2.07	2.93	0.77
14	2.10	2.42	2.97	0.82
15	2.36	2.48	3.27	0.92
16	2.42	2.52	3.19	1.20
17	2.66	2.62	3.48	1.26
18	2.79	2.68	3.85	1.34
19	2.83	2.71	4.01	1.36
20	2.89	2.75	4.19	1.40

The columns 2, 3, 4 and 5 of the Table 3 show the average Delta E values for 20 washing cycles of the samples washed by using detergents A, B, C and water respectively. The lowest Delta E value after 20 washing cycles was 1.40 and it was resulted by the samples washed with water. The highest Delta E value after 20 washing cycles was 4.19 and it was resulted by the detergent type C. The maximum Delta E values given by the samples washed by detergent A and B are 2.89 and 2.75 respectively.

As per the Figure 1, that there is a gradual increase of Delta E values with increase number of washing cycles. This trend is common for all three detergents and water. Washing with water has resulted the lowest changes of Delta E values. The rate of increase of the Delta E values for the samples washed with detergents A, B and water have become very low after 16 washing cycles, whereas the samples washed with detergent C show upward trend even after 16 washing cycles.

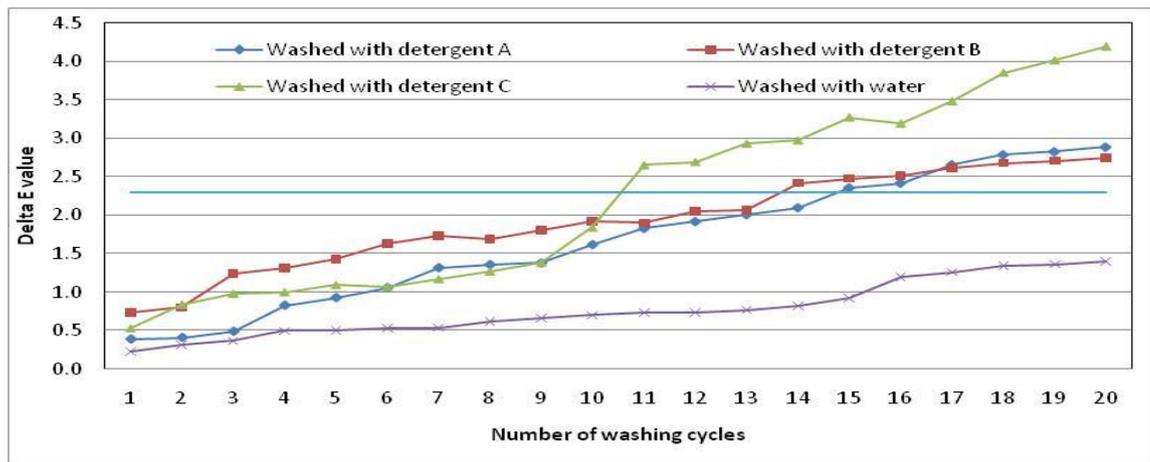


Figure1. Variation of the Delta E values against number of washing cycles

CONCLUSIONS AND RECOMMENDATIONS

The value Delta E is used to express the colour change in many applications. The recent studies have proposed that when Delta E value exceeds 2.3, the change of colour is noticeable to the human eye. This value is termed as the “Just Noticeable Difference”. The samples washed with detergents A, B and C have crossed the “Just Noticeable Difference” value 2.3 after 15, 14 and 11 washing cycles respectively. Therefore, the colour deterioration is visible to human eye after the above mentioned washing cycles for the studied detergent types.

As per the results, it is obvious that all the detergent types affect the colour of the selected white school uniform shirting materials. It appears that detergent C continuously affects the colour even after 20 washing cycles. This detergent may be probably harmful to the fibre materials as well. Hence it is necessary to carry out further research to ascertain whether it causes any measureable reduction in strength. Therefore, attention must be given when selecting detergents for washing white school uniforms. Though the water without any detergent has given the least colour change, washing with only water is less effective in removing dirt and soils from the white school uniforms.

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SOFTWARE PABX PILOT DEPLOYMENT IN CAMPUS NETWORK OF THE OPEN UNIVERSITY OF SRI LANKA

M. Punchimudiyanse^{1} J. P. P. Tharanga¹ and E. M. S. S. Edirisinghe²*

¹ *Department of Mathematics and Computer Science, The Open University of Sri Lanka*

² *Information Technology Division, The Open University of Sri Lanka*

INTRODUCTION

A private automatic branch exchange (PABX) is an automatic telephone switching system within an institution used in their communication needs. Electronic PABX systems incur huge costs for upgrading and maintenance based on the number of telephone extensions. Generally, telephone service providers assist an institution in connecting its branch offices. Advancement of technology has paved way to have digital connectivity to the PABX systems from telephone service providers via E1/T1 links where multiple telephone connections provided through a single wired or wireless connection.

Corporate institutions are moving towards software based PABX systems that use session initiation protocol (SIP) and their voice calls are routed over computer networks connected to the Internet. This is termed as voice over Internet protocol (VoIP) technology. We present a pilot project that is carried out to deploy a SIP based PABX over the campus wide computer network of the Open University of Sri Lanka (OUSL). The OUSL has the largest distributed computer network belongs to a government university in Sri Lanka, which interconnects its six regional centers situated in different provinces of the country via VPN. The primary solution is to provide a software phone (soft phone) to a user PC and the secondary solution is to have intercom calls routed to Smart phones of employees via OUSL WIFI network. This PABX system is capable of reducing call costs by routing the intercom voice communications through a VPN and connecting IP phones for places that require physical phones.

TECHNICAL BACKGROUND

Session initiation protocol (SIP) is an application layer signaling protocol, which is capable of creating, maintaining, tearing down of sessions with multiple users. The first version of this SIP protocol is developed by Mark Handley, Henning Schulzrinne, Eve Schooler and Jonathan Rosenberg in 1996 (RFC2543). Then the SIP version 2 (RFC3261) is the current version published in 2002. The SIP protocol uses text-based messages in communications in performing five functions, namely, user location and registration, user availability, user capabilities, session setup and session management.

SIP can run over internet protocol (IP) version 4 and 6 and uses either user datagram protocol (UDP) or transmission control protocol (TCP). Most implementations use UDP and IP version 4 as UDP reduces the overheads in maintaining connections. Actual voice communication happens in peer-to-peer mode most of the time unless there is network address translation (NAT) between two clients.

A SIP client uses session traversal utilities (STUN) protocol to discover the public IP address if it is behind NAT. A STUN server helps the client behind NAT to set up calls through peer-to-peer IP connectivity using their respective public IP addresses. In corporate networks with firewalls controlling the in/out traffic, there can be restrictions to using STUN in making the call establishment difficult. The answer to that problem is using traversal using a TURN server (relays around NAT) server residing in the public side (Internet side) of the network, which provides media relaying service to clients when both SIP clients are using NAT.

ICE (Interactive Connectivity Establishment) protocol negotiates the mechanism of setting up

*Corresponding author: Email - malinda@ou.ac.lk

a call between two parties using STUN and TURN. It enables successful traversal through NAT in UDP based multimedia sessions established with protocols like SIP, which has offered/answered model of communications. The real-time transport protocol (RTP) transports actual voice data between two clients after SIP protocol setting up the connection. A standard voice codec, such as a-law, u-law, GSM, Speex, g722, g723, g726 and g729 encodes the voice data of a SIP call. The Secure RTP protocol encrypts a voice call to prevent eavesdropping. The initial key negotiation for SRTP is through plain text, which is insecure. Hence, the line is secured using TLS (transmission layer security) or ZRTP (composed of Z and Real-time Transport Protocol), which is a cryptographic key-agreement protocol that negotiates the keys for encryption between two endpoints in a VoIP call. In order to use the voice encryption, all clients participating in a voice call should have the encryption support in their soft phones.

METHODOLOGY

We found that the Asterisk is the most popular free PABX engine that utilizes the SIP protocol. It also has a native protocol named inter-asterisk exchange (IAX) in addition to the SIP protocol. Software based commercial PABX system named 3CX is having a free version, which only supports two simultaneous voice calls. The FreePBX and Elastix are popular free web based frontends to the Asterisk based PABX systems. Both Freepbx and Elastix provide additional features, appliances, hardware components and set of IP phones for a fee. In this pilot project, we have installed both Freepbx and Elastix in two different virtual machines and compared the free features by connecting software phones and smart phones. We opted for the Elastix front-end because it gives more features free such as call center, operator panel and endpoint management interface.

We have carried out an e-mail based survey to find OUSL employee feedback on available resources, their interest in having an intercom and to get their participation in the pilot project. In the pilot setup, we have deployed Elastix PABX on a virtual machine with the intention of moving it to a physical machine to connect SIP trunks in the future. We have focused on giving a particular user the ability to publish their presence of information in the Elastix so that if a user is not interested in receiving calls at a particular time, (eg. Meeting, not at a desk, busy with important task) he/she can mark the presence status as busy. Then the PABX forwards incoming calls to his/her voice mail. We have set up two extension numbers per user, one extension is intended for soft phone application installed on user's PC and the other extension is for user's Smartphone. We have enabled the hunting, call waiting and call conferencing features for those two extensions. In the hunting feature, if the user is not answering the desk extension, call will be automatically forwarded to Smartphone extension, if the smart phone is not answered or marked as "Do not Disturb" then the call is forwarded to voice mail. We have configured TCP for calls over VPN and the rest utilizes UDP within OUSL central campus.

Software Phone Selection for PC and SmartPhones

In this research, the project team has tested several free software phones for the compatibility in different Operating systems; ease of installation by the end-user themselves, Simplicity and features available such as encryption and call conferencing facility. Out of those applications, we chose the soft phone X-Lite for a typical Windows and Mac user who needs maximum of 3 way call conferencing but X-lite lacks the call forwarding feature. The Yate-client is selected for the power users who need to have more than three way call conferencing and call forwarding (attended) features and the installation on Windows, Linux and Mac OS distributions. The Yate client lacks call split feature when we want to break a conference call to individual calls but X-lite has it. The Ekiga soft phone also can be used for Linux clients.

The Zoiper soft phone supports windows, Linux and Mobile platforms android, IOS and Windows mobile. However, Zoiper does not allow call transfer, call conference features on its

free version. We used it as a compatible client for IOS, Android and Windows phone. For the phones with Android 4+ operating systems, we chose GS-wave as soft phone that has call encryption, 6 way conferencing and call transfer features. The Csipsimple soft phone is used as the android soft phone for a wider compatibility in the phones with older android versions.

RESULTS AND DISCUSSION

Our e-mail survey has received 82 responses indicating over 90% of the participants like to have their own intercom number. Over 80% of participants have an official PC connected to OUSL wired network, which is not shared with other users. Only 6% said “No” to receive intercom calls to their PCs while 48% said “YES” and 46% would like to try that out.

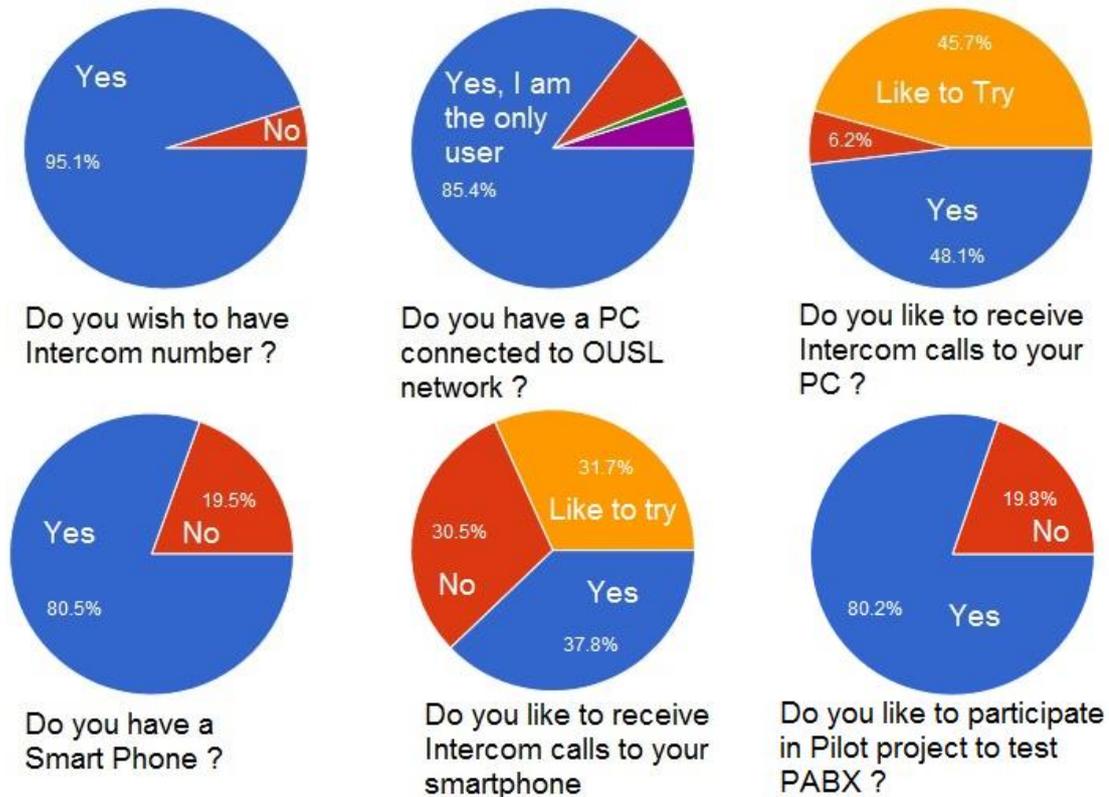


Figure 1. Outcome of the survey on intercom facilities for desktop PCs and Smartphones

The results of our survey also indicated that Smartphone density among the staff of OUSL is around 80%, while android OS dominated with around 85% and windows mobiles 12%. OUSL WIFI coverage is sufficient to cover almost every area in Colombo premises and providing user accounts to the needy users are underway. Intercom over WIFI is tested with users who have the WIFI connectivity and around 30% of people do not want to receive intercom calls via WIFI. 80% of the users have shown interest in participating in the pilot project, which is a huge motivational boost for us.

The OUSL campus network is protected by multiple firewalls and NAT is used only when traffic is routed to the Internet. Necessary ports are opened in firewalls to route traffic between the PABX and clients (PC and Smartphone) residing in different subnets while ensuring only RTP and SIP traffic is routed via those ports. Since NAT is not taking place, even the regional center clients could connect to PABX without ICE, STUN or TURN. The SIP over TCP and default public STUN servers accessible from the soft phones are proposed to connect the PABX and the clients through ADSL from the study centers of OUSL. We have created 30 extensions in the Elastix PABX system and tested for proper connectivity with both PC client and Mobile client via the WIFI network. We had a maximum of 12

simultaneous calls and a 4 way conference call with a mobile client. The System worked well with wired network while Smart phones worked well within the WIFI coverage area of fair signal strength. When the signal strength is low, high jitter and connection dropouts have occurred. Table 1 depicts the features that are tested for the proper functionality in the PABX.

Table 1. Features tested in the PABX System

Feature	Expected Result	Result
Two way call / Presence	One party calls an extension and it rings for pickup when soft phone status is available.	OK
Call waiting / forwarding	Alert a person in a call that they receive another call, forward calls blind mode and attended mode	OK
Call encryption	The call is encrypted and display a locked sign in mobile application	OK
Consultation	Keeping one call on hold and dial another number for getting a quick feedback	OK
Follow me service	Automatic forwarding of the call to Smartphone extension when PC extension is not answered, subsequently forward to voice mail when no answer to both extensions.	OK
Directory service	When first few letters of a name entered using the dial pad, PABX search and spell it out for dialing.	OK
Voice Mail	The call is forwarded to Voice mail when an extension is not answered. Indication and retrieval of voice mails	OK

CONCLUSIONS/RECOMMENDATIONS

The Software based PABX system is successfully tested within OUSL network and had no bandwidth issues in both wired and wireless networks with 12 simultaneous calls. Around 68kbps bandwidth is needed per voice call. High jitter, call dropouts occurred in places of poor WIFI signal strength. A campus wide deployment of this system is feasible and the outside telephone lines can be connected through SIP cards. If proper SIP trunks and number systems are negotiated, PABX systems in all the Sri Lankan universities can be linked via LEARN academic network.

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A WEB-BASED DOMAIN SPECIFIC COMPILER FOR DESIGNING EMBEDDED SYSTEMS

C. W. S. Goonetilleke^{1*} and C. J. Basnayake^{2*}

^{1,2}*Department of Electrical and Computer Engineering, The Open University of Sri Lanka*

INTRODUCTION

A Domain-Specific Language (DSL) is a computer language which specializes to a particular application domain. The realization of DSL differs in fundamental ways from that of traditional programming languages or General-Purpose Language (GPL). In contrast to a GPL, which is broadly applicable across domains, DSL lacks specialized features for a particular domain. DSL can be further subdivided by the kind of language, including domain-specific markup languages, domain-specific modeling languages, and domain-specific programming languages (Mernik, Heering, & Sloane, 2005). Domain Specific Compilers (DSCs) are used to compile a DSL and generate byte code or intermediate GPL code from DSL (Spinellis, 2001). Since DSLs allow solutions to be expressed in the idiom and at the level of abstraction of the problem domain (Mernik, Heering, & Sloane, 2005). The idea is, domain experts (in this case 8051 based developers) may understand, validate, modify, and often even develop DSL programs. But it is involved with the cost of learning a new language vs its limited applicability. Also the difficulty of balancing trade-offs between domain-specificity and GPL constructs like C language and Assembly Language Program (ALP) (Gregor, Stanislav, & Giovanni, 2010).

To overcome the above difficulties involved with DSL, DSCs can be designed as Visual Programming Language (VPL) which lets users create programs by manipulating program elements graphically rather than by specifying them textually (Enderle, Guenther, Hilscher, & Kenn, 2009). Scratch is a famous example for VPL. In Scratch there is no compilation step or edit/run mode distinction. Users can click on a command or program fragment at any time to see what it does (Gregor, Stanislav, & Giovanni, 2010). But in hardware based VPL design, logic flow is specifically depended on the hardware integration and therefore it is needed to have VPL code compilation rather than instant interpretation. Unlike Scratch Flow code is an example for a commercially available VPL which can be used to program embedded devices such as PIC, AVR and ARM using flowcharts instead of a textual programming language and compiles the VPL code against hardware design. But with VPLs, it is needed to create additional modules to manipulate new hardware and it also involves with lacking optimizations to binary code (Enderle, Guenther, Hilscher, & Kenn, 2009). Also, when comparing to textual based DSL, VPL based DSL is not suitable to implement complex codes in an efficient way since it keeps away developer further from the hardware level implementation of microcontroller (Gregor, Stanislav, & Giovanni, 2010). Therefore, present VPLs are not suitable to get understand working principles and architecture of an embedded system or a microcontroller. Programmers might need to have sophisticated hardware equipment and software tools for programming using present DSL based VPL compilers (Enderle, Guenther, Hilscher, & Kenn, 2009).

By getting advantages of both DSL and VPL, DSL can be extended with VPL and the entire compilation tasks can be moved to separate server by enabling web access to VPL tools. This approach is titled as a Web-based Domain Specific Compiler (WDSC). Since WDSC is web based, the programmer can create their programs online via using internet connected devices. Ultimately the programmer can design and program microcontroller based embedded system with sensors and actuators using WDSC, which consists with drag and drop UI. The entire process-flow can be designed and programmed using simple flow diagrams. The programmer

*Corresponding author: Email - charitha.ws@gmail.com/cjbas@ou.ac.lk

will be able to design an entire embedded system within a short duration and compile it via online by using WDC. The programmer only has to download the generated byte code from WDC into the microcontroller with a console cable and IC burner. The main objective of this project is to design the WDC that provides these advantages by minimizing the above difficulties.

METHODOLOGY

WDC consists of multiple levels of language implementation as shown in Figure 1. It has high level DSL generation from VPL, DSL to Assembly Language Program (ALP) compilation and byte code generation from the ALP.

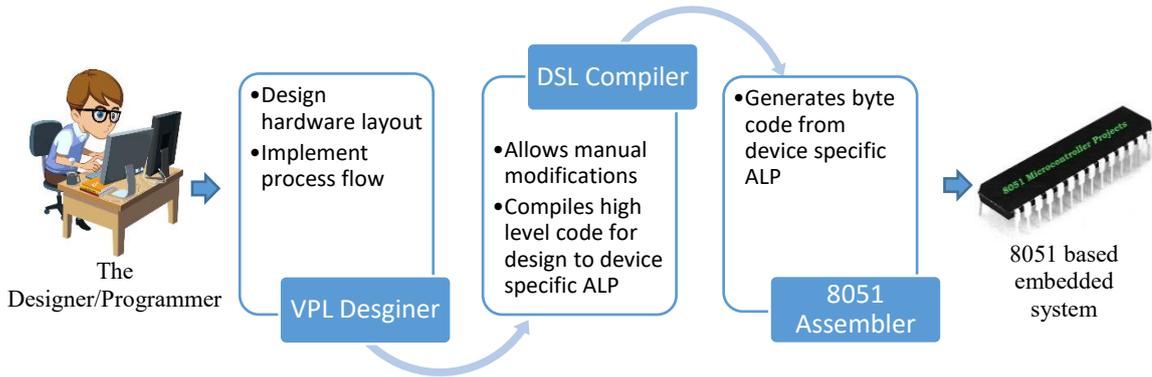


Figure 1. – Layers of WDC compiler

Figure 2 shows the WDC framework of 8051 based embedded system application design. The VPL implemented as a web user interface (WUI). It has two designing stages. The stage one is to design a hardware connectivity (physical design) and the stage two is to design and implement a logical design respectively. Based on physical design and logical design, the VPL generates DSL code using Java script based VPL to DSL interpreter. Programmer can modify DSL manually if required using the Code View UI. Also the programmer can generate the ALP or can download the byte code as a HEX file by using the Code View. DSL compilation is done by the server side DSC. The DSL is uploaded to the server for compilation from the client side. DSC is implemented using C++ and with the help of Lex and Yacc tools for implementing the lexical analyzer and the syntax analyzer. The code generator for DSC is also written by using C++. Server side also consists with 8051 macro assembler to generate the HEX file from the ALP.

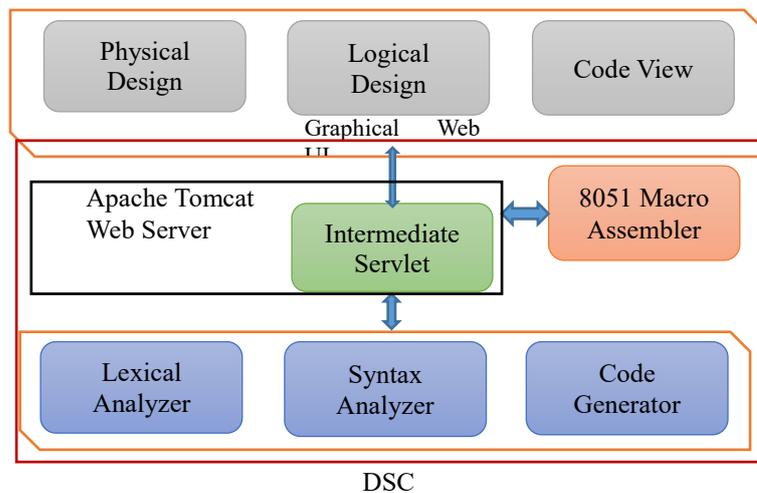


Figure 2. – WDC framework

GRAMMAR BEHIND THE DSC

There are four types of grammars available in deriving the DSC (Krithivasan, 2015). Basically DSC uses context-free grammar. The Grammar *G* of the DSC is shown in the Figure 3.

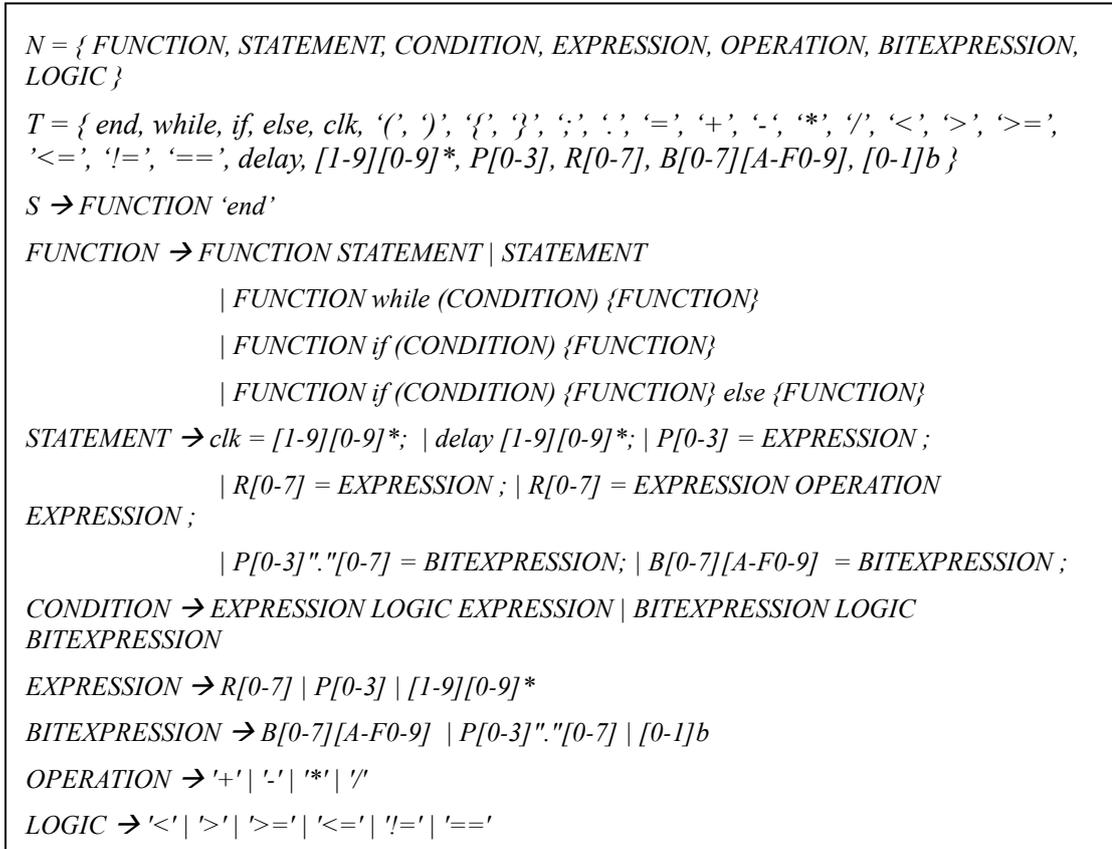


Figure 3. – Grammar of the DSC

$G = \{N, T, P, S\}$; Where, *N* – Nonterminal strings, *T* – Terminal strings, *P* – Production rules and *S* – Start symbol

RESULTS

To verify the WDSC functionality sample scenario carried out by implementing digital weight scale. Figure 4(a) showing connected weight sensor and Seven segment display while Figure 4(b) showing the logic flow and code snippets. Figure 5 showing the DSL code and generated ALP.

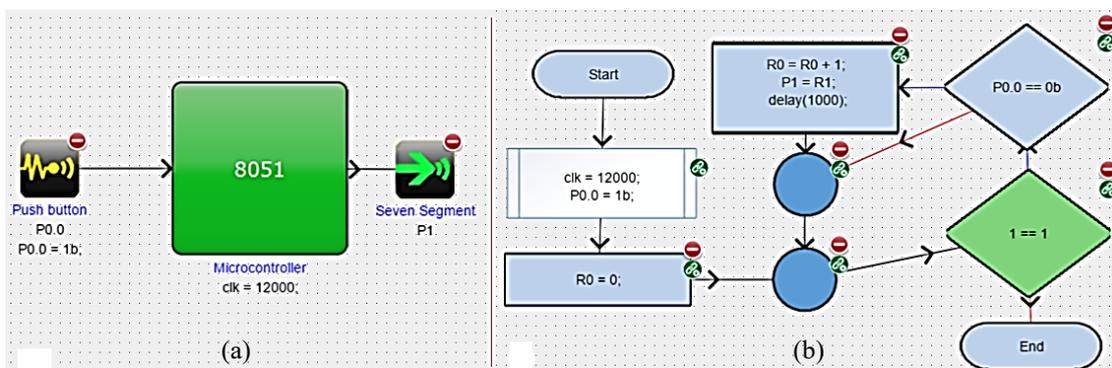


Figure 4. – (a) Physical Design & (b) Logical Design WUIs

The screenshot shows the '8051 Graphical Compiler' interface. At the top, there are tabs for 'Design', 'Logic', and 'Code'. Below the title bar, there are buttons for 'Save', 'Copy', and 'Compile'. The main area is split into two panes:

- 8051 Code (DSL):**

```

1 clk = 12000;
2 P0.0 = 1b;
3 R0 = 0;
4 while (1 == 1) {
5   if (P0.0 == 0b) {
6     R0 = R0 + 1;
7     P1 = R1;
8     delay(1000);
9   } else {
10  }
11 }
12 end

```
- 8051 Assembly Code (ALP):**

```

1 ORG 0000H
2   SETB P0.0
3   MOV R0, #0
4 L000:
5   CLR C
6   MOV A, #1
7   SUBB A, #1
8   CLR C
9   JNZ $+3
10  SETB C
11  LJMPL L001
12 L002:

```

Figure 5. – Code View with DSL program and ALP

CONCLUSIONS

The WDSC accepts generic forms of expressions and is not hard coded for specific task. Since it graphically allows to map any sensor input in both bits and byte formats, various sensors and actuators can be incorporated as the digital weight scalar example. The logical design WUIs provide necessary code-blocks and logical conditions to work on different domains of applications. Built in delays, while loop and if, else conditions provide much more capability to the WDSC. Since the WDSC is integrated with both VPL and DSL, it provides more user friendly programming environment.

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EXPLORATION OF NATURAL DYE EXTRACTED FROM ANNATTO SEEDS TO FABRICATE DYE SENSITIZED SOLAR CELL

G. C. Wickramasinghe¹, S. D. M. Rosa², G. M. L. P. Aponsu² and V. P. S. Perera^{1*}

¹Department of Physics, Open university of Sri Lanka

²Department of Applied Sciences, Sabaragamuwa University of Sri Lanka

INTRODUCTION

The various types of solar cells that convert solar energy into electricity have been innovated and the solar cell that has recorded the highest photon to current conversion efficiency is the multiple junction GaAs solar cell which has efficiency around 44% (Gratzel, 2001). The problem with this kind of solar cell is its high cost of production and toxicity of the materials. Large number of research groups has worked on solar cell devices consisting of semiconductor thin films to reduce the high cost of production and to improve efficiency. Accordingly, development of solar cells sensitized with a dye, the dye sensitized solar cell (DSSC), is a relatively new class of low cost and environmental friendly device. This solar cell was developed by Gratzel and co-workers as a practicable device which is an interesting field of research at present (O'Regan and Gratzel, 1991). Conversion of visible light into electricity in DSSCs base on the photosensitization of wide band gap TiO₂ semiconductor nanoporous film using dye molecules.

Usually DSSCs are fabricated using Ruthenium bipyridyle dye which is synthesized particularly to sensitized solar cells. Ruthenium complexes are considered as good sensitizers for DSSCs but synthesis of these dyes are complicated and costly due to the rarity of transition metal use in this dye (Escobar and Jaramillo, 2015). Therefore, DSSC prepared using natural pigments are encouraged to replace the Ruthenium dye. The natural dyes found in flowers, leaves and fruits can be extracted by simple procedures. Due to the abundance and low cost, natural dyes are popular subjects of research even though they are biodegradable (Haryanto et al., 2013). Some natural dyes can be extracted by using organic solvents which can be applied to sensitized DSSCs without further purification of the dye extraction because only the pigments with particular functional groups could attached on the oxide semiconductor surface.

In this study, DSSC were prepared using natural dye extracted from Annatto (*Bixa Orellana*) seeds as the sensitizer. Bark of the Annatto seeds contain pigment bixin which is a carotenoid. In this paper, we report on the fabrication of dye sensitized solar cell with natural dye extracted from bark of Annatto seed using ethyl acetate as the solvent of extraction of bixin.

METHODOLOGY

Extraction of dye

Annatto (*Bixaorellana*) seeds were put into a mortar. Then, ethyl acetate was added into the mortar and the red coat of the seed was carefully peeled off into ethyl acetate solution using a pestle. When the seed coat was dissolved in the ethyl acetate solution, it was collected into a test tube using a pasture pipette and solid residues were filtered out to obtain a clear dark orange colour dye solution. After that the dye solution was transferred into a boiling tube and kept close until use.

Preparatin and assembling of the cell

FTO glass sheets of dimensions 1.5cm × 3cm were cleaned in an ultrasonic bath respectively with tape water, tepole and distilled water. Adhesive tape was fixed on the conducting glass sheet to restrict the thickness and area of TiO₂ film. TiO₂ paste was prepared by mixing 0.5 g of TiO₂ powder with 1.5ml of ethyl acetate, 1 drop of triton-x-100, 1 drop of terphenol and

* Corresponding author: Email - vpper@ou.ac.lk

0.6ml of ethanol in a mortar until a thick paste was obtained. After that the past was spread on the conducting sheet using the doctor blade method to prepare the TiO_2 film. TiO_2 films on the conducting glass plates were sintered in a furnace at 450°C for 30min to burn the volatile materials. After that sintered TiO_2 films on conducting glass sheets were immersed in Annatto seed dye solution in the boiling tube. The TiO_2 films in the boiling tube with dye solution were heated in a hot water bath for 5 minutes. After that TiO_2 films in the dye were kept for 12 hours to absorb the dye adequately on the TiO_2 films.

The photochemical solar cells were assembled by filling the liquid electrolyte between the dye coated TiO_2 film and counter electrode. Pt sputtered conducting glass sheets were used as the counter electrodes of the cells. The electrolyte composed of 8ml of ethylenecarbonate, 2ml of acetonitrile, 0.83g of potassium iodide (KI) and 0.1269g of iodine (I_2). Then the two electrodes were clipped together to form the photochemical solar cell.

Characterizations of the dye and the solar cell

I-V curves of the cells were obtained using a galvanostat potentiostat coupled to a computer while illuminating them with white light LED bulb (10Wm^{-2}). The extracted dye was characterized by UV-3000 spectrometer and FTIR spectrometer.

RESULTS AND DISCUSSION

The Annatto seed contains pigment bixin which is a red colored organic chemical compound. Figure 1 shows the schematic chemical structure of bixin.

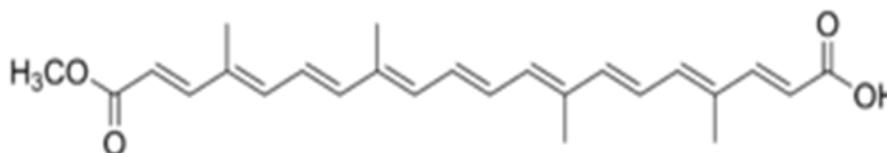
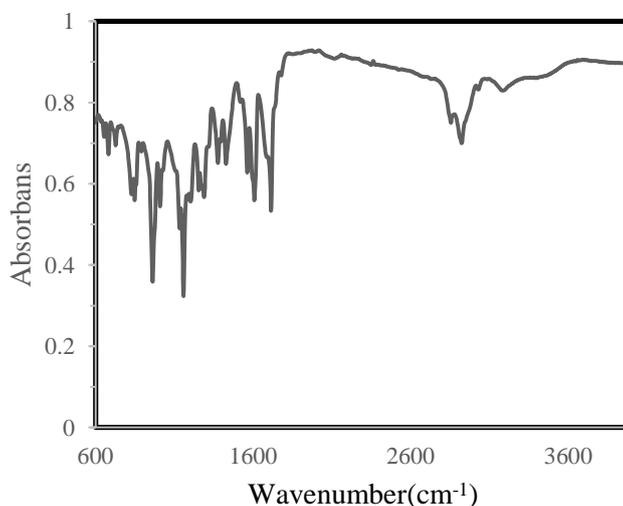


Figure 1. Schematic chemical structure of bixin in Annatto seed

The absorption spectrum of Annatto seed extracted in ethyl acetate solution is shown in Figure 2. The pigment exhibits an absorption band within the visible region having two peaks appearing at 459nm and 489nm. The energy difference between the lowest unoccupied molecular orbital (LUMO) and highest occupied molecular orbital (HOMO) was calculated using absorption spectrum which is found to be 2.21 eV.



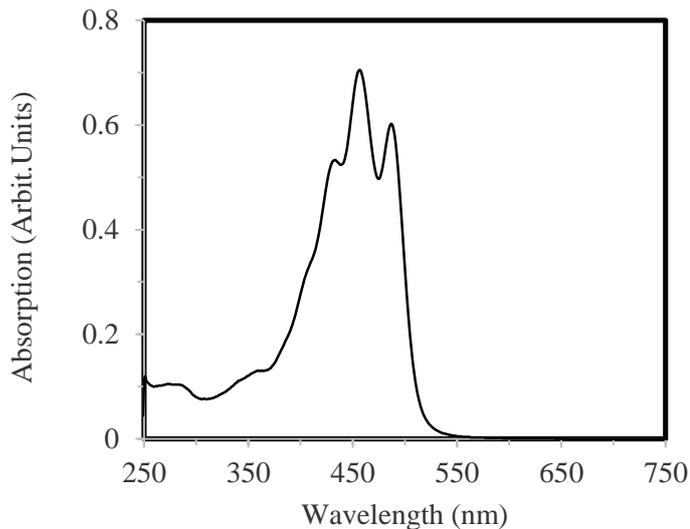


Figure 2. UV visible spectra of dye extracted from the bark of Annatto seed

Figure 3. FTIR spectra of dye extracted from the bark of the Annatto seed

The FTIR data in figure 3 convinces that the dye contains hydroxyl group which helps the dye to attach effectively on TiO_2 film. The band at around 3000cm^{-1} suggests that the dye molecule accompanies with hydroxyl groups in carboxylic acid. The C-O stretching of an ester emerges in the range from 1000cm^{-1} to 1300cm^{-1} . The C=O stretching occurs at about 1720cm^{-1} . These absorption peaks verify the characteristic bonds in dye extraction.

The I-V characteristic of the FTO / TiO_2 /dye/electrolyte/Pt photochemical solar cell is shown in figure 4. The open circuit photo voltage of the cell was $\sim 0.55\text{V}$ and short circuit photocurrent was $\sim 1.0\text{ mA}$ when illuminated with 10Wcm^{-2} white light LED lamp. The efficiency of solar cell is around 0.02% and fill factor was 41.2% .

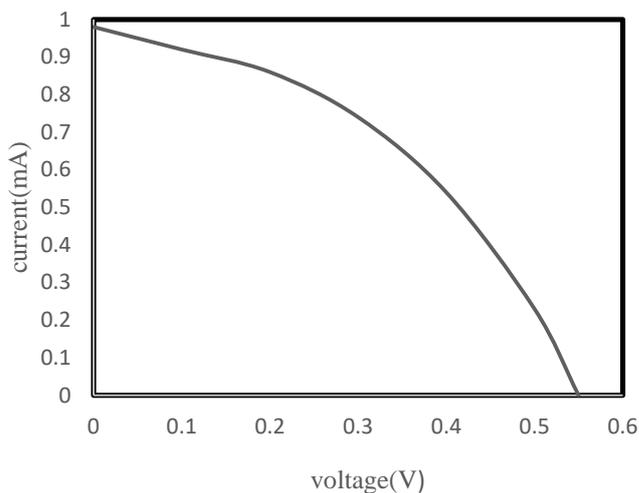


Figure 4. I-V characteristic of a solar cell sensitized with dye extraction of Annatto seeds

CONCLUSION

The photoelectrochemical solar cells sensitized with the dye which was extracted from bark of Annatto seeds in ethyl acetate have shown photocurrent of $\sim 1.0\text{ mA}$ and photo voltage of $\sim 0.55\text{ V}$. The efficiency of FTO/ TiO_2 /Dye/electrolyte/Pt cell reached 0.02% under

irradiation with white LED lamp of 10 Wcm^{-2} . The active pigment in the Annatto seeds was found to be bixin which was characterized with UV-visible and FTIR spectroscopy.

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DEVELOPMENT OF RADIATION GRAFTED SUPER WATER ABSORBENT POLYMER MATERIAL FOR ARID AREA AGRICULTURE IN SANDY SOIL

S. Y. Ratnayake¹, K. R. C. De Silva^{1*}, M. Rasangika¹, T. Fernando¹, M. Ranaweera¹,
A. K. Ratnayake¹, S. D. M. Chinthaka²

¹Sri Lanka Atomic Energy Board, 60/460, Orugodawatta, Wellampitiya, Sri Lanka

²University of Sri Jayawardanapura, Gangodawila, Nugegoda, Sri Lanka

INTRODUCTION

Radiation grafted super water absorbent polymers (SWAPs) can absorb and retain large amounts of water relative to their own mass and has slow water releasing capability. These materials have excellent hydrophilic properties, high swelling capacity and high swelling rate. SWAPs can be effectively used in agricultural applications owning the aforementioned properties [1, 2]. Gamma radiation- induced grafting technique is used to develop SWAPs since it offers a number of advantages such as ease of processing at room temperature, low energy consumption and no need of initiators [3]. Use of this technique provide both grafting and crosslinking during the irradiation where grafting form support for the degradation enhancement and the crosslinking from support to hold the 3-D structure of the product. This crosslinking network is essential for the water retaining capacity of the product. In this research, a SWAP material was developed by radiation-induced grafting of acrylic acid (AAc) monomer onto cassava starch (SL-SWA-T-3). Cassava starch is a natural commonly available biodegradable material found in many areas of the country. The maximum absorption of the developed product and the commercially available products show almost same values in between 20,000-25,000%. However, some of the agricultural areas in Sri Lanka like Kalpitiya need high absorption rate rather than maximum absorption due to its sandy soil condition. It is one of the areas in Sri Lanka that cultivates vegetables for the local market. SWAP is the most suitable option for this type of area and higher absorption speed within first 10 minutes is the most important feature and key factor. Therefore, our study is especially focused on improving the absorption speed of the developed SWAP along with the optimization of the other properties such as the maximum water absorption percentage and the time required to release 50% of the absorbed water with compared to the commercial product in order to provide a proper solution to address the above mentioned issues in the country.

METHODOLOGY

Materials

Cassava starch, Acrylic acid (AAc), potassium hydroxide (KOH), polysorbate 20 (Tween 20) and glycerol. All chemicals were of commercial grade. Distilled water was used in all the experiments.

Method

135.9 g of Cassava starch was added to 469.3 g of water and stirred using a mechanical stirrer until homogeneous dispersion of starch. Then 5.0 g of glycerol dissolved in 50 ml water was added and stirred for 10 min. A solution of 48.9 g of KOH in 100 g of water was added slowly to the mixture with stirring for 45 min. Then 135.9 g of AAc mixed with 5 g of Tween 20 dissolved in 50 ml of water was quickly added to the mixture and stirred for another 1 hr. This mixture was packed in polythene bags and irradiated at 4 kGy dose via a Co-60 gamma-irradiator at a 0.33 kGy/h dose rate. The irradiated samples were dried in the oven and extruded into small parts using an extruder machine. About 5 g of this sample was dipped in

* Corresponding author: Email - rowan@aeb.gov.lk

1000 ml of water and the corresponding mass values at different time intervals were measured. All the experiments were done for 3 replicates. The water absorption and releasing percentages were estimated by the percentage increase and decrease of weights respectively according to Eq.1 and Eq.2.

$$\text{Water absorption \%} = \frac{(W_t - W_i)}{W_i} \times 100 \quad (1)$$

Where W_i and W_t indicate the initial dry weight and weight after absorbing water at time t .

$$\text{Water releasing \%} = \frac{(W_i - W_t)}{W_i} \times 100 \quad (2)$$

Where W_i and W_t indicate the initial saturated weight after 10 days and weight after releasing of water at time t .

RESULTS AND DISCUSSION

The water absorption capability was studied to characterize the developed SWAP in terms of its water absorption capacities. Figure 1 shows variation of the water absorption capacity with time. To assess the water absorption capacity of newly developed SWA, the water absorption capacity of developed SWAP is compared with commercially available SWA (Figure 1). The maximum absorption capacity of developed SWAP reached the range of 22,000-25,000% in ten days. The commercially available SWAP also shows similar behavior. This implies that both the developed and commercial SWAPs show similar water absorption performance pattern with higher absorption percentages.

The water releasing performances of developed SWAP was also evaluated. The slow releasing ability of water from the SWAP is a major requirement for the possible application of the SWAP in dry zone agriculture. The slow releasing of water maintains required soil moisture level for agricultural activities in dry region. The water releasing behavior of both developed and commercial SWAP was studied up to ten days (Figure 2). The trend of water releasing is favorably slow for both developed and commercial SWAP and both show similar nearly linear behavior during the period of time under investigation. This suggests that the developed SWAP can be used as water releasing agent for longer period of time for arid area agriculture.

The quick absorption of water and retention for longer period of time are important factors for the feasible use of SWAP in arid area agriculture. The quick absorption of water by SWAP is extremely important for the use of SWAP in arid environment. This property allows the applied water to be rapidly absorbed and retained specially in sandy arid soil. If not retained, the applied water is rapidly drained through large capillary spaces in sandy dry soil. The early water absorption behavior of developed SWAP was studied. It showed that the developed SWAP reached the absorption percentage of 4500 within two minutes and reached about 6000 at 10 minute whereas this capacity for commercial SWAP is around 1000 at two minute time and 2700 at ten minute time respectively (Figure 3). This indicates that the developed SWAP shows faster water absorption behavior than the commercially available SWAP. In this respect the developed SWA shows superior water absorption properties compared to commercial SWAP.

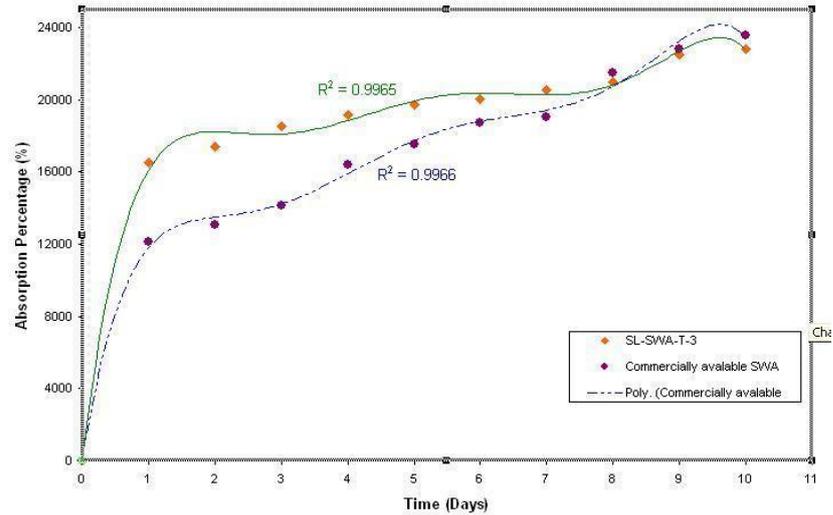


Figure 1. Variation of water absorption percentage within first 10 days

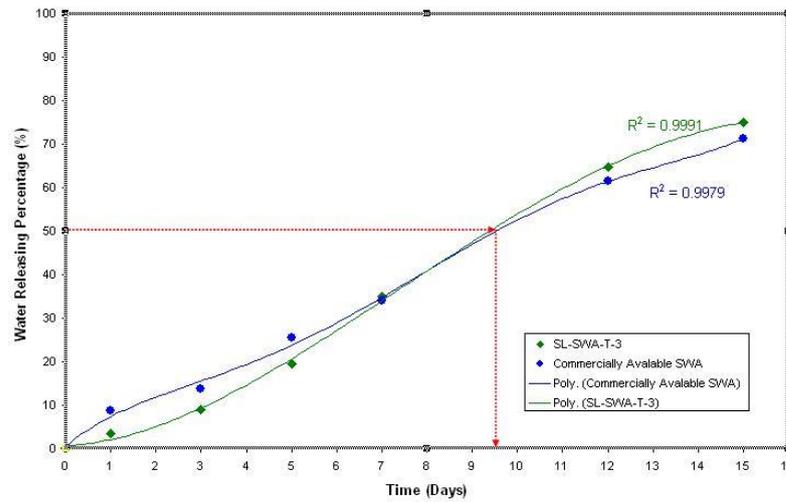


Figure 2. Variation of percentage of water released with time for developed and commercial SWAPs

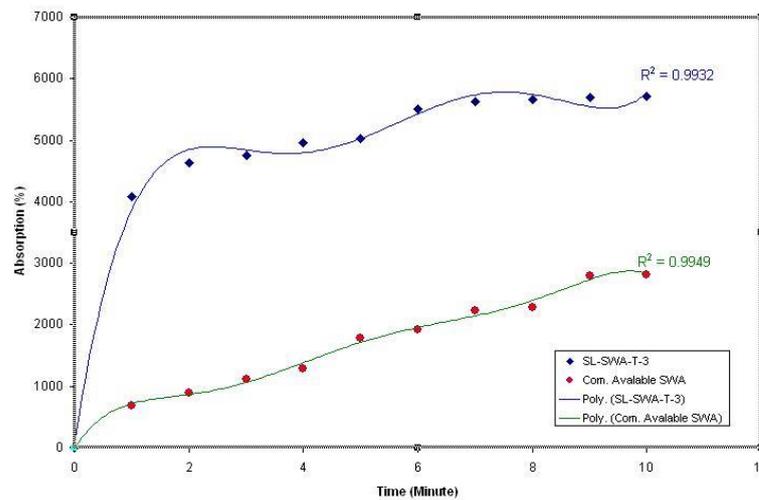


Figure 3. Variation of water absorption percentages during first ten minutes

CONCLUSIONS

In this study radiation grafted and cross linked SWAP is successfully developed and characterized in terms of its application in water absorption, retention and slow release. Both the developed and commercial SWAPs show similar water absorption and releasing properties. However, the water absorption rate during the first 10 minutes of the developed SWAP was two times higher than the commercial SWAP. This indicates that the developed SWAP can be successfully used in arid area agriculture in Sri Lanka especially in dry sandy soil in which the water retention is very poor. Further, the developed SWAP could be a potential water retaining agent that can contribute to expansion of agricultural practices to the area currently not feasible due to the low rainfall and lack of irrigation.

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EVALUATION OF EFFECT OF SUPER ABSORBENT POLYMERS (SAPs) DEVELOPED IN SRI LANKA ON EXTENDING THE VASE LIFE OF CUT FLOWERS (*Chrysanthemum instagrum*)

T.N. Fernando¹, S. A. Ariadurai^{2*}, A. G. B. Aruggoda¹, C. K. Disanayaka³ and S. Kulathunge³

¹ Department of Agricultural and Plantation Engineering, The Open University of Sri Lanka.

² Department of Textile and Apparel Technology, The Open University of Sri Lanka.

³ Atomic Energy Board, No 60/460, Baseline Road, Orugodawatta, Wellampitiya, Sri Lanka.

INTRODUCTION

Chrysanthemum is considered as the most popular cut flowers in many parts of the world. *Chrysanthemums* have a long vase life (approximately two weeks under appropriated conditions) as opposed to most other cut flowers. It belongs to the family ‘Asteraceae.’ Its main difference from other flowers is its range. It has sprays (clusters of flowers), single flowers, pompoms and spiders. These main varieties are different from each other. The ideal day temperature for *chrysanthemums* is 20 °C – 27 °C and the night temperature is 12 °C – 20 °C. Maintaining flowers in clean water is important. If water is not changed, there could be bacteria and other pathogens growing thereby blocking the water circulation from the bottom of the stalk to the flower. So it is important to keep the water clean and change water every other day. Keeping quality is an important parameter for evaluation of cut flowers for both domestic and export markets (Malavige, 2016). Stem (stalk) bending is one of the major problems in some cut flowers. Cut flower industry in Sri Lanka uses chemical preservatives such as silver nitrate (AgNO₃) and 8-hydroxyquinoline citrate to preserve the flowers for longer duration. These chemicals are expensive and hazardous to the environment. Some use less hazardous, low cost materials such as clorox or sodium hypochlorite (NaOCl), lime juice, vinegar, coconut water, Calcium Chlorite (CaCl₂), Aluminum Sulphate (Al₂(SO₄)₃) *etc.* (Ekanayake *et al.*, 2008). However these solutions are very difficult to handle, especially in decoration and in ornamental preparations. The present study is focused on introducing new media for survival of cut flowers using Super Absorbent Polymers (SAPs). SAPs are structurally cross linked, highly swollen and are hydrophilic polymer networks capable of absorbing a large amount of water or aqueous saline solutions, practically 10 to 1000 times of their original weight or volume (Ramazani-Harandi *et al.*, 2006), in relatively short periods of times. The slow release of water to the growth media allows for moisture retention, reduced watering frequency and is economical. The aim of this study was to evaluate survival of cut *Chrysanthemum instagrum* flowers on newly prepared survival media using three SAPs developed in Sri Lanka (hereafter named “SLSAPs”).

METHODOLOGY

The experiment was conducted at the research laboratory of the Agricultural and Plantation Engineering of the Open University of Sri Lanka. Laboratory temperature was kept at 22°C. *Chrysanthemums instagrum* variety was selected for this experiment and same degree of mature flowers were purchased from florists in the early hours of the day and brought to the lab within half an hour. In the laboratory, flowers were dipped in a water bath to minimize the transport stress on flowers for 3hours and distal ends were re-cut before use. Three SLSAPs were prepared as described in Fernando *et al.*, (2015c) using three cellulose samples.

These are,

SLSAP_{ALK} - SAP using cellulose extracted from alkaline pretreatment (Fernando *et al.*, 2015c)

*Corresponding author: Email - saari@ou.ac.lk

SLSAP_{AHP} - SAP using cellulose extracted from alkaline hydrogen peroxide pretreatment (Fernando *et al.*, 2015b)

SLSAP_{MwA} - SAP using cellulose extracted from microwave assisted alkaline pretreatment (Fernando *et al.*, 2015a)

These SLSAPs were allowed to swell in 0.23% Sodium Hypo Chlorite (NaOCl) solution and tap water (pH – 7.56, Electric conductivity- 0.6 mS). Thirteen treatments were prepared as follows,

- T1 - 15g of swollen SLSAP_{Alk} from 0.23% NaOCl solution
- T2 - 15g of swollen SLSAP_{AHP} from 0.23% NaOCl solution
- T3 - 15g of swollen SLSAP_{MwA} from 0.23% NaOCl solution
- T4 - 14.25 g of swollen SLSAP_{Alk} from tap water + 0.75 g of 1% CaCl₂ solution
- T5 - 14.25 g of swollen SLSAP_{AHP} from tap water + 0.75 g of 1% CaCl₂ solution
- T6 - 14.25 g of swollen SLSAP_{MwA} from tap water + 0.75 g of 1% CaCl₂ solution
- T7 - 14.75g of swollen SLSAP_{Alk} from 0.23% NaOCl solution + 0.25g of sucrose
- T8 - 14.75g of swollen SLSAP_{AHP} from 0.23% NaOCl solution + 0.25g of sucrose
- T9 - 14.75g of swollen SLSAP_{MwA} from 0.23% NaOCl solution + 0.25g of sucrose
- T10 - 14g of swollen SLSAP_{Alk} from tap water + 0.75g of 1% CaCl₂ + 0.25g of sucrose
- T11 - 14g of swollen SLSAP_{AHP} from tap water + 0.75g of 1% CaCl₂ + 0.25g of sucrose
- T12 - 14g of swollen SLSAP_{MwA} from tap water + 0.75g of 1% CaCl₂ + 0.25g of sucrose
- T13 - 15g (15 ml) of tap water (without biocide) / Control (C)

Tap water solution was used as control medium. 0.25g of sucrose was added to some of the treatments without causing change in gel formation of SAPs. Glass test tubes (15ml) were used for the experiment. Swollen SLSAPs from 0.23% NaOCl were used for treatment No.1, 2, 3, 7, 8 and 9, the reason being that SAPs could swell well in that solution and swelling ratio (amount of water that can hold in 1g of dried SAP) of developed SAPs in NaOCl solutions were 134, 154 and 104 in SLSAP_{Alk}, SAP_{AHP} and SAP_{MwA} respectively. Treatments No 4, 5, 6, 10,11 and 12 media were prepared by adding 0.75 g of 1% CaCl₂ solution to the swollen SAPs from tap water, the reason is that SAPs do not swell in CaCl₂ solution (swelling ratio <10 due to complex forms of SAP and Ca²⁺). Each treatment was replicated three times and it was arranged according to Completely Randomized Design (CRD). Wilting conditions of flowers were visually observed daily and date of wilt recorded according to a scale shown in figure 1. Date of full bloom with no petal discoloration and wilting was analyzed in each treatment using Minitab version14.



Scores:

- 5 – Full bloom with no petal discoloration and wilting
- 4 - Full bloom with no petal discoloration and slight wilting
- 3 - Slight petal discoloration with moderate wilting
- 2 - High level of petal discoloration with moderate wilting
- 1 - Wilted flower with discolored petals

Figure 1. Scale used for the evaluation of flower quality (De Siva *et al.*, 2013)

RESULTS AND DISCUSSION

The statistical analysis revealed that treatments were significant for the number of days of survival of *Chrysanthemum instagam* flowers (P = 0.000). Results shown in figures 2 and 3 indicate flowers in T1, T2, T3, T4, T5 and T6 media kept for 7 - 9 days in full bloom showed no petal discoloration and wilting. All flowers under the above mentioned treatments wilted after 9 -11 days with high level of discoloring of petals and moderate wilting. Flowers under T7, T8, T9, T10, T11 and T12 were kept for 12-13 days in full bloom with no petal discoloration and wilting. However, after 13-16 days all flowers showed a slight petal

discoloration with moderate wilting. Flowers in tap water (C) survived for approximately 9 days in full bloom with no petal discoloration and wilting. However immersed parts of the stalk were infected with microorganisms like fungus. Therefore, water had to be changed every 2 days. After 10-12 days high level of petal discoloration with moderate wilting was observed. Flowers in media without sucrose wilted and petals were discolored after 13 days while in media with sucrose they lasted 18 days. It can be concluded that SAPs with sucrose and biocide media are the best for survival of *Chrysanthemum instegram*. Jones, (2001) reported that chlorine is an important biocide that prevents contaminations by microorganisms. Further Salisbury and Ross (1996) reported that Ca^{2+} helps to strengthen plant cell wall structure. Also Ekanayake *et al.*, (2008) found that the lower concentrations (1%) of CaCl_2 were effective in preventing stalk bending in gerbera flowers. Furthermore, the flower benefits from sugars that the plant leaves manufacture through the process of photosynthesis. Once the flower is cut from the plant, the number of leaves providing food is greatly limited, as is the amount of light available for food production. As a result, the amount of food available to the flower is drastically reduced. To compensate this loss, sucrose is added to the water in which the flower stalks are placed to ensure continued development of the flower and greater longevity. The result of this study agrees with findings of earlier studies.



Figure 2. Photos taken 12 days after in survival media

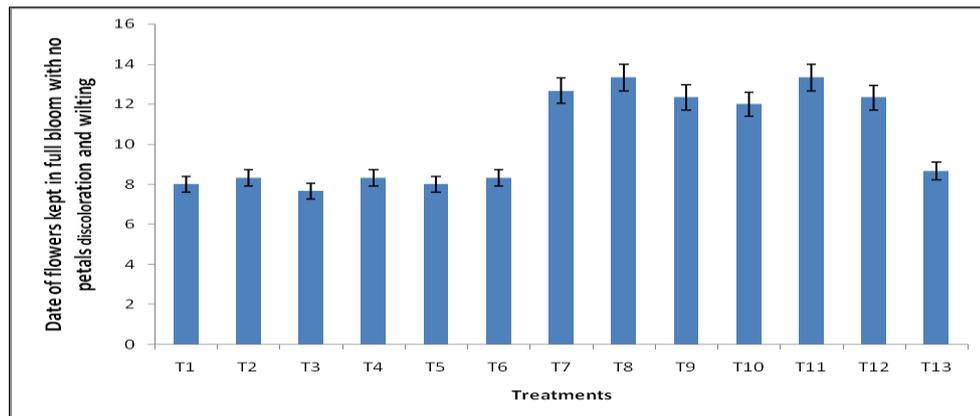


Figure 3. Number of days flowers survived in full bloom with no petal discoloration and wilting under each treatment

CONCLUSIONS

SLSAPs with sucrose and biocide media are the best among tested media for survival of *Chrysanthemum instegram*.

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WOUND HEALING ACTIVITY OF SOME LUPEOL DERIVATIVES USING SCRATCH WOUND ASSAY

Nisansala S. Bopage¹, K. Hector Jayawardena², S. Chandrani Wijeyaratne³,
Ajita M. Abeysekera⁴ and G. M. Kamal B. Gunaherath^{1*}

¹Department of Chemistry, The Open University of Sri Lanka, Nawala, Nugegoda

²Department of Zoology, The Open University of Sri Lanka, Nawala, Nugegoda

³Department of Botany, Sri Jayewardenepura University, Nugegoda

⁴Department of Chemistry, Sri Jayewardenepura University, Nugegoda

INTRODUCTION

Lupeol is a penta-cyclic lupane-type triterpenoid which shows an array of biological activities such as antiprotozoal, anti-inflammatory, antitumor, chemopreventive, antibacterial, and wound healing (Gallo and Sarachine, 2009, Harish *et al.*, 2008). It was also reported that lupeol is one of the constituents responsible for many biological activities among several plant species (Gallo and Sarachine, 2009). The wound healing activity of lupeol has been established using animal cell culture model using Madin-Darby Canine Kidney (MDCK) cells and Baby Hamster Kidney (BHK-21) cells (Bopage, *et al.*, 2014). The present study was designed to compare the wound healing potential of lupeol (**1**) and few common lupane triterpenoids, lupeol acetate (**2**), betulinic acid (**3**), betulin (**4**), and lupenone (**5**) with a view to understanding structure activity relationships (SAR) if any. The investigation was carried out using Scratch Wound Assay (SWA).

METHODOLOGY

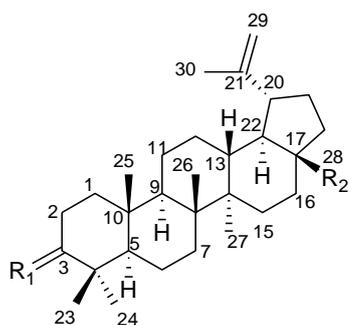
Scratch Wound Assay (SWA)

A monolayer of MDCK and BHK cells were distributed on 12-well tissue culture plates with growth medium (GM) [GM, 10% fetal bovine serum (FBS) in Dulbecco's modified Eagles medium (DMEM) supplemented with L-glutamine (Sigma Aldrich), antibiotics, penicillin 50 µg/mL and streptomycin 50 µg/mL (Sigma Aldrich) and 7.5% sodium bicarbonate]. Cultures were incubated in a humidified incubator maintained at 37 °C with 5% CO₂ (Liang, *et al.*, 2007). After the formation of a monolayer of cells, a scratch (wound) was performed on monolayer of cells along the vertical axis of each well under the microscope and washed with 750 µL of phosphate buffer saline (PBS). Each test well was then filled with DMEM (990 µL) and added 10 µL of DMSO containing appropriate amount of test sample, such that the final concentration of test sample is 25 µM. Plates were incubated for 24 hours at 37 °C with 5% CO₂. Initial width of the scratch and the width of the scratch after treatment, at different time intervals (12 h, 18 h, and 24 h) were measured by using a stage micrometer. The percentage healing of the wound at 24 h was taken as an indication of the relative activity of an extract. Two negative controls, 1% DMSO in growth medium and 100% DMEM were used in this experiment while asiaticoside (25 µM), a potent wound healing active compound (Shukla *et al.*, 1999) was served as the positive control.

Chemical Constituents

Lupeol (**1**) and lupeol acetate (**2**) were isolated from stem bark of *F. racemosa* (Bopage *et al.*, 2014). Other lupeol derivatives, betulinic acid (**3**), betulin (**4**), and lupenone (**5**) were obtained from the Chemistry Laboratory chemical collection (Jayasinha, 1999) and purified by preparative TLC.

*Corresponding author: Email - kbgun@ou.ac.lk



	R ₁	R ₂
Lupeol (1)	α-H, β-OH	Me
Lupeol acetate (2)	α-H, β-OAc	Me
Lupenone(3)	O	Me
Betulin (4)	α-H, β-OH	CH ₂ OH
Betulinic acid (5)	α-H, β-OH	CO ₂ H

RESULTS AND DISCUSSION

The percentage wound closure at 24 h representing the wound healing activity is given in **Table 1** and **Figure 1** for both BHK and MDCK cells.

Table 1: Wound healing Activity-activity (WHA) of lupeol (1), lupeol acetate (2), lupenone (3), betulin (4), and betulinic acid (5).

Sample ^a	% Closure of the wound ^b at t = 24 h ^b	
	BHK	MDCK
Lupeol (1)	83.1 (0.1)	78.6 (0.3)
Lupeol acetate (2)	33.7 (0.2)	33.2 (0.4)
Lupenone (3)	45.5 (0.1)	42.4 (0.4)
Betulin (4)	76.4 (0.2)	72.6 (0.3)
Betulinic acid (5)	42.4 (0.4)	42.4 (0.3)
Asiaticoside (A)	84.6 (0.7)	83.1 (0.1)
1% DMSO (Con1)	10.1 (0.7)	10.1 (0.1)
100% DMEM (Con 2)	11.2 (0.8)	11.3 (1.4)

^aSample concentration at a 25 μM

^bThe mean value follows the standard error of mean within the parentheses

Three triplicates for each sample and three measurements for each wound were taken.

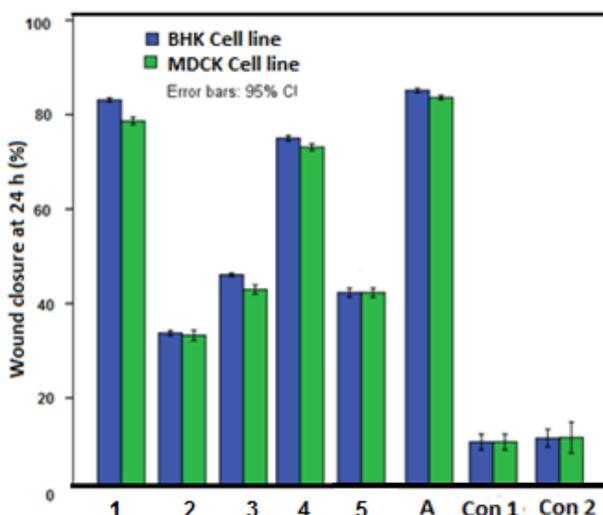


Fig. 1: Percentage wound closure of the compounds in the SWA SAR-assay. Bars represent the mean ±S.E.M. of nine measurements in the three experiments.

It is evident that among these compounds, only lupeol (1) and betulin (4) showed significantly high wound healing activity. When wound healing activity of lupeol (1) compared with those

of lupeol acetate (**2**) and lupenone (**3**), it is evident that the presence of 3-OH group is an essential structural feature for the WHA of lupane skeleton.

Despite the presence of 3-OH in betulin (**4**) and betulinic acid (**5**), only **4** showed a significant activity which is slightly less than that of **1** while **5** was found to be significantly less active. This may be attributed to the increase of hydrophilic nature at C-28. In **4** the C-28 Me group of lupeol has replaced by CH₂OH group which is an H-bond donor while in **5** it has been replaced by CO₂H group which is an H-bond donor as well as an H-bond acceptor, thereby immensely increasing the hydrophilicity at C-28 (**Fig 2**).

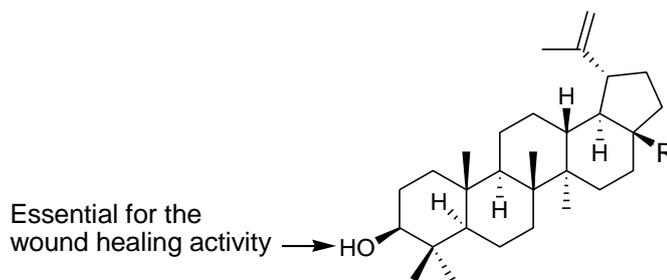


Fig. 2: Lupane Skeleton: Representation of wound healing active sites.

CONCLUSIONS

Lupeol and betulin showed the wound healing activity among the tested compounds of lupane skeleton. Further it was found that 3-OH is an essential feature in the lupane skeleton for its wound healing activity, Further these results indicate that the substituent at C-28 can influence the activity although the nature of the interaction involving the C-28 group cannot be elucidated based on the limited results of this study.

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A PRELIMINARY STUDY ON THE EFFECT OF METHANOLIC EXTRACTS OF BARKS OF *Phyllanthus reticulatus* AND *Bridelia retusa* ON SERUM LIPID PROFILES IN HYPERCHOLESTEROLEMIC RATS (*Mus norvegicus albinus*)

P. G. M. Kalpani¹, S. R. Weerakoon¹, S. Somaratne¹, N. Nilakarawasam², C. Ranasinghe³

¹Department of Botany, ²Department of Zoology, ³Department of Chemistry,
The Open University of Sri Lanka, Nawala, Nugegoda.

INTRODUCTION

Hypercholesterolemia is one of the serious disorders affecting a large population of the world today. There is substantial evidence documenting the relationship between coronary heart disease and atherosclerosis with increased serum cholesterol levels. A relatively constant level of cholesterol in blood is maintained primarily by controlling the level of *de novo* cholesterol synthesis. It is regulated in part by the dietary intake of cholesterol. Medications currently used to reduce body cholesterol levels are associated with unwanted side effects. Therefore, there is a growing interest in search of hypocholesterolemic metabolites from herbal medicines (Maruthappan and Sakthi, 2010; Yadav *et al*, 2014). Biological investigations of family Euphorbiaceae revealed that many members of this family consist of various medicinal properties such as hepatoprotective activity (Asha *et al.*, 2006), lipid lowering activity (Maruthappan and Sakthi, 2010), anti-inflammatory activity (Rao *et al*, 2005), antidiabetic activity (Chauhan *et al.*, 2010) and other activities (Mwine and Damme, 2011). *Bridelia retusa* and *Phyllanthus reticulatus* are such medicinally important two plant species available in Sri Lanka (Lalith *et al*, 2003). Very few studies have been conducted so far to investigate the effect of methanolic bark extracts of these two plant species on lipid lowering activity. The objective of the present study was to screen the methanolic crude extracts of *P. reticulatus* and *B. retusa* in a rat model for hypocholesterolemic activity.

METHODOLOGY

Plant material

Fresh barks of *P. reticulatus* and *B. retusa* were collected from Dambulla and Polonnaruwa districts respectively. Plant specimens were identified by comparing herbarium specimens deposited in Botanical Garden, Peradeniya, Sri Lanka and referring related literature. The bark samples were cut into pieces and subjected into shade drying. Dried pieces were powdered mechanically and stored in air-tight containers at room temperature for future use.

Preparation of bark extracts

A quantity of the ground samples (approximately 50 g) was weighed and subjected to soxhlet extraction with 400 ml methanol at 75°C for 6-8 hr. Extracts were slowly evaporated to dryness at 40°C using a rotary evaporator. The yield of *P. reticulatus* and *B. retusa* were 16.06% and 31.99% respectively. The extracts were stored between 2-8°C for further studies.

Experimental animals and cholesterol induction

Twelve male Wistar albino rats (*Mus norvegicus albinus*) weighing 180-200 g purchased from Medical Research Institute, Borella, Sri Lanka were used. They were kept under standardized animal house conditions (Photoperiod: approximately 12 h natural light per day, temperature: 28-30°C, humidity: 55%-60%) with water and standard diet *ad libitum*.

The experimental animals were acclimatized for 7 days before the commencement of the study and labeled appropriately. Cholesterol was induced in rats using a mixture of cheese (50 g), butter (50 g) and cow ghee (20 ml). The equal amount of this mixture (~2 ml) was given to all the rats except the control group (Group 1) for three weeks to induce hypercholesterolemia and then the first 7 days treatment period one time per day orally.

Experimental design

In this preliminary study, twelve rats were divided into four groups of three rats each and were given the following treatments.

Group 01- Control group Group 02- Hypercholesterolemic control group

Group 03- Crude extract of *P. reticulatus* given at 2000 mg/kg body weight

Group 04- Crude extract of *B. retusa* given at 2000 mg/kg body weight

Treatment period for all these groups were 7 days and the extract was given orally once a day.

Measurements of body weight and biochemical parameters

At the beginning and on the 7th day at the end of treatments, and 14th and 28th days the animals were deprived of food overnight and anesthetized using diethyl ether to collect bloodsamples from the tail vein. Samples were centrifuged at 2000 rpm for 30 minutes to obtain serum. Total cholesterol (TC), LDL Cholesterol (LDL-C), Triglyceride (TG), HDL Cholesterol (HDL-C) and Glucose were measured using standard kits.

Statistical analysis

Summary statistics were expressed as mean and standard deviation. The significance of difference between the hypercholesterolemic control and treated groups were determined using one-way analysis of variance (ANOVA) using SPSS Ver. 20. The acceptable level of significance was $p < 0.05$.

RESULTS AND DISCUSSION

Feeding rats with a high fat diet significantly elevated serum total cholesterol levels ($p < 0.05$) in comparison with normal rats received standard diet during the period of three weeks. These results indicate that the hypercholesterolemic diets increased cholesterol levels in rats successfully (Table 1).

Table 1.Cholesterol levels of normal and induced rats with the percentage of increment. Mean follows the standard deviation within parenthesis.

Group	No. of rats	Initial cholesterol level (mg/dl)	Induced cholesterol level (mg/dl)	Percentage of cholesterol increase (%)
01	3	73.73 (6.12)	80.56 (1.87)	9.2
02	3	73.22 (19.54)	128.83 (6.49)	75.94

Table 2. Lipid profile of the rats at the 7th, 14th and 28th day of the experiment. Mean follows the standard deviation within parenthesis. * indicated that the difference is statistically significant at $p < 0.05$.

Treatment	Day	01(Normal diet control)	02(Hypercholesterolemic control)	03 (<i>P. reticulatus</i> treated)	04 (<i>B. retusa</i> treated)
Total cholesterol (mg/dl (SD))	07	82.76 (4.35)	129.37 (4.26)	99.15 (1.20)*	96.83 (3.55)*
	14	81.76 (1.41)	129.18 (1.80)	90.61 (0.94)*	92.80 (3.47)*
	28	81.76 (1.41)	131.58 (1.75)	91.65 (3.11)*	88.89 (0.44)*
Triglyceride (mg/dl (SD))	07	53.06 (5.65)	103.24 (10.03)	82.06 (0.38)*	88.92 (1.53)*
	14	52.82 (3.55)	105.88 (4.12)	70.38 (0.24)*	80.69 (0.41)*
	28	52.96(2.91)	107.09 (5.38)	68.95 (0.24)*	79.36 (0.83)*
LDL-C (mg/dl (SD))	07	40.64 (3.11)	116.22 (10.41)	100.91 (0.50)*	102.36 (7.36)*
	14	40.28 (0.80)	115.59 (10.39)	100.78 (0.76)	104.47 (10.40)
	28	40.49 (0.31)	116.77 (10.55)	98.15 (0.84)	102.36 (11.15)
HDL-C (mg/dl (SD))	07	51.37 (4.07)	78.47 (2.46)	93.60 (2.91)*	92.39 (1.39)*
	14	53.11 (3.22)	77.44 (2.43)	86.99 (3.93)*	83.93 (2.93)*
	28	53.36 (2.04)	74.38 (2.32)	83.70 (2.17)*	81.93 (3.66)*

Results given in Table 2 revealed that administration of *P. reticulatus* (Group 03) and *B. retusa* (Group 04) significantly decreased the total cholesterol and triglyceride levels and significantly increased HDL-Cholesterol levels compared to hypercholesterolemic control group (Group 02). The increase of LDL-Cholesterol levels was significant only on the 7th day of the experiment. Blood parameters measured on the 14th day and 28th day of the experiment (without treatment of crude extracts) revealed that there was a continuous decrease of total cholesterol, LDL-Cholesterol, triglyceride and increase of HDL-Cholesterol levels when compared with the parameters of 7th day of the experiment.

According to literature (Tatiya *et al.*, 2011), *B. retusa* bark extract acts as hypoglycemic agent in rat models. Similarly our results of fasting blood glucose level (Table 3) showed that there was a decrease in blood glucose level of rats supplemented with the crude extract of *B. retusa* (Group 04)

when compared with the initial blood glucose level of rats, but it was not statistically significant ($p > 0.05$). The crude methanolic extracts of the two plants showed no harmful elevation or reduction of glucose levels in blood levels of Wistar albino rats when considering the normal blood glucose level of them (50-135 mg/dl, Braslasu, 2007).

The atherogenic index (TC/HDL-C ratio) is used to predict the risk of coronary heart disease and as a marker of small dense LDL-Cholesterol (Maruthappan and Sakthi, 2010). These results indicated that the reduction of atherogenic index of treated groups when comparing the cholesterol induced group showing the beneficial effect of extracts in cardiovascular disease (Table 4).

Previous studies reported that the ability of some phytochemicals such as flavonoids to lower high cholesterol in hyperlipidemic rat models (Kurowska *et al.*, 2000). Therefore, high amount of saponins, phytosterols, tannins and flavonoids present in the methanolic extracts of *P. reticulatus* and *B. retusa* may be responsible for this hypolipidemic effect in rats (Sarin *et al.*, 2014).

Reduction of the induced cholesterol level by pretreatment of crude methanolic extracts of *P. reticulatus* and *B. retusa* could be due to interfering with metabolism or biosynthesis of lipids in the body. However, additional studies are being done to investigate the exact phytochemicals of crude extracts of the plants responsible for lowering cholesterol in the lipid profile and the mechanism of action.

CONCLUSIONS

The results of this preliminary study show a potentially beneficial effect of crude methanolic extracts of barks of *B. retusa* and *P. reticulatus* on hypercholesterolemic conditions in Wistar rats due to the reduction of total cholesterol, LDL cholesterol and triglyceride levels and increase in HDL cholesterol levels in rats. However, dose dependent and time dependent studies should be carried out to confirm these results.

Table 3. Fasting blood glucose levels of rats

Group	Glucose (mg/dl (SD))	
	0 th day	7 th day
01	79.04 (16.27)	72.91 (2.92)
02	79.99 (36.18)	88.29 (27.32)
03	89.52 (22.89)	97.99 (16.07)
04	82.85 (19.81)	71.27 (10.88)

Table 4. Atherogenic index in all groups

Group	Atherogenic index
01	1.611
02	1.648
03	1.059
04	1.048

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TOURIST ARRIVALS AFTER THE INTERNAL CONFLICT IN SRI LANKA: A TIME SERIES ANALYSIS USING *HOLT- WINTER'S* METHOD

S. R. Gnanaprasagam^{1*} and T. M. J. A. Cooray²

¹Department of Mathematics and Computer Science, The Open University of Sri Lanka

²Department of Mathematics, University of Moratuwa

INTRODUCTION

The tourism industry is one of the most important sectors for a successful economy in a country. It accounts for a large part of Gross Domestic Product (GDP), foreign exchange generation and employment figures of any country. Previous empirical studies discovered the impact of tourism on economic growth worldwide. King and Gamage (1994), particularly, attempt to address some of the issues relevant to the economic impact of tourism in Sri Lanka. The study of Wickremasinghe and Ihalanayake (2006) reveals the contribution of tourism to Gross Domestic Product (GDP) in Sri Lanka.

Forecasting tourist arrivals is essential for planning, policy making and budgeting purposes. Therefore, this study is mainly focused on forecasting international tourist arrivals to Sri Lanka. Previous studies reveal that exponential smoothing methods perform quite well although the choice of exponential smoothing methods is very subjective. Similar studies are carried out by Kurukulasoorya and Lelwala (2011 & 2014) using classical time series decomposition approach and using exponential smoothing approach for modeling exercises. The objectives of the study are as follows:

- To develop time series models by using Holt- Winters' smoothing method
- To forecast (ex-post forecast) monthly tourist arrivals for the entire year 2016

METHODOLOGY

Monthly tourist arrivals after the internal conflict are extracted from the statistical annual reports of Sri Lanka Tourism Development Authority for this study. Time series plot, Augmented Dickey- Fuller (ADF) test and Kruskal- Wallis test are used to observe the behavior of the series. Holt-Winter's method is; relatively good for short- term forecasting, simplicity, no need of large amount of historical data and more preferred forecasting technique by many statisticians. Therefore, this method is employed to fit the additive and multiplicative seasonal models. Mean Absolute Percentage Error (MAPE) is used as the measure of accuracy.

Estimating smoothing constant is the most important part of exponential smoothing method. The common approach is to work with several values of smoothing constants and select the best combination which produces the minimum Sum of Squares of Errors (SSE) for the evaluation criteria used. This procedure is time consuming and thus in this study the grid search and auto search procedures which use the software called *STATISTICA* frequently, for the determination of smoothing constants, are carried out. The *STATISTICA* provides the estimates of best 10 combinations of smoothing constants in the ascending order of SSE. In addition to this, the values are chosen by setting the initial values as 0.01 and incremental step value by 0.1 or 0.05 for all the cases.

For the model diagnostic checking; Anderson Darling (A-D) test with normal probability plot are applied for normality checking, plot of residuals versus fitted values and plot of residuals versus order of the observations are examined to check the serial correlation and heteroscedasticity of residuals of the selected models respectively.

*Corresponding author: Email - srgna@ou.ac.lk

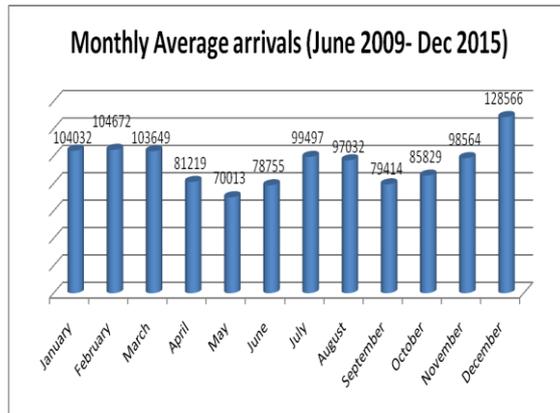
RESULTS AND DISCUSSION

Table 1. shows the international tourist yearly arrivals from June 2009 to December 2015 with its annual growth rate from January 2009 to December 2015.

Table 1: International tourist arrivals after the conflict in Sri Lanka

Year	Arrivals	Rate	Year	Arrivals	Rate	Year	Arrivals	Rate
2009	260161	2.15%	2012	1005605	17.48%	2015	1798380	17.76%
2010	654476	46.12%	2013	1274593	26.75%	Total Arrivals	7,376,343	
2011	855975	30.79%	2014	1527153	19.81%			

As per the statistics appear in Table 1, it can be seen that the total number of international tourists had visited the island, after the conflict, is over 7.376 million. Also it is observed that only in the year 2015, nearly 1.8 million tourists had visited the island and which is the biggest hit in tourism history of Sri Lanka. Further, it is noted that, every year there is a positive annual growth rate in which a sudden increase is also observed soon after the conflict in the year 2010 as 46.12%.



With reference to Figure 1, the average arrivals in every year are categorized; December as peak month while January, February and March as mini peak months. July, August and November are at moderate level in tourist arrivals. On the other hand, the lowest numbers of arrivals are recorded in the months of May and June in every year.

Figures 2(a) and 2(b) show the graphs of the time series and auto correlation function (ACF) of the 1st differenced series.

Figure1: Plot of monthly average arrivals

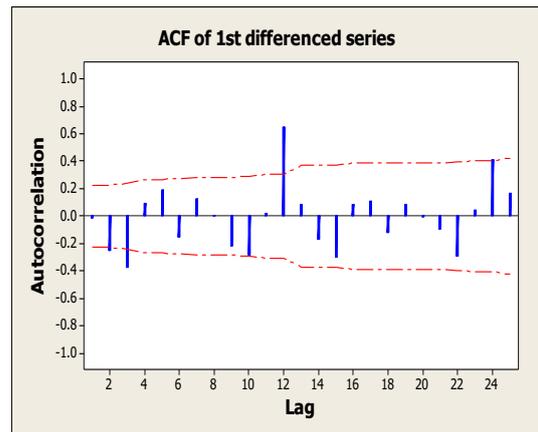
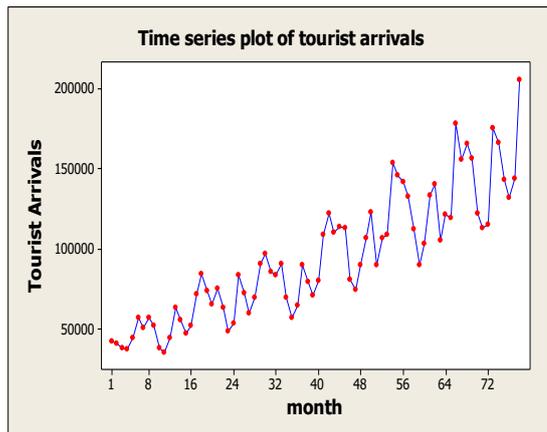


Figure 2(a): Time series plot of arrivals

Figure 2(b): ACF of 1st differenced series

From Figure 2(a), it can be clearly seen a positive trend with a seasonal pattern. Further from the p-value (0.99) of ADF test, it can be concluded with 95% confidence that there is a trend in the series. In addition, the p-value (0.00) of Kruskal- Wallis test confirms the existence of seasonality in the series. Thus, the more appropriate method for the modeling exercise is Holt-Winter’s method.

Since the ACF graph of original series does not decay exponentially, it can be claimed that the series is non-stationary. Also spikes at 12th and 24th lags in Figure 2(b) suggest that, the series has seasonality and its length is 12. Thus, the series has to be transformed as a stationary series. For this transformation method of differencing is applied. In this study, additive seasonal and multiplicative seasonal models are considered to select the appropriate model. Accordingly, the results are shown in Table 2.

Table 2: Summary of models by Holt- Winter's method

Model Type	Search Procedure	Estimates of smoothing constants	A-D Test (p- value)	MAPE
Additive	Grid	$\alpha = 0.15, \beta = 0.05, \gamma = 0.10$	0.831	11.36
	Auto	$\alpha = 0.292, \beta = 0.060, \gamma = 0.058$	0.401	12.36
Multiplicative	Grid	$\alpha = 0.25, \beta = 0.05, \gamma = 0.05$	0.518	12.72
	Auto	$\alpha = 0.246, \beta = 0.00, \gamma = 0.75$	<0.005	-

By examining separately, the plots of residuals versus fitted values of all four models, it is seen that the residuals are almost scattered randomly, thus it can be suggested that the residuals are independently distributed in every model. Similarly, the plots of residuals versus order of the observations suggest that the variances of residuals in all four models are constant as they are almost symmetric about zero with no systematic patterns.

However, from the p value of A-D test for fourth model, it can be concluded with 95% confidence that, the residuals of the last model do not follow normal distribution. On the other hand, the residuals follow normal distribution for the first three models in Table 2 as their p-values are more than 5% and the corresponding normal probability plots are almost linear in each of those three models. Hence, only the first three models satisfy the diagnostic tests. Therefore, the ex-ante forecasts are obtained only for the first three models in Table2.

Table 3 below gives the monthly-wise expected number of international tourists for the year 2016. It is observed that, over 2.041 million total tourists can be expected in the year 2016.

Table 3: Ex-post monthly forecast for the year 2016

Month in 2016	Ex-post Forecast	Month in 2016	Ex-post Forecast	Month in 2016	Ex-post Forecast
January	174,760	May	140,577	September	159,777
February	175,581	June	149,586	October	166,476
March	174,349	July	180,187	November	179,265
April	151,636	August	178,044	December	211,350
Total expected arrivals for the entire year 2016					2,041,588

CONCLUSIONS AND RECOMMENDATIONS

Since the first model in Table 2 has the minimum MAPE (11.36%) value, Holt- Winter's additive seasonal exponential smoothing model with smoothing constants $\alpha = 0.15$, $\beta = 0.05$, and $\gamma = 0.10$ is selected as the best model. Thus this model can be recommended for the short term forecasting arrivals in near future.

Since the international tourist arrivals are dramatically increasing after the internal conflict in Sri Lanka and the contribution of tourism to the economy of a country is significantly high, more attention on this industry is needed when the infrastructure development takes place in all over the island.

From the ex-post forecast, it can be concluded that the expected international tourists is more than 2.041 million for the year 2016. It is about 13.52% increase in comparison with the year 2015. It is noted that, this estimated growth rate for the year 2016 is less than the growth rates of previous years after the conflict. Since the tourist arrivals are increasing every year, the country has to be ready in order to facilitate the future tourists in a way to attract them. Also it is the responsibility of the relevant officials and decision makers in the country to provide the needs of the tourists specifically the accommodations facility.

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TEACHERS' PERCEPTION ON THE EFFECTIVENESS OF THE POST GRADUATE DIPLOMA IN EDUCATION PROGRAMME

R. Mangaleswarasharma^{1*} and A. Sathiaseelan²

Dept. of Secondary and Tertiary Education, Open University of Sri Lanka¹, Dept. of Education, University of Jaffna².

INTRODUCTION

Teachers play the crucial role in the development of the student, society as well as the nation. Lokman (2012) claims that teachers form the nucleus of any system of education. Professional development (PD) enhances teachers' knowledge, skills and attitudes and enables them to enrich approaches in order to improve the quality of teaching and learning. Post Graduate Diploma in Education (PGDE) programme is the basic professional qualification a Sri Lankan graduate teacher can obtain. The main purpose of PGDE programmes is to bring about professional and career advancement of non trained graduate teachers. Faculty of Education of the Open University of Sri Lanka (OUSL) offers PGDE programme of 15 months duration in open and distance mode. It conducts PGDE through almost all its Regional/ Study centres all over the Island.

Teachers' beliefs, perceptions and attitudes towards PD initiatives have a powerful impact on the effectiveness of those programmes after implementation. (Friedman, 2011). Therefore, strong consideration should be given to teachers' perceptions on PD practices to enhance their quality. Understanding teachers' perceptions and views of PD practices may be helpful to improve the outcomes and success of those practices. Hattig and de Kock (2008) also found that beliefs, perceptions and attitudes of teachers towards the PD experiences have a tremendous impact on the effectiveness of those programmes.

Hence, this study identifies teachers' perceptions on the effectiveness of the PGDE programme they participated in. Effective teacher PD can influence teachers' learning, the method and practice of teaching and student learning. Effective PD can bring about improved student achievement by empowering teachers and teaching. Villereal (2005) identified seven fundamental principles that give an effective professional development programme for schools with a diverse student population. He summarized these principles as a lifelong process, based on adult learning theory, essential for quality schools for minority students, can be enhanced through a technology enriched environment, partnered with a strong curriculum, critical in an accountability system, require commitment and support from federal and state level.

The literature emphasized that effective PD programmes need to be attentive to the broader change process and should focus on the improvement of student learning through teacher development. Therefore this study aims to explore teachers' perceptions on the effectiveness of the PGDE programme conducted by the OUSL.

To guide the research, the following research questions were formulated.

1. What are teachers' perceptions in relation to the effectiveness of the PGDE programme.?
2. Are there any significant relationships between teachers' perception on the effectiveness of the PGDE programme and teachers' in terms of;
 - Gender
 - Age
 - Length of teaching experience
 - First degree?
3. How can the effectiveness of the PGDE programme be improved?

* Corresponding author: Email - rmang@ou.ac.lk

METHODOLOGY

This study used a survey research design. This study involved the population of Graduate teachers in Sri Lanka. The target population was Graduate teachers in Jaffna district. The sampling technique used in this study was purposive sampling technique. One hundred and fifty five graduate teachers who followed PGDE at Jaffna Regional Centre (JRC) of the Open University of Sri Lanka (OUSL) in 2014/2015 academic year were purposively selected for this study. Researcher designed survey questionnaire was used to study teachers' perceptions on the PGDE programme. One hundred and ten student teachers responded to the survey.

DATA ANALYSIS

The data from the questionnaire survey was analyzed with the SPSS (Statistical Package for Social Sciences). The data were analyzed using statistical mean (\bar{x}) and standard deviation (SD). Mean and standard deviation were employed to determine the patterns in the views of teachers on the effectiveness of the PD programme. ANOVA test and t-test were used to examine if there is any relationship between demographic characteristics and teachers' perceptions.

To understand thoroughly about teachers' perceptions on the effectiveness of the PGDE programme, student teachers were asked to respond to 14 items in the survey instrument. Teachers' perceptions about the effectiveness of the PGDE were identified on a 4-point Likert scale. Teachers' responses were analyzed and presented as frequencies and percentages. Means and SD were also calculated to study their perceptions.

RESULTS AND DISCUSSION

This part presents the findings of the study.

Table 1. Demographic characteristics of the survey respondents.

Main characteristics	Sub Group	Total	
		N	%
Gender	Male	47	43
	Female	63	57
Age	20-25	1	1
	26-30	42	38
	31-35	44	40
	36-40	16	15
	41-45	6	5
	above 45	1	1
Experience	1- 2	57	52
	3- 5	21	19
	6- 10	28	25
	11- 15	1	1
	Above 15	3	3
Degree	Arts	46	42
	Science	38	35
	Commerce	4	4
	Fine Arts	13	12
	Agriculture	1	1
	ICT	8	7

The above table shows that 57% of the teachers are female and 79% of them are below 35 years age. Further, 52% of them have less than two years of teaching experience and 42% of them are Arts graduates.

The following table illustrates teachers' perception on the PGDE programme.

Table 2. Teachers' perceived effectiveness of the PGDE programme

	Perceptions on effectiveness of PGDE programme	OUSL		SA		A		D		SD	
		Mean	SD	N	%	N	%	N	%	N	%
1	The professional development programme was designed based on the interests and needs of the participants	3.28	0.584	33	32	68	67	1	1	0	0
2	Developed my ability to work collaboratively with parents and colleagues	3.26	0.626	34	33	64	63	4	4	0	0
3	Developed ability to reflect critically on own practice to improve the quality of my work	3.42	0.619	47	46	54	53	1	1	0	0
4	Renewed my enthusiasm for teaching	3.66	0.605	72	71	29	28	1	1	0	0
5	Developed my ability to learn independently	3.55	0.653	63	62	36	35	3	3	0	0
6	Prepared me to perform administrative duties	3.36	0.669	45	44	52	51	5	5	0	0
7	The objectives of the programme were made clear	3.3	0.575	34	33	68	67	0	0	0	0
8	The material covered will be useful in improving student learning	3.47	0.623	52	51	49	48	1	1	0	0
9	The programme has overall value to help accomplish nation's educational goals	3.3	0.639	38	37	60	59	4	4	0	0
10	The professional development provided adequately addresses the need for strong teacher-student relationships	3.53	0.641	59	58	41	40	2	2	0	0
11	Received regular, timely feedback on our performances	3.31	0.689	43	42	52	51	7	7	0	0
12	Teaching practice was observed multiple times and by multiple observers	3.35	0.699	45	44	52	51	4	4	1	1
13	A valid rubric was used for observing teaching practice	3.5	0.628	56	55	45	44	1	1	0	0
14	Enable teachers to practice new techniques in a stimulated class room environment before trying them with real students.	3.44	0.637	50	49	50	49	2	2	0	0

Most of the student teachers strongly agreed that the programme was effective. More than 50% of the student teachers strongly agreed that their PGDE programme renewed their enthusiasm for teaching (Mean= 3.68, SD=0.556), developed their ability to learn independently (Mean=3.55, SD=0.653), adequately addressed the need for strong teacher-student relationships (Mean=3.53, SD=0.6641), used a valid rubric for observing teaching practice (Mean=3.50, SD=0.628) and material covered in the programme will be useful in improving student learning (Mean=3.47, SD=0.623).

However some student teachers did not agree with some statements regarding the effectiveness of the PGDE programme. Mean values are lower for some aspects including the programme developed their ability to work collaboratively with parents and colleagues (Mean=3.26, SD=0.626), designed based on the interests and needs of the participants (Mean=3.28, SD=0.584), the objectives of the programme were clear (Mean values =3.30, SD=0.575). Further, teachers expressed their disagreement on the statement "The programme has overall value to help accomplish nation's educational goals" (Mean=3.28, SD=0.639).

To investigate the relationships between teachers' demographic characteristics namely gender, age, length of experience, first degree and their perceptions on effectiveness of the PGDE programme, ANOVA test was used. This is further illustrated in detail as follows:

Table 3. ANOVA on overall mean scores of perceptions on the effectiveness of the PGDE programme

Demographic variable	Items on the effectiveness of the programme	Sum of Squares	df	Mean Square	F	Sig.	
Age	Developed ability to reflect critically on own practice to improve the quality of my work	Between Groups	3.793	4	0.948	2.535	0.045
		Within Groups	37.407	100	0.374		
		Total	41.2	104			
	The professional development provided adequately addresses the need for strong teacher-student relationships	Between Groups	6.283	5	1.257	2.748	0.023
		Within Groups	46.184	101	0.457		
		Total	52.467	106			
	Received regular, timely feedback on our performances	Between Groups	5.787	5	1.157	2.364	0.045
		Within Groups	49.953	102	0.49		
		Total	55.741	107			
	Teaching practice was observed multiple times and by multiple observers	Between Groups	6.621	5	1.324	2.624	0.028
		Within Groups	51.481	102	0.505		
		Total	58.102	107			
	A valid rubric was used for observing teaching practice	Between Groups	5.542	5	1.108	2.508	0.035
		Within Groups	44.194	100	0.442		
		Total	49.736	105			
Enable teachers to practice new techniques in a simulated classroom environment before trying them with real students.	Between Groups	8.774	5	1.755	4.248	0.001	
	Within Groups	42.547	103	0.413			
	Total	51.321	108				
Gender	The objectives of the programme were made clear	Between Groups	1.858	1	1.858	4.976	0.028
		Within Groups	39.941	107	0.373		
		Total	41.798	108			

For the research question regarding the relationship between teachers' perceptions and their demographic characteristics, significant differences were observed between teachers' age and their perceptions on PGDE programme. Significant difference was observed between young and elder teachers' perceptions on six aspects of the programme. (p value <0.05).

Significant differences were observed between teachers' gender and their perceptions on PGDE programme. Significant difference was observed in the perceptions of male and female teachers on the item "The objectives of the programme were made clear" ($p < 0.05$). However, no significant difference was revealed in the relationship between teachers' gender and their perception on other thirteen items. No significant differences were observed between teachers' perceptions on the PGDE programme and the length of their teaching experience and their first degree.

CONCLUSION

This study explored the graduate teachers' perceptions on the PGDE programme conducted by the OUSL. Most of them had positive views on the programme; however they found some aspects of the PGDE programme were not effective. Further, their perceptions on the effectiveness of PGDE programme were significantly affected by their age and gender. As teachers are the most valuable human resources in the Sri Lankan Education system, effective professional development programmes should be planned and provided to improve their quality. The following recommendations were made based on the findings of the study.

PGDE programmes should be planned and designed according to the needs and interests of the participants. It should be able to develop abilities among the teachers to work in and out of the school. Hence, it is quite important to take into account teachers' perceptions on programme. The university might consider reviewing their curriculum with a view to accomplishing nation's educational goals.

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**L2 MOTIVATIONAL SELF-SYSTEM THEORY:
L2 MOTIVATIONAL LEVELS IN THE SRI LANKAN LEARNING CONTEXT**

Dilmini Direckze^{1} and Madawi Sumanasinghe²*

^{1,2}*Department of PGIE, The Open University of Sri Lanka*

INTRODUCTION

Research on motivation to learn a second language or a foreign language has been in focus in the field of education for many years. As per Dörnyei and Chan (2013), some important milestones of language motivation research includes Gardner and Lambert's (1959, 1972) pioneering research that introduced the concepts of integrative and instrumental orientation, Clement's (1980) addition of self-confidence to the motivational research paradigm, Gardner's (1985) and Gardner and MacIntyre's (1992, 1993) detailed discussion of the socio-educational model in second language acquisition (SLA), the educational shift in motivation research in the 1990s (eg. Crookes & Schmidt, 1991; Dörnyei, 1994) and the L2 Motivational Self system proposed by Dörnyei (2005, 2009).

Dörnyei has reconceptualized L2 motivation as part of the learner's self system outlining the effect of two significant theoretical developments: L2 field and conventional psychology. Dörnyei (as cited in Far, Rajab, & Etemadzadeh, 2012) states that the L2 motivational self system considers the idea of "possible selves" that "give form, meaning, structure, and direction to one's hopes and threats, thereby inciting and directing possible behavior". The concept of possible selves is captured from Higgin's self-discrepancy theory (as cited in Far, Rajab, & Etemadzadeh, 2012). Carver et al. (as cited in Dörnyei, 2009) emphasise that possible selves - representing the individuals' ideas of what they might become, what they would like to become, and what they are afraid of becoming denote a unique self-dimension in that they refer to future rather than current self-states. Markus and Nurius (as cited in Dörnyei, 2009) points out three main types of possible selves: ideal selves that we would very much like to become, selves that we could become and selves we are afraid of becoming. Many researchers have conducted a great deal of research to discover the relationship between ideal selves and academic self guides.

Through his research, Dörnyei (2009) identifies that L2 motivational self system is made up of three components: Ideal L2 self, Ought-to-L2 self and L2 Learning experience. Data of his Hungarian research and new theoretical approaches determines that future self guides i.e. ideal and ought to selves are central components of L2 motivational self system. Ideal L2 self is derived from the inner desire to learn the language by the learner. Dörnyei (2009) points out that "if the person we would like to become speaks a L2, the 'ideal L2 self' is a powerful motivator to learn the L2 because of the desire to reduce the discrepancy between our actual and ideal selves". Ought to L2 Self which is the other main component of L2 motivational self system, is originated from the influence of the society where the learner belongs to. Dörnyei (2009) defines ought to L2 self as "the attributes that one believes one ought to possess such as duties, responsibilities, obligations etc. to meet expectations and to avoid possible negative outcomes". L2 learning experience is coined from the authentic participation of the learner in the learning process. According to Dörnyei (2009), "L2 learning experience, which concerns situated, 'executive' motives related to the immediate learning environment and experience such as the impact of the teacher, the curriculum, the peer group, the experience of success etc."

Dörnyei (2009) emphasizes that Gardner's socio-educational model as well as influential conceptualisations suggested by Noels and Ushioda "appear to converge in a common tripartite construct, which is fully compatible with the L2 Motivational Self System."

* Corresponding author: E mail - dilmini.direckze@gmail.com

This study is based on Dörnyei’s L2 Motivational Self-System and analyses a language learner’s L2 motivational levels in terms of their ideal L2 selves, ought to L2 selves and L2 learning experience demonstrating the relationship of various factors and their influence on each other and the L2 motivational system as a whole. Thus the objective of the study is to identify the main component of L2 motivational self system that affect the Sri Lankan learners. Language teachers, specifically second language teachers often have the challenge of motivating L2 learners to get the maximum benefit when learning L2. This study focuses on Dörnyei’s L2 Motivational Self-System theory in Sri Lankan or South Asian learning context. Sri Lanka is a multilingual, multi cultural country comprises of approximately 20 million population. Learning a second language is quite common in the country while learning a third language gives an additional benefit in many instances.

METHODOLOGY

Profile of the target group

A questionnaire based on Ideal L2 self, ought to L2 selves and L2 learning experience was given to a group of 26 students in two advanced level classes i.e. 17-18 years old students in a semi-urban government mixed school in Central Province in Sri Lanka. Students come from lower middle class and lower class families which lack formal education and language education.

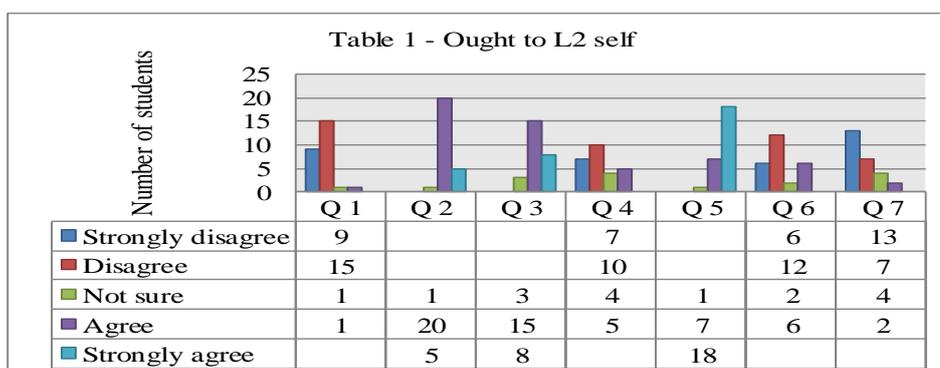
Gender equality can be observed in classes thus in the research: out of 26 students, 12 are girls and 14 are boys. All the students speak Sinhala as the mother tongue and learn English as the second language. Although the students have been learning English since grade 3, they are not confident enough to speak in English as their proficiency level is limited. They do not get any influence from their families to speak in English thus they feel shy talking in English even with their peers during group work though they want to learn to speak. Even at school, they hear speaking in English only from their English teacher which happens during the English period. According to their English teacher, they show a lot of interest in learning the language during English period.

Method

This study was done with only quantitative data which was collected from the questionnaire using Likert scale format. Questionnaire was translated and given to students in their mother tongue, Sinhala. First part of the questionnaire was designed to obtain the biological details of the learner together with information about the learning context. Second part of the questionnaire which was divided in to three categories according to the three components of L2 Motivational Self-system, contained seven questions for ought to L2 self, nine questions for ideal L2 self and eight questions for L2 learning experience.

RESULTS AND DISCUSSION

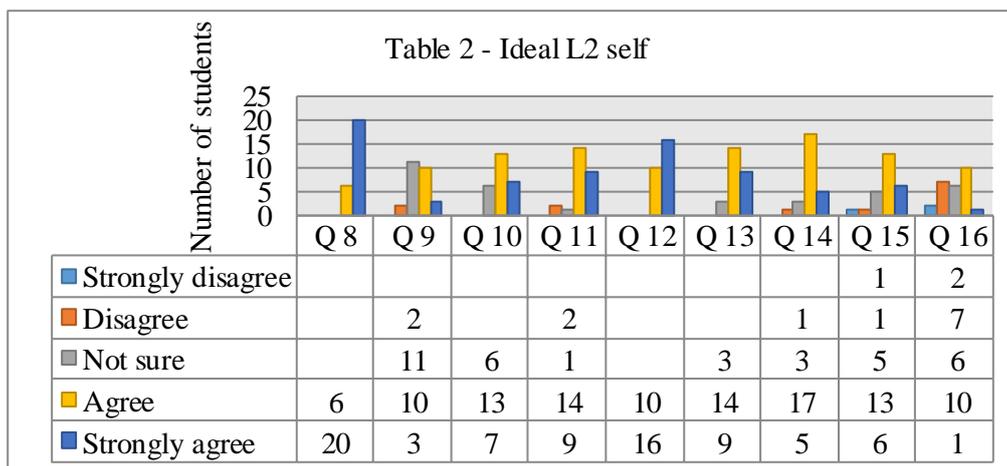
The rating results according to the answers of students for questions 1 to 7 related to ought to L2 self-component are given in Table 1.



In the table 1, the answers depict that certain societal factors help students to motivate to learn L2. According to the results in the question 2 (*My parents believe that I must study English to be an educated person*) parents of the target group as well as students themselves believe that they should learn English to be educated people, to obtain a good reputation and respect from peers, family, and teachers and also to get a good job. Most of the students have a strong belief that they should learn English to get social recognition.

However, it is visible that close friends of the target group or the people surrounding them do not motivate or influence them to learn L2. Answers to the question number 4 (*I have to study English to please my parents*) reveal that the target group believes that their parents want them to learn English not merely for the happiness of parents but for the benefit of their children. To summarize the results of ought to L2 self, it is revealed as this target group is motivated by certain societal factors. Parents, society, and their beliefs related to social recognition and a better job motivate the students to learn L2. Yet, the influence of their close friends who are in the same caliber regarding the language proficiency and formal education setting are not motivating the target group which gives a perception of the attitudinal state of the target group.

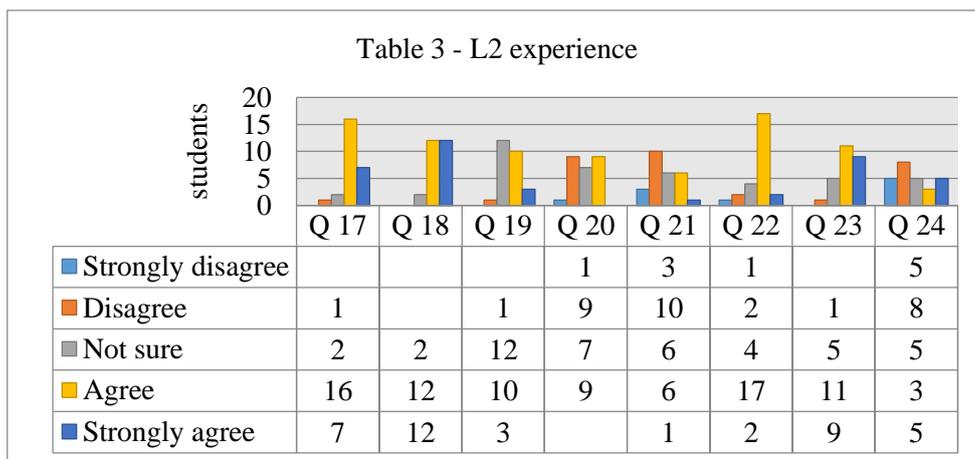
Result of the nine questions designed to find out the motivation of L2 learners in relation to Ideal L2 self are given in Table 2.



According to table 2, majority of students seem to have inner desire to learn L2 implying inner motivation. Although most of the students answered to question 9 stating that they could be happy even if they do not know much English, almost all of them believe that English is a compulsory requirement for their future as per the answers to question 8 (*The things I want to do in the future require me to use English*). However, several students have a negative comment or attitude on question number 16 (*Studying English is important because an educated person is supposed to be able to speak in English*). There could be several reasons behind this confidence or attitude. Although they have limited English proficiency, they are recognized as the cleverest students in the whole school which make them feel that their education is not affected by L2. Another reason could be that they are not confident in learning L2 thus making an effort to face the challenge by being educated without allowing L2 learning affect their education as a whole.

It is noticeable that several students mentioned that they are not sure of imagining things. The effect of visualizing is proven strong but without having a proper training, it will only be day dreaming. Showing that they do not know about how to visualize gives the view that they know the difference between day dreaming and visualizing.

Answers of the questions designed to find out the motivation related to L2 learning experience is given in Table 3. Answers depict that students lack L2 learning experience. Majority of students are motivated by their English teacher (question 17: *My English teacher always maintains a supportive and pleasant classroom climate where we are free from embarrassment and ridicule*) as well as the lessons in the text book (question 19). As per question 23, they believe that they can do higher studies in English medium and they can speak in English with their English teacher, family, and friends. Yet, depicted by question 22, they state that they get nervous when talking to a fluent speaker of English. Even though they genuinely want to learn English, most of the students do not read English newspapers or books. Students are not quite comfortable with using English with peers in the classroom. They have mixed feelings when they think about themselves as people who do not know English.



CONCLUSIONS/RECOMMENDATIONS

Validity of the L2 Motivational Self System has been demonstrated through numerous studies and research done not only in Europe but also in Asia where different languages are in use. This study which is done using only one government school in Central Province provides considerable facts about L2 learning and L2 motivational self system. Out of ideal L2 self, ought to L2 self and L2 learning experience, students are motivated mostly by ideal L2 self. Capacity of motivating through ideal L2 self can be enhanced by teaching how to visualize and imagine the desires of students related to L2 learning.

Another observation which could be noticed in the school is that neither teachers nor parents are motivated or encouraged to use English in the school premises. As a result, students hear or use English only during their English period, i.e. only for 30 - 40 minutes per day. From the ratings of the questions, it is understood that students don't use or are not motivated to use English at home either. They seldom get the opportunity to watch English films or an English programme in TV as no other person at home understands English. Everybody watches TV at night and they normally seem watching what majority prefer to watch.

Students are not motivated much with ought to L2 self and L2 learning experience mainly due to the fact that both ought to L2 self and L2 learning experience interrelate with the environment and society and people surrounding them. It seems that students have the inner desire to learn L2 but they do not know how to motivate themselves through close friends and learning contexts.

Although teachers cannot change the society in a large scale and the people surrounding students, it will be effective if the school environment and people communicate with students in school premises motivate them in L2 learning. Providing a friendly environment and pleasant L2 learning experience by providing the opportunity to use new technology in L2 learning could be quite effective as they stay more than 6 hours in the school premises

everyday. More than the responsibility of the teacher, we personally believe that it is the responsibility of the principal and the management of the school to encourage teachers and students to do their part. This way, language teachers will get numerous opportunities to increase student motivation in L2 learning. As Dörnyei (as cited in Dörnyei & Skehan 2003) clearly states, wide range of academic and social motives are needed in order to have a sophisticated motivational life of classrooms.

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INVESTIGATING EFFECTIVENESS OF PEER LEARNING AND TEACHING IN TEACHING LANGUAGE CLASSROOM

I. N. J. Bogamuwa^{1*}

¹*Department of Language Studies, The Open University of Sri Lanka*

INTRODUCTION

Teaching Language and Literature (TLL) is one of the second year courses offered in the B.A. in English and English Language Teaching (ELT) Programme at the Open University of Sri Lanka. This course deals with the pedagogy of English Language Teaching and also aims to develop competencies for the teaching of English to second language (ESL) learners. Part one of this course aims to promote competencies for the teaching of language in the ESL classroom while exploring the topics such as psychology and theories of learning, the acquisition of language, the methodology of teaching, and teaching English for academic and specific purposes. However, it was noticed that the majority of the students do not take part actively in the classroom discussions although the majority of the students are teachers. This inactive behavior could be due to lack of generic skills. In response to this issue the reciprocal peer learning and teaching model was utilized in the Teaching Language (TL) class. Reciprocal peer learning can be defined as students, generally of the same class or cohort, learning with and from each other (Boud, 2001). Reciprocal peer learning emphasizes that students simultaneously learn and contribute to other students' learning. In addition to that, peer learning contributes towards the development of students' generic skills of team-work, time-management, organizational and presentation skills (Lim, 2014). When students are provided an opportunity to work with each other instead of work individually is an effective methodology as it forces students to be interactive with others. Most studies on peer teaching have predominantly been based on teaching of disciplines related to science, mathematics and information technology etc. rather than subjects related to language and literature. Thus, the purpose of this study was to explore how TL students evaluate their own peer teaching while investigating these students' learning behaviour. Furthermore, it examines the usefulness and helpfulness of the peer-teaching activity in the TL class and TL students' attitudes toward the peer-teaching activity.

METHODOLOGY

Second year B.A. in English and ELT students who follow TLL course were divided into groups of seven and each group was assigned a teaching task once the lecturer had provided the introduction to the lesson. For the first and second days of the class each group was allocated a strategy in language learning and a method/ approach of teaching language as their peer teaching topics respectively. These students were given a preparation time and asked to select a group leader. Further, they were instructed to include their own examples that they had encountered through their experience. Thus, each group was given the responsibility of teaching the given topic to the rest of the class, because in reciprocal peer teaching, students are individually, as well as collectively, accountable for optimizing their own learning and achievement (Bound, 2001). Each peer teaching session was monitored by the lecturer while providing the required feedback at the end of the session. However, peer learners were provided an opportunity to ask questions and give their feedback at the end of each teaching session before the lecturer's comments were given.

*Corresponding author: Email – inbog@ou.ac.lk

In order to gather information from the students, a questionnaire was administered after all TL sessions were over. The questionnaire developed by Lim (2014) on peer teaching was adapted. Second year TLL students were asked to respond on a voluntary basis to the questionnaire as it applied to their learning Teaching Language. Although there were around seventy students who took part at the beginning of the peer teaching sessions only sixty completed and returned the questionnaires. This questionnaire consisted of three sections, the first of which contained the group self-evaluation checklist; second and third sections comprised questions related to learning behaviour and the usefulness and helpfulness of the peer teaching activity in the TL class respectively. A 4-point Likert scale was utilized for the group self-evaluation checklist, 1 for Strongly Disagree, 2 for Disagree, 3 for Agree and 4 for Strongly Agree. Accordingly, group self-evaluation was calculated out of 20 marks by each student. In order to analyze the marks allocated by the students for their own group, frequency distribution and percentages were scrutinized. A descriptive analysis was also done to obtain further details of the group self-evaluation checklist. For section two and three of the questionnaire a 6-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (6) was used. The responses were aggregated into two categories as strongly disagree to disagree and strongly agree to agree. For further analysis, the Mean values and percentages of section two and three were also scrutinized. In order to collect the TL students' attitudes towards the peer teaching, an open ended question "Do you have any comments about the way the Teaching Language classes were conducted?" was given at the end of the questionnaire.

RESULTS AND DISCUSSION

1) How do TL students evaluate their own teaching?

Table1. Descriptive analysis of group self-evaluation checklist

Statement	1: SD		2: D		3: A		4: SA	
	Frequency	(%)	Frequency	(%)	Frequency	(%)	Frequency	(%)
The group was well prepared for the peer teaching.	3	5	12	20	43	71.7	2	3.3
The group understood the task well.	0	0	5	8.3	40	66.3	15	25
Majority of the group members helped keep the group on task.	2	3.3	4	6.7	39	69	15	25
The group led the peer teaching class well.	0	0	8	13.3	43	71.7	9	15
I am satisfied with the performance of the group.	1	1.7	6	10	41	68.3	12	20

Values: 1: Strongly Disagree, 2: Disagree, 3: Agree and 4: Strongly Agree

According to the descriptive analysis of the group self-evaluation checklist in table 1, 71.7% of the TL students agreed that their group was well prepared and led the peer teaching class well. Furthermore, more than 66% of the students agreed that their group understood the task well, the majority of the group members helped keep the group on task as well as they were satisfied with the performance of their own group. These results agree with Saito (2008) where he says that the peer-teachers must understand work well enough to present it to their peers in a peer-teaching activity. In addition to that, when considering the marks assigned by the TL students for their group self-evaluation, the majority of the students (70%) had allocated marks ranging from 15 to 19 out of 20 for the teaching of their own group, whereas the remaining 30% of students had assigned marks between 7 and 14.

2) What is the learning behaviour of the TL students?

Table 2. Learning behaviour of the TL students

Statement	Strongly Disagree to Disagree (%)	Strongly Agree to Agree (%)	Mean Value
I am an independent learner.	18.3	81.7	4.42
I do pre-preparation before each Teaching Language lecture.	23.3	76.7	4.13
I do revision after each Teaching Language lecture.	21.7	78.3	4.12
I am a motivated learner.	8.3	91.7	4.53
I prefer to study on Teaching Language by myself	46.7	53.3	3.52

Values: 1: Strongly Disagree, 2: Somewhat Disagree, 3: Disagree, 4: Agree, 5: Somewhat Agree, and 6: Strongly Agree.

Table 2 demonstrates the summary of the feedback of TL students about their learning behaviour. Accordingly, TL students had shown that they are more independent and motivated learners and the mean values of these two factors, which were 4.42 and 4.53 respectively, were found to be highly significant. However, the mean value assigned to study by themselves (3.52) was not found to be so significant comparatively. Thus, it indicates that although these students were very independent and motivated learners, comparatively they still did not prefer to study by themselves. These results agree with Lim (2014) where he found out that although two-third of his students preferred to learn by themselves the majority enjoyed the peer teaching in the class. The mean values obtained for pre-preparation (4.13) and revision (4.12) of the TL lessons were also highly significant, indicating that these students may have done their groundwork before the lectures since they knew that they had to engage in peer-teaching activity.

3) How far peer teaching is helpful and useful to the TL student?

Table 3. Feedback of the TL students about the peer teaching

Statement	Strongly Disagree to Disagree (%)	Strongly Agree to Agree (%)	Mean Value
I enjoyed discussing Strategies and Methods in Language Teaching with classmates.	16.7	83.3	4.55
I enjoyed helping classmates in Teaching Language.	6.7	93.3	4.65
I learnt better in Teaching Language by interacting in class.	13.3	86.7	4.55
I learnt better in group work.	21.7	78.3	4.30
Having to explain to my peers helped me to understand better.	5.0	95	4.95

Values: 1: Strongly Disagree, 2: Somewhat Disagree, 3: Disagree, 4: Agree, 5: Somewhat Agree, and 6: Strongly Agree.

According to Table 3, the majority of the TL students had agreed that they enjoyed peer teaching while obtaining the benefits of group work, interaction and explanation. The mean values assigned to all these factors were correspondingly found to be highly significant. Specially, TL students had agreed that having to explain to their peers had helped them to understand better (95%) and they had enjoyed helping classmates (93.3%). Hence, these results adequately supported that peer teaching is greatly helpful and useful to the TL student.

4) What are the TL students' attitudes towards the peer teaching?

The feedback provided for the open ended question "Do you have any comments about the way Teaching Language classes were conducted?" were analyzed in order to examine the TL students' attitudes towards the peer teaching. Although 13% of the students abstained from responding to this question, 80% had provided positive responses whereas 7% of them responded negatively. Majority of the students had mentioned that peer teaching was very good and helpful. Among these positive comments; "Doing group activities are really good for those who are shy to ask questions in public. They can get help from peers at the same time they learn" and "I think peer teaching is more interactive and it keeps the class lively" were provided. Further some had mentioned that they prefer to have practical sessions like peer teaching than just listening to a conventional lecture and it was a new experience for them. Among negative responses: "I prefer to have lecturer's explanations than by the peers" and "I don't like group work. I like lecturer-talk method. I think group work is time consuming" were provided. However, even among the positive comments some students had mentioned that the time allocated for their peer teaching and discussions were insufficient.

CONCLUSIONS/RECOMMENDATIONS

Overall, the TL students had very positive attitudes towards peer teaching activity. According to the findings, the majority of the TL students were satisfied with their own peer teaching by evaluating their own groups positively. Furthermore, these results agree with Beever and Paterson (2002) that peer teaching encourages independent learning while improving self-confidence and communication skills as the majority of the TL students felt that they were independent learners as well as they learnt better by interacting. Simultaneously, it showed that peer teaching was an encouraging tool in learning as the majority of the students indicated that they enjoyed discussing and helping each other while grasping the subject knowledge better by interacting and explaining to the others. The TL students' positive feedback and optimistic attitudes suggest that peer teaching-learning strategies can be further extended to encourage undergraduates in a variety of contexts and disciplines.

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DEVELOPING SELF-REGULATED LEARNING PRACTICES AND METACOGNITIVE SKILLS THROUGH ACTIVITY BASED LEARNING: POSSIBILITIES AND CHALLENGES

S. Kugamoorthy^{1}*

*¹Department of Secondary and Tertiary Education, Faculty of Education,
The Open University of Sri Lanka*

INTRODUCTION

There are a variety of teaching strategies that teachers can use to improve student learning. Nowadays, most of the teachers use lecture method in their classrooms. However, with the students in the present context, lecturing does not hold their attention for very long, even though it is a method of conveying information to students. Teachers have to use learner-centered teaching-learning approaches to improve the metacognitive abilities of the students through the self-regulated learning practices which can be used in the activity based teaching-learning approach.

Self-regulated learning is a complex process, containing cognitive, motivational and contextual elements. Meta cognition is the instrument that controls these elements and which forms the basis of the process of self-regulated learning. Pintrich (2000) described self-regulated learning as: “an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation and behavior, guided and constrained by their goals and the contextual features in the environment”. The self-regulation of cognition and behaviour are important aspects of learning and the extent to which students become self-regulators of their own learning influences their academic success (Beishuizen & Steffens, 2011).

Effective self-regulated learners actively set goals, decide on appropriate strategies, plan their time, organize and prioritize materials and information, shift approaches flexibly, monitor their learning by seeking feedback on their performance and make appropriate adjustments for future learning activities (Meltzer, 2007). Formal education should be to equip students with self-regulatory skills (Bakracevic Vukman & Licardo, 2010; Boekaerts, 1997). Dignath and Büttner’s (2008) findings indicated role that teachers play in the development of self-regulated learning is insignificant in the teaching-learning processes.

The Faculty of Education of the OUSL realizes the importance of quality teachers for quality education. Therefore the faculty has introduced several teacher education programmes and using innovative approaches to increase self- learning abilities and metacognitive skills among the student teachers.

Objectives of the study

The main objective of this study is to examine the possibilities and challenges faced by student teachers to improve their self-regulated learning practices and metacognitive skills through activity based teaching-learning approaches used in Post Graduate Diploma in Education (PGDE) Programme conducted by the Faculty of Education. The specific objectives of this research are as follows:

1. To identify usefulness of activities adopted for Activity Based Learning approach;
2. To examine to what extent the Activity Based Learning approaches increase self-regulated learning practices among student teachers;
3. To Identify the metacognitive skills achieved by the student teachers through the self-regulated learning practices;

* Corresponding Author Email: skuga@ou.ac.lk

4. To evaluate the problems faced by the student teachers to engage effectively in self-regulated learning practices in the activity based learning sessions; and
5. To make appropriate suggestions and recommendations to improve the effectiveness of the activity based learning approach.

RESEARCH METHODOLOGY

Quantitative and qualitative research approaches were used in this study within a framework of a survey research design. The study was conducted on the student teachers who followed PGDE programme in Tamil medium at the Colombo Regional Center of the OUSL in the 2011/2012 academic year. The total number of Tamil medium student teachers enrolled for the programme was 1054. Among them, 104 student teachers who followed PGDE programme at the Colombo Regional Centre were purposively sampled for this study. Data were gathered only from student teachers who were physically present at the Colombo Regional Centre for the activity based contact session on the day of visit by the researcher. Out of 104 student teachers 56 responded to the questionnaire. The data were collected using questionnaire. The questionnaire was structured type and focused on collecting data on three identified key areas namely; (i) identify usefulness of activities adopted for Activity Based Learning approach (ii) the extent the Activity Based Learning approaches increase self-regulated learning practices among student teachers, (iii) the metacognitive skills achieved by the student teachers through self-regulated learning practices and (iv) the problems faced by the student teachers to engage effectively in self-regulated learning practices in the activity based learning sessions. There were eleven main items in the whole questionnaire. Rating scales, selection of the most appropriate answer, structured type questions as well as a few open-ended questions were included in the sub items. The data obtained were tabulated and analyzed by applying elementary quantitative techniques such as frequencies and percentages. Open ended questions were analyzed qualitatively.

RESULTS AND DISCUSSION

Usefulness of Activities Adopted for Activity Based Learning

All the respondents were adult learners between the ages 30 to 45 years. The majority (86%) of the student teachers expressed that as adult learners, they do not expect all the information need to be given by the day school lecturers. Ninety six (96%) percent of the student teachers mentioned that they like to search more information themselves for their own learning.

Table 1. Students' Rating on Usefulness on Activities Adopted for Activity Based Learning

Activities	Greatly (%)	To Some Extent (%)	Moderately (%)	Little (%)
Group Discussion	72	28	-	-
Group Activities	87	13	-	-
Individual Presentations	79	16	05	-
Group Presentations	69	11	08	12
Peer Discussion	86	14	-	-
Individual Learning Activities	76	14	06	04
Group Learning Activities	91	09	-	-
Research Based Assignments	83	11	06	-

Student teachers expressed that the activities given for them in their PGDE programme such as group discussions (72%), group activities (87%), individual presentations (79%), group presentations (69%), peer discussions (86%), individual learning activities (76%) group learning activities (91%) and research based assignments (83%) were very useful and motivated them to do self-learning and search more relevant information for their learning.

Increase self-regulated learning practices

Group activities encourage students' involvements during the activity based day schools in various ways. The following statements were given to examine how far activity based learning approaches increased student teachers' involvement for self-learning practices.

Table 2. Students' Rating on Involvement of Self Learning Practices

Statements	Greatly (%)	To Some Extent (%)	Moderately (%)	Little (%)
Motivating to attend the activity based contact sessions	57	43	-	-
Searching more information for learning activities	21	64	15	-
Doing pre preparation for learning activities	17	71	07	05
Motivating to participate in group learning	36	57	07	-
Increasing participation in the group activities	50	41	07	02
Willing to take leadership positions in the group activities	43	43	14	-
Coming forward to do the presentations	14	71	14	01
Respecting the valuable presentations of peers	13	79	07	01
Creating opportunities for learning with peers	36	50	14	-
Coming forward to correct the incorrect answers of peers	21	64	14	01
Evaluating the presentations of the peers	28	57	14	01
Coming forward to give more information for insufficient explanation	28	57	14	01

As indicated in Table 2, the findings revealed that the majority of the student teachers have accepted that activity based learning contact sessions have increased their involvement in self-learning practices. More than 90% of the teachers expressed that activity based learning contact sessions have motivated and increased their participation in group learning and group activities. Further, they stated these sessions enabled them to respect the valuable presentations of peers. From the findings, it is clearly shown that activity based learning approaches have improved the self-learning and peer learning practices among the PGDE student teachers.

Meta Cognitive Skills

The following list of skills was given to the student teachers and they were asked to identify the higher order cognitive skills they achieved through the activity based learning approaches.

Table 3. Students' Ratings on Skills Development

Skills	To a Great Extent (%)	To some Extent (%)	Moderately (%)
Self -motivation	28	64	08
Planning	14	79	07
Sharing	15	64	21
Creativity	08	71	21
Analytical skills	22	71	07
Evaluating skills	21	71	08
Self- evaluation	14	79	07
Critical thinking	28	60	12
Reflective skills	07	86	07
Criticizing	14	64	22
Self -learning	21	71	08
Presentation skills	36	57	07
Leadership	21	71	08
Team spirit	43	50	07

According to Table 3, the findings revealed that activity based learning contact sessions have facilitated the student teachers to improve their higher order cognitive skills in a positive manner. More than twenty percentage of the teachers expressed that they have achieved higher order cognitive skills such as critical thinking, evaluation skills and analytical skills to a great

extent through the activity based learning contact sessions. They also agreed activity based learning contact sessions have improved their self-learning, presentation skills, leadership skills and team spirit to a great extent. It clearly shows that activity based learning sessions have helped them to develop not only the basic skills but also the higher level cognitive skills among the student teachers.

Problems and Issues Faced by the Student Teachers

Open ended questions in the questionnaire allowed the student teachers to mention the problems faced by them due to their involvement in the activity based contact sessions effectively. The following constrains were indicated by some of the student teachers: Among the respondents 36% of the student teachers expressed that they were unable to involve effectively due to lack of pre preparation and 56% indicated that time allocation for the activities was not enough. At the same time, 42% of them pointed out that the classroom facilities to formulate the groups and carry out the activities were not enough whereas 37% said large numbers in the groups was a problem for them. 24% of the student teachers reported that they did not receive support from all the group members. Majority of the student teachers stated that the time allocated for instructors feedback was not enough (68%) and 49% of them indicated that the questions raised by the peers after the presentation were not enough. The results revealed there are problems exist in the planning and implementation of activity based learning contact sessions and the Faculty of Education need to give more attention to address the above problems.

CONCLUSIONS AND RECOMMENDATIONS

The study revealed that the activity based learning contact sessions have motivated the student teachers to attend the sessions and helped them to increase their involvement in self learning and peer learning practices. Activity based learning contact sessions have made all the student teachers active learners and at the same time it has been very helpful to improve peer learning environment and team spirit among the student teachers. Effectiveness of the contact sessions has increased and it has helped them to develop basic and higher order cognitive skills such as critical thinking, evaluation skills and analytical skills. Lack of time allocation for instructors' feedback, insufficient time allocation for the activities, lack of classroom facilities to formulate the groups and to carry out the group activities were the main constrains faced by the student teachers during the activity based contact sessions. Overall, the analysis appears to suggest that in order to increase the active participation of the student teachers in the PGDE programme, Faculty of Education of the OUSL and other relevant teacher education institutions should adopt activity based learning strategies. This activity based learning strategies help to increase the self-learning practices and develop Meta cognitive skills among the student teachers. Further, faculty should give more attention to allocate classrooms with adequate facilities, and to allocate enough time for the activities.

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ANALYSIS OF CLINICAL FEATURES WITH MICROSCOPY OF CUTANEOUS LEISHMANIASIS SUSPECTED PATIENTS ATTENDING THE DERMATOLOGY CLINIC AT GENERAL HOSPITAL HAMBANTHOTA.

L. D. G. De Silva^{1*}, V. Somaratne², S. Senaratne¹, M. Vipuladasa², S. N. Kahatapitiya¹,
D. D. S. De Silva¹, I. D. J. C. Dissanayake¹, S. Ranasinghe¹, R. Wickremasinghe¹

¹Department of Parasitology, University of Sri Jayewardenepura.

²General Hospital, Hambanthota.

INTRODUCTION

Leishmaniasis is a vector borne parasitic disease which affects 12 million people globally and estimated two million new cases occurring every year (WHO 2009). Rather than a single disease entity leishmaniasis has a wide spectrum of disease manifestations resulting mainly in 3 clinical forms. Visceral leishmaniasis (VL), Mucocutaneous leishmaniasis (MCL) and Cutaneous leishmaniasis (CL). Among all three forms, CL is most frequent in Sri Lanka.

Leishmaniasis was declared as notifiable tropical disease in Sri Lanka in year 2008. Up to date there were more than 2000 CL cases reported and it is now an established disease (Siriwardena *et al* 2003, Nawarathne *et al.*2007) affecting almost all the provinces in this country. Even though not potentially fatal or debilitating as VL or MCL forms, CL can be personally and socially disruptive (Herwaldt 1999) due to different types of clinical presentations which results disfiguring scars.

Vectors of leishmaniasis are sandflies belonging to a subspecies of the genus phlebotomous. *Leishmania donovani* the causative organism of CL is transmitted between sandfly vector and the human host, the main host for this species. However, recently it was found that domestic dogs had shown the presence of *Leishmania* parasites, providing primary evidence of an animal reservoir in Sri Lanka (Rosypal *et al* 2010).

On taking blood meal from host, infected female sandfly regurgitate the flagellar *leishmania* promastigotes into the skin, which invade or are phagocytosed by host cells primarily macrophages causing the typical cutaneous lesion. The disease starts with a macule then a papule, which enlarges and then becomes an ulcer, with a rare possibility of the lesions remaining non-ulcerative and diffused. They often end up as skin lesions with a raised edge and a central crater (Fact sheet Epidemiology unit 2012). The clinical presentation of CL in Sri Lanka, are non tender non itchy papules, scaling nodules or ulcers affecting mainly exposed areas in the body specially limbs and face. (Siriwardena *et al* 2003, Nawarathne *et al* 2007) Lesions may heal spontaneously within weeks to months, or last for a year or more. Although there were several clinical manifestations, the morphologic appearance of lesions is known to vary depending on the species or strain of the causative organism (Dedet *et al* 1989) and the immune status of the patient (Guessous-Idrissi *et al* 1997).

Diagnosis of cutaneous leishmaniasis is based on clinical symptoms, microscopic observation of parasites in stained tissue smears, culture of promastigotes or by molecular detection methods such as PCR. Microscopic identification of amastigotes in stained preparations varies depending on the number of parasites present and /or the experience of the person examining the slide (Magil *et al* 2005).

As there were no studies described to evaluate parasite loads using the slit skin smear in different clinical presentations this study aimed to describe the correlation of *L.donovani* amastigote parasite load in Giemsa stained smears with CL clinical presentation patterns in Sri Lanka.

* Corresponding author: Email - gayanigds@gmail.com

METHODOLOGY

Sampling

Skin samples were taken from suspected CL lesions of 87 patients referred to the Dermatology clinic, General Hospital, Hambanthota. Clinical presentations of the lesions were examined and photographs were obtained with the consent of the patient. Lesions and the adjacent normal looking skin around them were cleaned and sterilized with soap, normal saline, and 70% ethanol consequently. For making stained smears tissue was taken using a disposable scalpel blade. Skin tissue was smeared on a clean glass microscopic slide, fixed with 100% methanol for one minute, and stained with 10% Giemsa. The stained tissue smears were examined for the presence of characteristic amastigotes by light microscopy using Olympus microscope at 100x oil immersion magnification. The number of amastigotes was counted by two individuals as double blind study using WHO described method.

Parasite load calculation

The amastigote numbers of skin smears were graded according to WHO recommended grading (WHO 2010) as follows;

- 6+: > 100 parasites per field
- 5+: 10–100 parasites per field
- 4+: 1–10 parasites per field
- 3+: 1–10 parasites per 10 fields
- 2+: 1–10 parasites per 100 fields
- 1+: 1–10 parasites per 1000 fields
- 0: 0 parasites per 1000 fields

Clinical feature assessment

Clinical categorization as papule, nodule, nodulo-ulcerative, ulcer (dry/wet) and plaque was made by the consultant dermatologist according to previously described method (Ranawake *et al* 2012, Bari *et al* 2006).

Ethics Statement

The study was approved by and carried out under the guidelines of the Ethical Review Committee of the Faculty of Medical Sciences, University of Sri Jayewardenepura. All patients provided written informed consent for the collection of samples and subsequent analysis.

RESULTS AND DISCUSSION

Different types of clinical presentations were observed and characterized (Figure1). Out of the specimens from 87 suspected CL patients 30 Dry ulcers, 8 nodular ulcerative lesions, 28 nodules, 4 papules 8 plaques, 2 satellite lesions and 7 wet ulcers were noted. 49/87 lesions were positive for SSS. Most frequent clinical presentations were nodules and dry ulcers (66%) (Table1). The duration of lesions varied from 1- 36 months. Majority of the lesions were within 1-6 months (83.9%).The sites of the lesions varied from most commonly in the arm , leg, forearm, face, ear ,neck, abdomen, and chest.

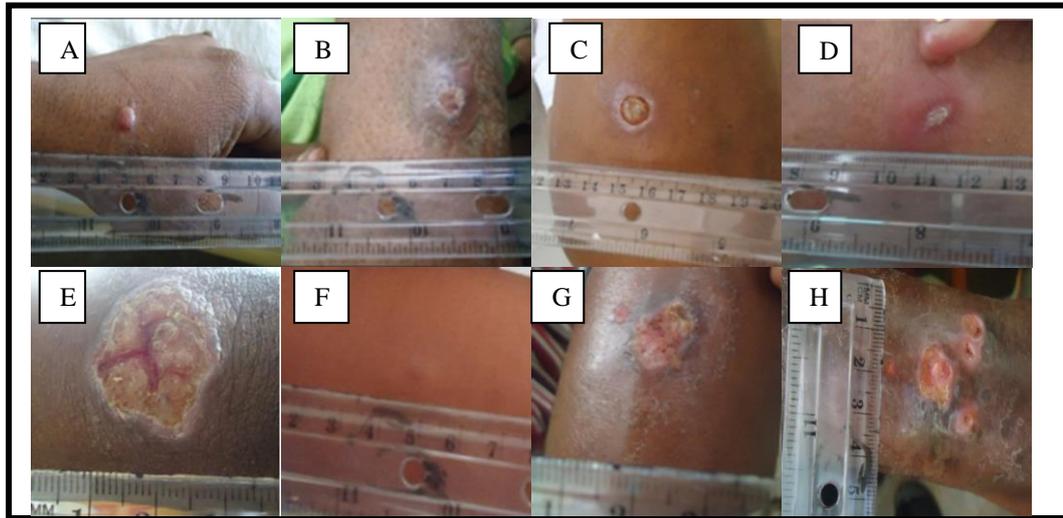


Figure 1. Spectrum of clinical presentations

A. Nodule B. Ulcerative nodule C. Dry Ulcer D. Plaque E. Wet ulcer F. Papule G, H. Satellite lesions

The parasite counts seen in the SSS of the patients in relation to the clinical presentations of the lesion are given below (Table 1).

Table 1. Parasite counts in SSS in relation to clinical presentation (n=49)

Parasite count	Dry ulcer (N=22)	Ulcerative nodule(N=5)	Nodule N=(15)	Papule N=(2)	Plaque N=(3)	Satellite lesion N=(1)	Wet ulcer N=(1)
1+	4	3	2	-	-	-	1
2+	10	1	5	2	1	-	-
3+	5	1	4	-	1	1	-
4+	1	-	1	-	1	-	-
5+	2	-	2	-	-	-	-
6+	-	-	1	-	-	-	-

Out of the 49 SSS positive lesions, 84% showed relatively low parasite counts ranging from (1+) to (3+). The (3+) gradings mainly included dry ulcers (n=5/22) and nodules (n=4/15).

A wide range of parasite burden was observed in dermal tissues of CL patients with nodules and dry ulcers showed more parasite loads in comparison with other type of lesions. It has been reported in previous studies, that *Leishmania* parasites are scanty and difficult to demonstrate in skin lesions with papular presentation (Salotra *et al* 2003). Our study confirmed these observations. However, only small number of papular lesions was found in our study. This may be due to ignorance of patients to present to treatment, as papules are the

earliest clinical manifestation of CL and due to the fact that they are single, non-tender, non-itching and usually dry (Ranawake *et al* 2012). Individuals seek treatment when, the lesion which had started as a papule and then gradually enlarged and ulcerated, with changes in the surrounding skin. The clinical presentation results having nodules and ulcers as the highest form of presentation supports this theory. Parasite numbers may increase when the papules enlarge to form nodules and ulcers when they remain untreated. Our results showing 3+ parasite counts with nodules and ulcers may be due to this reason.

Direct microscopy with slit smears of CL lesions is reported to have low sensitivity (13–60%) (Zijlstra *et al* 2000). Similar observations were made in slit smears of CL patients with 30% positivity in patients with nodular lesions, 44% positivity with dry ulcers, and 4% positivity with papules. The duration of the lesions of most nodules and Dry ulcers were between 1- 12 months. In a study by Siriwardana *et al* 2008 showed that nodules with 5-9 months duration had the highest parasite positivity.

CONCLUSIONS/RECOMMENDATIONS

In this study parasitic load was overall low in all lesions. This may be due to the fact that *L.donovani* Mon -37 strain in Sri Lanka is naturally attenuated (Mccall *et al* 2013). Also it was shown that only 49 out of 87 CL suspected patients were parasitologically positive for Cutaneous leishmaniasis. Absence of such suspected lesions may be due to clinical manifestations of leishmaniasis which could imitate several other conditions such as insect bites, tropical ulcers, leprosy etc. Results of this study indicate that perhaps, in the absence of an animal reservoir, nodules and ulcers that are rich in LD bodies could be the main human parasite source for transmission in the community.

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EXPERIENCES OF CLOSE RELATIVES OF ADULT PATIENTS ADMITTED TO AN INTENSIVE CARE UNIT: A QUALITATIVE STUDY

H. S. L. Gamage¹ B. M. L. K. Thilakarathne¹ S. M. P. Gayani¹ H.E. Yapa^{2*} and P. W. G. D. P. Samarasekara²

¹Teaching Hospital, Peradeniya

²Department of Nursing, The Open University of Sri Lanka

INTRODUCTION

Admission to an Intensive Care Unit (ICU) is often associated with severe acute illness and is recognized as an extremely stressful event, for both the patient and his/her close relatives (McKinley *et al.*, 2002). The close relative is defined as mother, father, sister, brother, step father, step mother, son, daughter, mother in law, father in law, brother in law, sister in law and current or former spouse (US Legal definitions, 2016). During the period of ICU stay, the patient's relatives may be subjected to strong emotions due to changed roles, responsibilities and daily routines. These relatives commonly experience very sensitive inner feelings such as pain, fear, uncertainty, worry, stress, anxiety, depression, and no words to express their feelings (Wahlin, Ek and Idvall, 2009). It is due to the unfamiliar environment of ICU, special cloths worn by health care team, presence of special equipment around their patient and the effects of alarm systems (Johansson, 2006), uncertain prognosis, fear of death or permanent disability and, financial concerns (Bijtebier *et al.*, 2001). The physical setup of the ICU is a potentially hostile environment to the close relatives of critically ill patients (Wenham & Pittard, 2009). Reasons include the unfamiliar sights and sounds, medical and technological equipment, the constant monitoring of the patient and the alarming signals (Delva *et al.*, 2002). These traumatic experiences are arisen as the close relatives are not psychologically prepared for their patient's critical illness because most admissions occur as emergencies (Wolf *et al.*, 2014).

Consequently, assistance from ICU health care team is essential to alleviate anxiety and distress of patient's close relatives which may precipitate due to life threatening nature of patient and intimidating environment of the ICU. The close relatives sought to access information readily to diminish their anxiety and the ICU health care team needs to work collaboratively with them to improve their emotional state (Al-Mutair, 2014). Furthermore, close relatives may expect honest information, reassurance and support and the need to feel cared for by the ICU health care team (Williams, 2005). However, Molter (1979) indicated that the ICU health care team mostly concentrates on patient's needs leaving little time to deal with needs of close relatives.

The close relatives provide an input of positive energy and strength contributed to the patient wellbeing. In addition, they are very important in reducing patient's fear and anxiety and increasing patient's experience of safety. As such, for uplifting the patient's state, close relatives are required to relieve their anxiety and stress and need to be adapted to the ICU environment and are expected to communicate effectively with the health care team. Thus, the purpose of the current study was to explore the experiences of close relatives of adult patients admitted to the ICU. Further, the study was guided by the following specific objectives: to describe sensitive inner feelings of the close relatives; to explain the experiences related to the physical set up of the ICU and to recognize the assistance received from the ICU health care team.

*Corresponding author: Email – heyap@ou.ac.lk

METHODOLOGY

This qualitative descriptive study was conducted by using purposively selected 15 close relatives of patients admitted to the ICU at the Teaching Hospital, Peradeniya. In-depth interviews were carried out using semi-structured interviewer guide during visiting hours from January to February 2016. Ethical approval was obtained from the Ethical Review Board of the Faculty of Medicine, University of Peradeniya prior to the data collection. All 15 interviews were recorded on a digital voice recorder and were transcribed verbatim and then translated into English. Probes were used to get more information and to encourage participants (Ulin, Robinson & Tolley 2005). Close relatives below 18 years of age and close relatives of patients treated in the ICU for less than 72 hours were excluded.

The duration of the interviews varied between 45 minutes to one hour. Interviews were continued until data saturation was attained. Qualitative content analysis method as described by Graneheim and Lundman (2004) was used to analyze the transcribed text. All interviews were tape recorded and then transcribed into texts. The transcribed text from each interview was read and each sentence or group of words were broken into meaning units (Graneheim & Lundman, 2004). Identified meaning units were summarized using a few words and then the condensed meaning units were used to develop categories. The categories for all the interviews were discussed under different themes.

RESULTS AND DISCUSSION

Nine female and six male close relatives aged between 30 to 60 years were participated in this study. Four themes has been derived from close relatives experiences include unbearable painful experience, fear of their relatives' death, sense of insecurity, and feelings of satisfaction.

Unbearable painful experience

Some close relatives stated that they had experienced pain, fear and no words to express their stressful feelings. Participant 1, 3 and 8 expressed these feelings as follows;

Terrible... It is hard to express my feeling. But I'll say... what it is like. Because we see this thing like people from exterior. I think this will never come to our lives, You may know and when it is with someone from your family ... It is very painful feeling (P1).

Terrible....there is no words say ...there is no exact word to explain my pain and fear (P3).

I feel very difficult to bear this situation. Do not know what happen next. I have only painful memories so far.... (P8)

Similar experiences were expressed in the study conducted by Urizzi and Correa (2007). It is understandable that close relatives attempted to find, by gesticulation and silence, a word that would express their inner feelings, but they were unable to do so. On the other hand, non verbal expressions were stronger than verbal expressions, since words sometimes do not decode the experienced circumstances.

Fear of their relative's death

The analysis of the statements showed that the possibility of death was mentioned by many participants. They stated that they had experienced fear of their relative's death. However, the word "Death" was mentioned by only three. This is shown in the statements below.

You don't agree that my father is dying, in his mind he feel like he'll survive and go

back home again.....Do normal things...walking, talkingso that's i think. Though, we know that death very close to us (P6).

I feel really upset; our father connected to lot of tubes. He will not come to our life.... [crying] (P2).

I really fear about my brother. Patient next to my loving brother has dead. Next will be my..... [crying] (P4).

These experiences were consistent with the study conducted by Urizzi and Correa (2007). In the ICU, fear of death is mostly related to the stigma this setting implies. To close relatives, ICU means being between life and death. In addition, the ICU is a place where close relatives sense insecure as they realize the severity of their patient's clinical state.

Sense of insecurity

Some of the participants expressed that ICU is a special premises that makes anxious and insecure though it promote patients recovery. Some close relatives stated that the colorful monitors and alarm systems increased their stress. The following statements were expressed by participant 5, 13 and 15.

After he admitted here.....I felt that here is a special area with lots of alarm sounds and busy staff. I know that here is where my father recovers, but I felt scared... (P5).

It is frightening....because when she is in the ICU and colorful monitors are blinking around her. Oh.....I am scared. I am scared of my daughter (P13).

I feel more afraid, because we know that the ICU is for people who are bad....with all the instruments....But we know this is the place ideal for treatments....(P15).

Consistent experiences were identified in the study conducted by Urizzi and Correa (2007) and Fridh, Forsberg & Bergbom (2008). The inherent features of the ICU environment such as the highly stressful nature of the efforts implemented by staff, unfamiliar alarm sounds, and constant monitoring of the patients create close relatives to feel more anxious, distress and insecure.

Feelings of satisfaction

Most of the participants stated that they feel satisfy and happy about the care delivered by the ICU health care team. That can be perceived from the following statements.

We are very pleased about their work because there are many thoughtful people in ICU staff. They take care of my husband....(P14)

Some days after, schedules, staff members and alarms are familiar to us....We even feel happy of their work....(P7)

Although few staff working here, they come and explained everything to me, Hm... I think they help me to understand my father's condition. (P3)

These feelings were contrast with the study conducted by Sheaffer (2010) while consistent with the study carried out by Urizzi and Correa (2007) and Kohi, Obogo and Mselle (2016). The close relatives are eager to access information about their patient readily to diminish their stress. However, sometimes, ICU health care team may not have sufficient time to meet patient's close relatives regularly.

CONCLUSIONS/ RECOMMENDATIONS

Four themes were emerged from participant's experiences include unbearable and painful experience, fear of their relative's death, sense of insecurity and feelings of satisfaction. It was concluded that pain, fear and no words to express their feelings as sensitive inner feelings. Furthermore, few participants were experienced fear of their relative's death. Anxiety, stress and insecurity were the most common experiences felt by close relatives in relation to the physical set up of the ICU. With regard to the assistance received from the ICU health care team, most of the close relatives experienced feelings of satisfaction, happy and cared for by the ICU health care team.

The findings pointed out the experiences of close relatives of adult patients admitted to an ICU. Health care team should endeavor to consider them in the caring process. A larger qualitative study with a multiple ICU settings is recommended to explore the variations of experiences of close relatives if exists.

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ASSESSMENT OF THE PREVALENCE OF *Leishmania* AMASTIGOTES IN BUFFY COAT FILMS IN PATIENTS IN A RENAL UNIT IN A CUTANEOUS LEISHMANIASIS ENDEMIC AREA IN SRI LANKA.

W.M.C.W. Menike^{1*}, R.T. Dasanayake², R. Wickremasinghe¹, J.C. Dassanayake¹, S. Kahatapitiya¹, I. S. Wijesiriwardene⁴, I. De Alwis³, P.H.K.I.S. Ranasinghe¹

¹ Department of Parasitology, University of Sri Jayewardenepura

² Nephrology Unit, Teaching Hospital, Anuradhapura

³ Blood Bank, Provincial General Hospital, Ratnapuara

⁴ Department of Pathology, University of Sri Jayewardenepura

INTRODUCTION

Sri Lanka is one of the newly emerged leishmaniasis disease foci in the world (Karunaweera et al. 2003, Alvar et al. 2012). The disease presents in three major clinical forms; cutaneous leishmaniasis (CL) which is confined to the skin, mutilating mucocutaneous leishmaniasis (MCL)/mucosal leishmaniasis (ML) which involves the mucocutaneous junctions of the oro-nasal cavity and potentially fatal visceral leishmaniasis (VL) (WHO 2010).

Sri Lanka mainly report CL with few cases of VL & ML (Epidemiology Unit Ministry of Health Sri Lanka (EUMHS) 2012, Ranasinghe et al. 2012).

Currently more than 500 CL patients have been reported annually from Anuradhapura, Polonnaruwa, Matara, Thangalle and Hambanthota districts (EUMHS 2012).

It was revealed in a recent study that both VL and CL causing strains in Sri Lanka are similar in their iso-enzyme migration patterns and belong to the same zymodeme *L. donovani* MON-37 (Karunaweera et al. 2003, Ranasinghe et al. 2012). VL may be asymptomatic or subclinical and self-resolving, but usually runs a sub-acute or chronic course (Mpaka et al. 2009). It is well reported that visceral leishmaniasis could remain asymptomatic up to 20% of an endemic community (Franca et al. 2013). Out of those only 5% will progress to VL depending on the patient's immunity and nutrition (Franca et al. 2013). Leishmaniasis is transmitted to humans mainly by the bite of an infected sandfly. However, it has been reported to have been transmitted via blood transfusions and organ transplantations (Dettwiler et al. 2010). About 100 cases of VL after kidney transplantation in the world are reported in the literature (Bauchekoua et al. 2014). It was also well documented that reactivation of asymptomatic or cured VL could occur when a person becomes immunosuppressed (WHO 2010, Dettwiler et al. 2010).

In Sri Lanka chronic kidney disease (CKD) is on the rise due to known and unknown aetiologies. Chronic kidney disease of unknown aetiology (CKDu) is reported from some parts of the country which include the CL endemic districts. Although CKD patients require repeated blood transfusions at several stages of the course of the illness and are prone to transfusion transmission of VL, there is no screening for *Leishmania* amastigotes carried out among blood donors in Sri Lanka.

Detection of *Leishmania* amastigotes in peripheral blood buffy coat smears is an alternative and minimally invasive procedure for the parasitological diagnosis of VL. Its sensitivity ranged from 50 to 99% (Monica 1998). As a definitive diagnostic tool, buffy coat smear has the potential to be carried out for point-of-care VL case management (Salam et al. 2012).

The objective of the study was to assess the presence of *Leishmania* amastigotes in buffy coat films among CKD and renal transplant patients in a renal unit in a cutaneous leishmaniasis endemic area in Sri Lanka.

*Corresponding author: Email – cmenike@gmail.com

METHODOLOGY

Data related to clinical features and history of Leishmaniasis and blood samples from 170 individuals were collected from June to October, 2015. The population comprised individuals with CKD who had undergone repeated blood transfusions, immunosuppressive treatments and KT attending clinics or being treated at the Renal Unit (RU), Teaching Hospital, Anuradhapura (THA). Diagnosis and selection of patients meeting the inclusion criteria were done by the Consultant Nephrologist at THA according to the criteria described in Kidney Disease Improving Global Outcomes (KDIGO) 2012, the clinical practice guideline for the evaluation and management of CKD.

Taking of the routine history and examination of patients were carried out by a medical officer in the RU, THA. Questionnaires were administered to collect additional information, such as socio economic factors that are related to acquiring leishmaniasis. Routine investigation reports and diagnostic cards of patients that are recorded in the RU were also used to collect information relevant to this study.

Venipuncture was done under sterile condition by a trained nursing officer. Two milliliters of venous blood was collected from each patient to an EDTA bottle. Collected blood was centrifuged in low speed (2000rpm/ for 10 mins with two- three break offs in four to five minutes intervals. (HIP. 2015) to separate buffy coat and thin layer (film) was drawn on a microscope slide with 10 µl of buffy coat.

The smears were fixed with absolute methanol and stained with Giemsa stain and examined under the microscope under oil emersion (100X) for the presence of *Leishmania* amastigotes.

RESULTS AND DISCUSSION

Results

Table 1. Categorization of patients and buffy coat examination.

Criteria	Male	Female	Amastigotes
1. BT only	98 (58%)	15 (9 %)	Not present
2. IM only	05 (03%)	05 (03%)	Not present
3. KT only			
4. BT & IM	00 (00%)	00 (00%)	Not present
5. BT & KT	00 (00%)	03 (02%)	Not present
6. IM & KT			
7. BT, IM & KT	00 (00%)	00 (00%)	Not present
	26 (15%)	03 (02%)	Not present
	14 (08%)	01 (0.6%)	Not present
Clinical Features			
1. Yes	42 (25%)	07 (04%)	Not present
2. No	101 (59%)	20 (12%)	Not present
Skin Lesions			
1. Yes	01 (0.6%)	00 (00%)	Not present
2. No	00 (00%)	00 (00%)	Not present

BT: Blood transfusions; IM: Immunosuppressive Treatments; KT: Kidney transplant

131 (77%) patients had a history of blood transfusions and 44 (26%) had undergone kidney transplant within the last two years. 57 (34%) patients were on immunosuppressive treatments within last two months and continues to be on treatment.

Out of 170 patients studied, none of the patient had clinical features suggestive of VL

(Fever, anaemia, lymphadenopathy, hepatosplenomegaly etc...) However, there were 04% with fever, 03 % with lymphadenopathy and about 03% of hepatosplenomegaly. Those clinical features could be due to chronic infections that are usually found in that group of patients. There were 18% of patients present with pallor, but it could not be regarded as clinical feature that is directly related to leishmaniasis. Only one patient (0.6%) had a lesion that could be suspected as Leishmaniasis, but diagnosed as negative by Slit Skin Smear and biopsy examination.

From the 170 individuals tested, all patients were negative for *Leishmania* amastigotes in buffy coat films.

DISCUSSION

In the last 20 years, the increasing frequency of organ transplantations and the improvement of associated immunosuppressive treatments have led to the recognition of several cases of VL complicating organ transplantation (Bauchekoua et al. 2014).

Since the advent of HIV infection and increased use of immunosuppression for transplantation and chemotherapy, populations that suffer from the disease have increased (WHO 2010).

There was a demonstration of a reactivity of 37% to VL in haemodialysed polytransfused patients from Brazil during the burden of VL (Luz et al. 1997). The presence of antibodies against *Leishmania* and its DNA in blood donors has been found (Luz et al. 1997). This indicates that there are asymptomatic reservoirs. Thus, blood transfusion might be a risk factor for VL.

As all the patients in this study were negative for *Leishmania* amastigotes there was no association to be shown between CKD/KT and VL according this study.

This study reveals that VL may not still be an acute problem among CKD/KT patients community in a Cutaneous Leishmaniasis (CL) endemic areas in Sri Lanka, none of the patients had past history of VL and none of the patients had proven past history of CL.

Although demonstration of even a single amastigote upon microscopic examination of tissue smears or multiple promastigotes in cultures is considered sufficient for positive diagnosis of the disease, the sensitivity of the tissue examination, except in the case of splenic aspirate, is low (Sundar & Rai 2002).

Therefore, antibody detection should be performed in this group of patients to see whether asymptomatic VL exists among could be an aetiological factor for CKD in a CL endemic area in Sri Lanka.

CONCLUSIONS/RECOMMENDATIONS

Visceral Leishmaniasis may not still be an acute problem among CKD/KT patients in a Cutaneous Leishmaniasis (CL) endemic area in Sri Lanka. However, serological tests are recommended to arrive at further conclusions regarding correlation between CKD/KT patient's population and VL in a cutaneous leishmaniasis endemic area in Sri Lanka.

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REASONS FOR PRIMARY SUB-FERTILITY AMONG COUPLES ATTENDING SUB-FERTILITY CLINICS AT TWO GOVERNMENT HOSPITALS

P. N. Hewabitage^{1}, L. K. M. P. Gunawardhana², M. K. N. S. Gunarathna³,
E. M. S. Bandara⁴ and B. S. S. De Silva⁵*

^{1,2}National Hospital of Sri Lanka, Colombo. ³Base Hospital, Balangoda.

⁴Department of Medical Laboratory Sciences, the Open University of Sri Lanka

⁵ Department of Nursing, the Open University of Sri Lanka

INTRODUCTION

Sub-fertility is defined as a failure to conceive after one year of unprotected regular sexual intercourse (Taylor, 2003). It can be classified as primary and secondary sub-fertility (Greenhall & Vessey, 2009). Primary sub-fertility occurs when a couple has never been conceived (World Health Organization [WHO], 2013). Challenges to having a child are found to arise from one or more reasons in either or both partners. Worldwide; ovarian, tubal, uterine, hormone related causes and poor fertility awareness are found to be the reasons for female sub-fertility (Mital et al., 2012; Hamton, Mazza, & Newton, 2012). Male related reasons are mainly problems with sperm production, transport or sexual dysfunction (Karavolos et al., 2013). There are reasons common to both genders such as age, obesity, diet, and exercise (Hassan & Killick, 2003). Primary sub-fertility is a prevalent problem and has significant consequences for both individuals and the wider community such as social, financial, psychological and family problems (Jajoo & Chandak, 2013). Fortunately, many couples have a chance of conception by modifying lifestyle factors (Anderson et al., 2010). However, reasons related to sub-fertility are not clearly identified in Sri Lanka (Ministry of Health, 2014). The findings of this study will provide baseline data regarding the reasons for primary sub-fertility in a Sri Lankan context. Therefore, the purpose of the study was to describe reasons for primary sub-fertility. The specific objectives were to determine the reasons for primary sub-fertility among males, females and both.

METHODOLOGY

A quantitative approach with a descriptive design was employed in this study. A purposive sample of 150 couples within the age 20 – 45 years with primary sub-fertility was recruited for this study. Data were collected using a structured questionnaire which consisted of self administered questions related to social, demographic, occupational, food, exercise, and sexual history of the couple and menstrual history of female. Secondary data and physiologic measurements were collected separately by the investigators. Prior research findings and opinions of experts were sought to achieve content validity of the questionnaire. It was pre-tested with randomly selected 25 couples to test the readability and understandability. Data were analyzed by descriptive statistics using Statistical Package for the Social Sciences (SPSS) 20. Study was conducted at the sub-fertility clinics of two government hospitals; the De Soysa Hospital for Woman (DSHW) and Castle Street Hospital for Woman (CSHW). Ethical approval was obtained from the Ethics Review Committee of National Hospital of Sri Lanka and permissions to conduct the study were obtained from the directors of above hospitals. Voluntary participation was encouraged and written informed consent was taken prior to data collection.

RESULTS AND DISCUSSION

The response rate of the study was 80.6%. Among the participants, 48% of men and 59.5% of women were more than 30 years of age. When considering the distribution of primary sub-

* Corresponding author: Email - pavithra.nadeeshani@yahoo.com

fertility among men and women, 26.4% corresponded to male related reasons while 22.3% cases were due to female related reasons. A combination of both male and female related reasons was found in 28.9% of couples. The rate of unexplained sub-fertility among them was 22.3%.

Sperm count and quality problems which were identified through semen analysis were the most commonly depicted reason among male sub-fertility causes (33%). Post testicular causes such as sexual dysfunction (23.1%), testicular causes like varicocele (18.2%), and pre testicular causes like hormonal (8.3%) were the other commonly identified reasons. Karavolos et al., (2013) also discovered similar findings. In the current study, progressive motility and sperm concentration of male were relatively less than other sperm parameters such as volume and motility. Further, in 17.3% of male, reason for primary sub-fertility was unknown.

When considering female related reasons, ovarian causes (21.5%) was the commonest reason observed which was compatible with the findings of Jajoo and Chandak (2013) in Sri Lanka. Premature ovarian failure, fallopian tube problems, endometriosis, and Poly Cystic Ovarian Syndrome (PCOS) were next mostly common reasons in present study (Table 1). This is consistent with the findings of Mital et al., (2012). However, some women were reported to have more than one reason for sub-fertility. Only 16.6% could accurately identify the fertile window of the menstrual cycle in their attempts at conception although 53.7% of women believed they had timed intercourse mainly within this window. Thus, a prominent reason among females of this study was the poor fertility awareness. A survey of Hamton, Mazza, and Newton (2012) in Australia also confirmed similar findings that, most women seeking fertility assistance cannot accurately identify the fertile window.

Table 1. Reasons for primary sub-fertility among female

Reason	Percentage
Unknown	26.4
Ovulation disorders	21.5
Premature ovarian failure	13.2
Fallopian tube problems	9.1
Endometriosis	7.4
PCOS	5.8
Ability to identify fertile window	16.6

Table 2. Reasons for primary sub-fertility among both male and female

Reason	Male %	Female %
Overall obesity	66.9	33.1
Central obesity	53.7	37.2
No regular exercise	47.9	86.8
Smoking > 9 times/week	16.4	Nil
Alcohol > 7 drinks/week	29.4	Nil
Caffeine > 500mg/week	0.8	Nil
Daily fruit consumption	10.7	13.2
Daily leave consumption	11.6	20.7
Folic acid supplements	8.3	73.6
Duration of sub-fertility > 3years	38	38

There were reasons common to both men and women for primary sub-fertility. Wise et al., (2013) highlighted that, there is a strong association between sub-fertility and high Body Mass Index (BMI). Apart from that, fertility treatment is also found to be less successful in overweight men and women in some other studies (Pasquali et al., 2003; Wise et al., 2013). As expected, one third of women (33.1%) and two third of men (66.9%) were either overweight or obese in this study. Exercise has been shown to increase fertility (Rich-Edwards et al., 2002). However, 86.8% of women and 47.9% men did not engage in a sport activity or exercise regularly (Table 2).

Baird et al., (2005) pointed out that, ageing leads to a decline in reproductive functions in both partners after 30 years of age. Majority of both the males and females were more than 30 years of age at the time of present study also. According to (Taylor, 2003), if the duration of sub-fertility is more than three years, the couples' chance of spontaneous conception remarkably reduces. Among the participated couples, 38% of couples had sub-fertility for more than three years. This may either be due to the late presentation to fertility assistance or not getting appropriate treatments for sub-fertility.

In United Kingdom, Hassan and Killick (2004) discovered that harmful substances such as alcohol, smoking, and caffeine consumption increases sub-fertility. Conversely, harmful substance consumption was within safe limits among subjects in this study. This contrast may be due to the cultural differences between countries.

When dietary habits are concerned, around one third of both men (28.1%) and women (29.8%) were vegetarians in the current study. Although, vitamin intake either from food or supplements was low in the couple in current study, these micronutrients are found to be of paramount importance in oocyte and sperm production (Ebisch, 2007)

CONCLUSIONS AND RECOMMENDATIONS

According to the results, commonest identified reasons of primary sub-fertility among men in this study were sperm quality problems, post testicular causes such as sexual dysfunction, and testicular causes such as varicocele. When considering females, ovulatory problems, premature ovarian failure, fallopian tube problems, endometriosis, PCOS and poor fertility awareness were the commonly identified reasons. In general, negative life style such as obesity, lack of exercise, and unexplained sub-fertility were the reasons common in both male and female.

Many females were unable to identify the fertile window. However, a prolonged duration of sub-fertility without properly addressing relevant problem may put couples at more risk of childlessness. Therefore, greater emphasis should be placed on educating couples when they first report trouble conceiving. At the community level, this may be a potential role for nurses to embrace in primary health care services.

Overall, to protect future fertility in young males and females is a public health issue. The problem of primary sub-fertility may be reduced to some extent by getting appropriate fertility assistance, to have a baby at right time, to maintain healthy life, and to have good and healthy food. It may be facilitated by aiming to have a BMI between 20 and 25 kg/m², consuming a balanced diet, focusing on regularly engaging in exercises, and by fertility awareness programs for sub-fertile couples. Therefore, it is recommended that measures should be taken at the community level and national level to promote behaviors that maintain fertility, remove risk conditions, and to identify primary sub-fertility as early as possible

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EVALUATION OF THE EFFECTS OF COMPOST AS A SUBSTITUTION FOR INORGANIC FERTILIZERS ON YIELD OF RICE (BG 94 - I) IN AMPARA DISTRICT

M. A. W. Mohamed Anas¹, Y. B. Iqbal¹ and C. S. De Silva^{2}*

¹*Rice Research Station, Sammanthurai*

²*Department of Agricultural and Plantation Engineering, Faculty of Engineering Technology, The Open University of Sri Lanka.*

INTRODUCTION

The integrated nutrient management system is an alternative and is characterized by reduced input of inorganic fertilizers and combined use of chemical fertilizers with organic materials such as animal manures, crop residues, green manure and composts. Several researchers have demonstrated the beneficial effect of combined use of inorganic and organic fertilizers to mitigate the deficiency of many secondary and micronutrients in fields that continuously received only N, P and K fertilizers for a few years, without any micronutrient or organic fertilizer. The effects of organic fertilization and combined use of inorganic and organic fertilizer on crop growth and soil fertility depends on the application rates and the nature of fertilizers used.

In general, the application rates of organic fertilizer are mostly based on crop N need and estimated rates of N supplied via organic fertilizer, but do not consider the amount of P and K provided with organic fertilizer. However, the N/P ratio of organic fertilizer is usually significantly lower than the N/P uptake ratio of the crop nutrients, salt or heavy metal accumulation has also been reported in many papers, especially for the long-term or heavy use of organic fertilizers with higher contents of P, K, salt, or heavy metals. Objectives of this experiment are to determine the effects on growth and yield parameters of rice grown in the Ampara District by using integrated fertilizer application

MATERIALS AND METHODOLOGY

A field experiment was planned at Rice Research Station, Department. of Agriculture, Sammanthurai, in sandy loam soil of the costal area of the Ampara District. The experiment was arranged in a randomized complete block design (RCBD) with 3 replicates during 2015/2016 *Maha* season. Bg 94 – 1 rice variety was used for this experiment. The individual plot size of the experiment was 15 m² (5mx3m). Plant in the plot spacing was 30 cm x 15 cm. Land preparation was done by ploughing the field once by a tractor and preparing the bunds and beds were done manually. Beds were cleaned and maintained weeds free. The seeds were soaked in clean water for about 24 hours. Then the seeds were taken out from water and washed and placed in a wet gunny bag. The next day the germinated seeds were established in the 5m x 3m size beds by using the random seed sowing method after reducing the water level of the field.

Treatments of the Experiment

The experiment has five treatments as follows:

- T₁.** Compost at the rate of 1000 kg acre⁻¹
- T₂.** NPK at the rate of 90 – 22 – 24 kg N, P₂O₅ and K₂O acre⁻¹
- T₃.** 50% of Compost at the rate of 500 kg acre⁻¹ and 50% of NPK at the rate of 45 – 11 – 12 kg N, P₂O₅ and K₂O acre⁻¹

*Corresponding author: Email - csdes@ou.ac.lk

T₄ 25% of Compost at the rate of 250 kg acre⁻¹ and 75% of NPK at the rate of 67.5 – 16.5 – 18 kg N, P₂O₅ and K₂O acre⁻¹

T₅ Control (no inorganic fertilizer and organic manures)

Compost was prepared by incorporating water grass, cow dung, Gliricidia leaves, charcoal and other green manure and animal wastages over a period of 6 months. Compost (1000 kg acre⁻¹) was added three days before sowing to the plots which received integrated compost treatment. Compost used for this research had 6.8 pH, 32% OM and 720 ms cm⁻¹ electrical conductivity. Compost was applied to certain plots.

Triple Super Phosphate (T.S.P.) –was applied as a basal fertilizer (22 kg acre⁻¹) of certain plots on the same day of sowing. First top dressing was done after 21 days of sowing. Urea (20 kg acre⁻¹) was applied to certain plots. Second top dressing (Urea – 35 kg acre⁻¹ and MOP – 20 kg acre⁻¹) was applied after 42 days of sowing (DOA, 2010).

Measurements taken during the experiment

The following data were collected at 14th week and the 19th week after sowing.

Plant height (cm):- 09 plants were randomly selected from each treatment. The heights of the selected plants were measured manually by using the measuring scale. The height was measured from the base of the main stem to the top of the canopy.

Panicle length (cm): 09 panicles were randomly selected from each treatment. The panicle lengths of the selected plants were measured manually by using the measuring scale. The panicle length was measured from the bottom of the panicle to the top of the panicle.

Number of filled grain per panicle: - 09 panicles were randomly selected from each treatment. The number of filled grain was counted and recorded.

Number of unfilled grain per panicle: - 09 panicles were randomly selected from each treatment. The number of unfilled grain was counted and recorded.

1000 grain weight (g): - The weight of thousand seeds from the selected plants was measured by an electronic balance.

Seed Yield (g):- Collected seeds after the harvesting left for drying under sunlight. Weight of the seeds was measured.

All the data were collected for the experimental purpose were analyzed statistically using ANOVA with SAS package.

RESULTS AND DISCUSSION

Growth Parameters

Canopy height at 100% flowering

Use of compost with chemical fertilizer was found beneficial for canopy height of paddy (Table 1). The highest canopy height at 100% flowering was recorded in the treatment of half dose of compost applied along with half dose of chemical fertilizer (85.92) followed by full dose of chemical fertilizers (85.80), and control plots (82.70). Differences among these treatments were found to be non significant statistically. However these results agree with Masarirambi *et al.* (2012) as they also found that the half a dose of chemical and organic fertilizers gave significant canopy height. This study showed that there was no relationship between canopy height and the application of different type and combination of fertilizer.

Yield Parameters

1000 – grain weight

Maximum number of 1000 grain weight of 28.88g was recorded in the T₃ treatment. i.e., half dose of compost + half dose of chemical fertilizer followed by full dose of chemical fertilizer (26.34g) and ¼ dose of compost + ¾ dose of chemical fertilizer (26.12g). There was no significant difference between treatments T₂ and T₄. Treatments T₁, T₃, T₅ were significantly different. But the minimum 1000 grain weight (23.08g) was counted in control plots. The results were in line with the findings of Parmer and Sharma (2002), Kuepper (2003) and Sarwar *et al.* (2007, 2008) as their findings too showed that the organic fertilizer improved the 1000-grain weight. There was positive relationship between 1000 – grain weight and application of substitution of inorganic fertilizers with organic manures.

Table 1. Growth and Yield Parameters

Treat ment	Canopy height (cm)	Panicle length (cm)	No. of filled grains per panicle	No. of unfilled grains per panicle	1000 grain weight (g)	Yield (kg/ha)
T ₁	80.15 a	20.40 a	33.00 c	21.00 a	24.17 c	3.60 cd
T ₂	85.80 a	21.90 a	37.00 c	20.00 a	26.34 b	4.75 ab
T ₃	85.92 a	25.03 a	72.00 a	11.00 a	28.88 a	5.47 a
T ₄	80.63 a	22.20 a	49.33 b	27.66 b	26.12 b	4.31 bc
T ₅	82.70 a	19.98 a	23.00 d	28.00 b	21.91 d	3.08 d

Seed yield

Seed yield increased significantly ($P \leq 0.05$) in combination of half dose of compost with half dose of chemical fertilizer (T₃) compared to the compost alone (T₁), and chemical fertilizer alone were applied (T₂) as well as (table 1). The application of half dose of compost along with half dose of chemical fertilizer yielded maximum (5.47 kg ha^{-1}) followed by full dose of chemical fertilizer (4.75 kg ha^{-1}) and ¼ dose of compost along with ¾ dose of chemical fertilizer (4.31 kg ha^{-1}) and the differences among these treatments were found to be statistically significant. The minimum yield (3.08 kg ha^{-1}) was measured in control plots. When compost was applied even alone, it shows increasing trend in paddy yield in this study. (Jagadeeswari and Kumaraswami, 2000; Rekhi *et al.*, 2000; Dixit and Gupta (2000), Ahamed *et al.*, (2002), Sarwar *et al.* (2008) and Ali *et al.* (2012), have also observed increased yields of rice with the use of organic manures in combination with chemical fertilizer.

CONCLUSIONS

There was no effect on canopy height and panicle length due to the application of substitution of inorganic fertilizers with organic manures. There was a positive relationship on numbers of filled grain per panicle, numbers of unfilled grain per panicle, 1000 – grains weight and seed yield due to the application of substitution of inorganic fertilizers with organic manures. Overall results indicate that the combination of half dose of compost along with half dose of inorganic fertilizer is the best integrated fertilizer application for the sandy loam soil of the costal area of the Ampara District even though it is not significantly different from the inorganic fertilizer only treatment. However when consider the cost of inorganic fertilizer and the subsequent soil and groundwater, this study proves that the half dose of inorganic with half dose of organic will be a better option in the view of health hazards due to water pollution. The compost could be produced at a very low cost compared to the inorganic fertilizers and such prepared compost would not only be a supplement to chemical fertilizers

but also reduce the environmental pollution. Hence, the cost of production will be analyzed for the integrated use of compost and chemical fertilizer alone and it can be predicted that the yield would increase and the low cost for organic fertilizer may improve the income of farm families on sustainable basis.

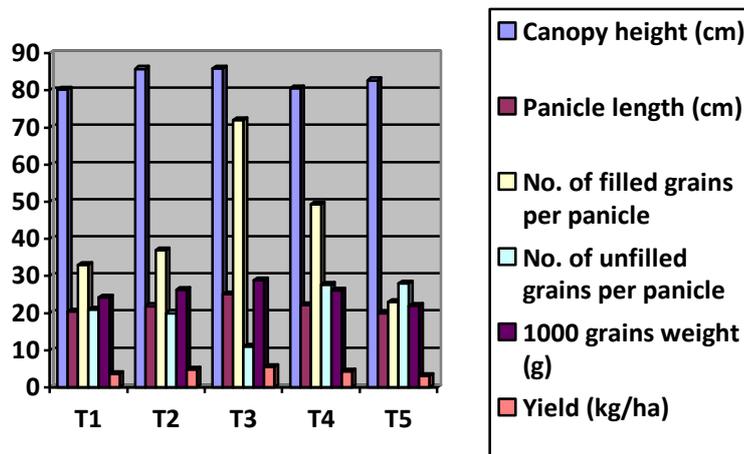


Figure 1. Overall results of the parameters

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CONSTRAINTS ON WATER AVAILABILITY FOR AGRICULTURAL PRODUCTION IN THE DRY ZONE OF SRI LANKA AND THE POSSIBLE ADAPTATION MEASURES- A CASE STUDY IN RAJAGANA-ANURADHAPURA DISTRICT

P. T. N. Dishani¹ and C. S. De Silva^{2}*

^{1,2}Department of Agricultural and Plantation Engineering, Faculty of Engineering Technology, The Open University of Sri Lanka.

INTRODUCTION

Groundwater is the main source of rural water supplies in many developing countries and good quality ground water is a prime factor for sustenance of rural life. However, it has become a major problem today as this water is used for drinking and agriculture by more than half of the nation's population. The groundwater is the main water source for agriculture and domestic purposes in the dry zone of Sri Lanka. It is a well-established fact since thousands of years that the Dry and the Intermediate Zones of Sri Lanka is characterized by moisture stress when practicing agriculture. The large scale Mahaweli Diversion Irrigation Project could help this situation only partially. Though there were around 20,000 minor village tanks in these regions, only about 50% are in good operational conditions experiencing a gradual decrease of the capacity further (Udawattage, 1985, Kendaragama, 2000). There are also constraints such as decline of catchment forests, ineffective use of rainfall, improper water management, intensive cropping, increase of rural population, high tank evaporation losses etc. in using minor village tanks demanding supplementary water sources for comfortable existence. According to De Silva (2002), the major irrigation schemes could only supply water for about half of the crop lands. The water shortages are specifically experienced during *Yala* season as well as during some periods of *Maha* season where life-saving irrigation is required without which the smooth and uninterrupted cropping be hampered. It is therefore thought that extraction of shallow groundwater by means of constructing large diameter Agro-wells would be able to supplement water irrespective of naturally occurring moisture depletions within a range of a low maintenance cost even though the initial capital investment would be comparatively high for an average farmer. Thus, this paper aims to analyses the view of farmers on the constraints on water availability for agricultural activities and to recommend possible adaptation measures.

METHODOLOGY

This study was based on a primary questionnaire survey conducted in Rajangana area of the Anuradhapura district with a total sample size of 30 farmers. The area which comes under tail end of the Mahaweli scheme was only considered for this study where on 300 farm families were involved in agricultural activities. The main variables measured included demographic variables of the respondents such as age, education, and income, and the information related to climate change, knowledge on climate change adaptation, the effects on cultivation, and the observation on the field about the agro wells, irrigation system, types of crops grown, water source and water lifting techniques. Primary data were collected through interview schedules by conducting a social survey.

RESULTS AND DISCUSSION

Demographic Characteristics of the Respondents

All the respondents were involved with vegetable cultivation, 83.3% of them were heads of the households and 16.6% were spouses of the household head. There were 40% household heads involved in fulltime paddy cultivation. The mean age of the respondents was 41 years.

*Corresponding author: Email - csdes@ou.ac.lk

There were 80% respondents aged 31-50 year range. Majority of the population involved in agricultural activities are middle age group who could easily adapt the new technologies and ideas. Their main livelihood is agriculture and they like to improve their agricultural production by using new methods.

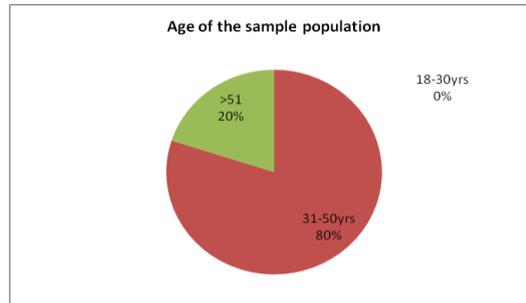


Figure 1. Age group of the sample population in Anuradhapura

Agricultural activities

An examination of the perception of the farmers and adjustment of their farm management practices, in the dry zone of Sri Lanka has revealed that during the last few decades, the pattern of rainfall has significantly changed and the farmers have observed the changes in the climate affecting their livelihood. The increase in average temperature combined with decreased rainfall has forced them to change their traditional paddy cultivation to shifting vegetable cultivation. Most of the farmers are involved in agricultural crop production. Farmers cultivate Banana, Brinjal, Bandakka, onion, capsicum, cowpea and several other vegetables fruit and cash crops. Since Rajangana comes under Mahaweli scheme, they cultivate paddy when they receive irrigation water and other field crops using the other sources such as agro well and village tanks.

Availability of water sources

Water storage is major problem for agricultural activity in the dry zones of Sri Lanka. But in selected areas farmers have about 80% of the agro well, 3% domestic wells and 17% irrigation water, which receives from the Mahaweli scheme. Agro wells are being introduced supplementary irrigation. Present agro well system is used without proper guidance on hydrological properties of the aquifer. Those farmers pump water in to their farming lands from the agro wells. Most of them pump water 3 or 4 hours continuously per day. Then lack of water in agro wells during middle of the dry season causes crop failure. The management of on-field water application systems constitutes a complex problem which the farmers are faced with daily. It is often an important bottleneck for efficient implementation and large scale development of advanced irrigation scheduling practices. Figure.02 shows the availability of water sources

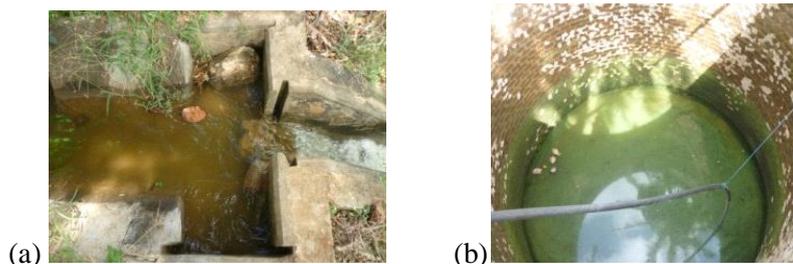


Figure 2. Types of irrigation source (a) Mahaweli water (b) Agrowell

Irrigation systems

In the study area farmers use various types of irrigation systems as they wish, without proper guidance. About 97% of the farmers use traditional way of earthen canal irrigation which leads to the water wastage and only 3% of the farmers use their own innovative sprinkler irrigation systems. To obtain sustainable water savings, it will be mandatory to require a minimum degree of technical quality for systems and to transfer to users a true mastery in managing water in on-farm irrigation systems, so enabling the water losses resulting from heterogeneities in the distribution of water to be controlled. This is due to farmers lacking the management skills to manage their irrigation systems properly. Consequences include reductions in crop yields and a waste of water resources. All these systems were not in suitable condition. Because of that they get themselves dried their well during the mid-season. For example, if they pump water for 3 hours, water level in the well goes down to the bottom and they have to wait for another day or two to do the next irrigation. This problem is aggravated due to the delayed rainfall pattern. Farmers have very poor knowledge on new agricultural technology. Sprinkler irrigation is often considered as being very effective compared to surface irrigation because it enables better control of water application.



(a) Hose pipe (b) Earthen Canal (c) Polythene (d) Sprinkler irrigation

Figure 3. Different types of irrigation used by farmers in the study area.

Some farmers use sprinkler irrigation which motivate other farmers also to use sprinkler irrigation. Total sample populations of the farmers requested further knowledge on sprinkler irrigation system to use the system successfully. The major barriers to adaptation are lack of knowledge on adaptation methods (81%), lack of funding (62 %) and absence of prior information on rainfall variability due to climate change (51 %). Limited availability and supply of location specific technologies and know how to cope with climate shocks and long term changes. Major drawbacks for sustainable agriculture production area lack of awareness of the complexities of climatic variation, limited agency support to strengthen adaptive capacity through consistent professional service delivery such as information, credit, relief, insurance, training and technology transfer.

Need for the farmers

Farmers expressed the shortage of water is the major problem. Even though they have agro wells they do not have proper efficient irrigation system. One farmer uses sprinkler irrigation made in his own and that farmer is doing a successful cultivation. Therefore 73% of the sample population requested for sprinkler irrigation system for successful cultivation by saving the water. Nearly 13% of the farmers requested agro well while 11% requested rainwater harvesting system. Only 3% of the total sample requested for pumps. Limited local collective efforts, weak local organizations, networking and their engagement with authorities and agencies responsible for assisting communities need to help cope with the effects of water losses.

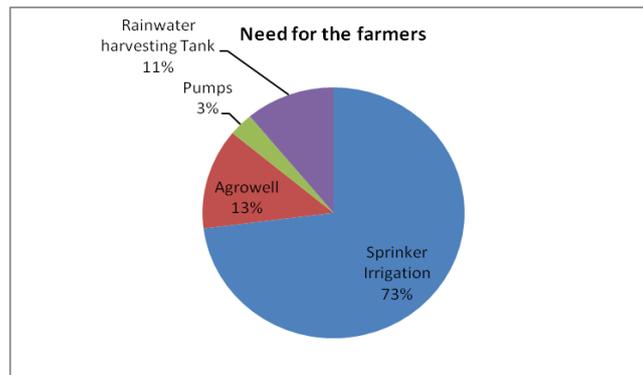


Figure 4. Need for farmers in the study area

CONCLUSIONS

The study focused on the need of the farmers in their own view point on the agricultural productivity by conducting and farmer survey in Rajagana-Anuradhapura District of the dry zone of Sri Lanka and also to recommend possible adaptation measures. Farmers expressed the shortage of water is the major problem. Even though they have agro wells they do not have proper efficient irrigation system due to financial constraints. Therefore 73% of the sample population requested sprinkler irrigation system for successful cultivation by saving the water. Nearly 13% of the farmers requested agro wells while 11% requested rainwater harvesting system. Only 3% requested pumps.

The study reveals that the community lacks guidance on new technology to improve agricultural productivity by them to improve their living standards. Limitation of water is the major problem and the farmers use irrigation methods which are not suitable for limited water sources. However, this control is dependent on a good quality level in the irrigation system design and in the selection of equipment, and also requires that the farmers develop appropriate skills for managing their irrigation system (knowledge and control of the pressures and flows that enable the system to distribute water uniformly over the field). Since the farmers are unable to invest on sprinkler irrigation system government intervention is necessary for installation and capacity building on the use of these systems along with other technology inputs to have sustainable shallow groundwater use in the Dry Zone of Sri Lanka.

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INFLUENCE OF SUPPLEMENTARY ILLUMINATION ON YIELD AND QUALITY OF GREENHOUSE BELL PEPPER (*Capsicum annum* L.)

K. M. A. S. Konara^{1*}, W. A. P. Weerakkody², K. W. L. K. Weerasinghe², S. Thrikawala¹

¹ Department of Agricultural and Plantation Engineering, The Open University of Sri Lanka

² Department of Crop Science, Faculty of Agriculture, University of Peradeniya

INTRODUCTION

Bell pepper (*Capsicum annum* L.) is an important vegetable crop in the world and one of the most intensively cultivated greenhouse vegetables in Sri Lanka (Anon, 2012). Even though bell pepper is grown under controlled environmental conditions, a very high percentage of fruit abscission observed amongst immature fruits is a major problem in popularizing this crop amongst farmers (AVRDC, 1986). Environmental stresses such as heat, drought, and low light conditions or failure of pollination/fertilization (Wien *et al.*, 1989a; Aloni *et al.*, 1996) are reported as potential causal factors that may induce abscission. Also, studies conducted by Aloni *et al.*, (1996) stated that high light intensities decrease abortion rates while lower intensities increase abortion in young fruits of bell pepper. Though bell pepper is a day neutral plant, tomato that belongs to the same family (*Solanaceae*) as bell pepper has already responded to the supplementary illumination exhibiting enhance yield (Lu *et al.*, 2012). Further research conducted in Sri Lanka has also shown that supplementary illumination can help in reducing fruit drop in gherkin (Karunaratne; 2014). Therefore, this research was undertaken to investigate the influence of enhancing light intensity (during cloudy/rainy weather) and extending day light duration on the growth and yield of bell pepper, the impact of supplementary lighting on immature fruit drop of bell pepper and to assess the cost effectiveness of supplementary lighting in commercial bell pepper cultivation.

METHODOLOGY

The experiment was conducted using the bell pepper variety, "Aristotle" under glass house conditions at the Dodangolla Experimental Station of the University of Peradeniya, located in the Mid-country Intermediate Zone, Sri Lanka during February to July 2015 (Yala season). Three treatments were assigned; T₁ – supplementary lighting to extend day length by 4 hours during 5.00 a.m. to 7.00 a.m. and 6.00 p.m. to 8.00 p.m., T₂ – supplementary lighting under rainy/cloudy weather from 7.00 a.m. to 5.00 p.m. using Light Emitting Diodes (LEDs = 15390 lux) and T₃ – control (without having artificial lighting) in a Completely Randomized Design with three replicates per treatment. Crop management was done according to the recommended practices (Weerakkody *et al.*, 2008). Plant height, inter-nodal length, leaf area, number of leaves, number of nodes and stem thickness were measured as vegetative parameters. The cumulative new fruit emergence and fruit drop were counted once a week and yields were recorded weekly as number of total fruits, their height, diameter, girth (cm) and yield per plant (g). Internal greenhouse environmental parameters such as light intensity, temperature and relative humidity were also recorded daily. Data were analyzed using Statistical Analysis System (SAS package) while mean separation was done with Least Significant Difference (LSD) at $P \leq 0.05$.

RESULTS AND DISCUSSION

There was no significant difference ($P \leq 0.05$) among light treatments on any of the vegetative growth parameters (plant height, number of leaves, leaf area, number of nodes, intermodal length and stem thickness) and cumulative new fruit emergence of greenhouse grown bell pepper (data not presented).

*Corresponding author: E mail – sigithi.ask@gmail.com

Mean temperature inside the greenhouse was 31 ± 2 °C while the relative humidity inside the greenhouse varied in the range of 60-85% at daytime during the period of study. Over the growing season, the total number of supplemental lighting hours given under rainy/cloudy condition (T_2) was 35.42 hours. The average light intensity under natural light (control) was 36,456 lux, under rainy or cloudy condition 1305 lux and time at which extend the day length 3285 lux.

The impact of different light treatments (T_1 , T_2) on number of fruits dropped per plant was significant ($P \leq 0.05$) in 7th week after transplanting; however there was no significant difference among light treatments on fruit drop thereafter. Hence, light treatments (T_1 , T_2) did not reduce fruit drop significantly, compared to control (Figure 1) which is clearly explained by the similar light intensity levels prevailed among the different light treatments 7th week after transplanting due to absence of rainy or cloudy conditions.

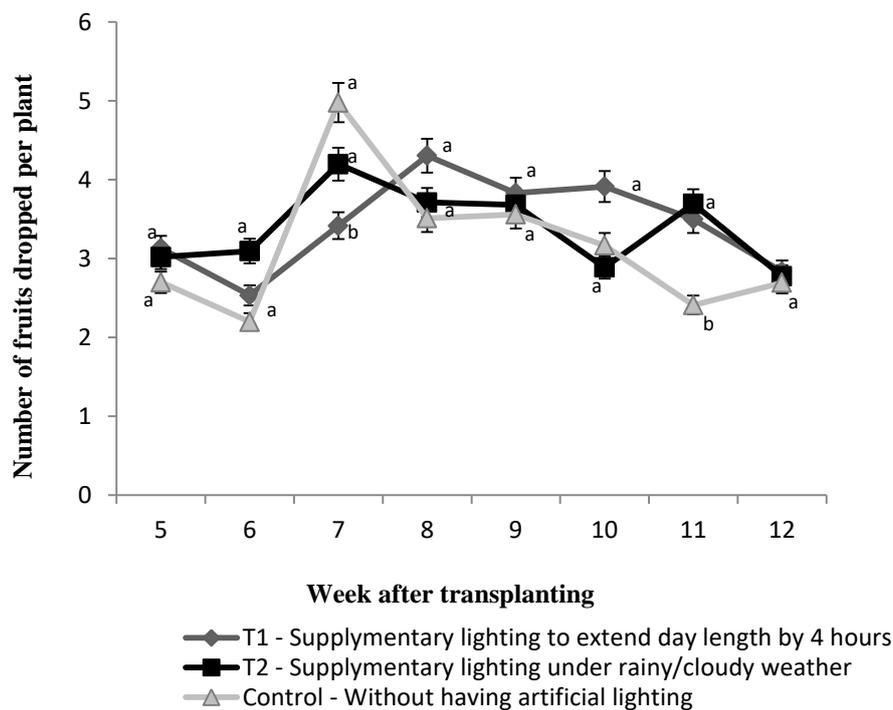


Figure 1. Variation of number of fruits dropped per plant under different light treatments.

Although there were variations, no significant treatment differences were observed in relation to new fruit emergence. The lowest rate of fruit emergence was recorded in plants treated with supplemental lighting to increase day length (T_1) while the highest value was recorded in plants treated with supplemental lighting under cloudy conditions (T_2). Therefore, expected boost in net assimilation under supplemental lighting, favoring source-sink relationship (Aloni *et al.*, 1996) for formation of more fruits and retaining them without dropping immature fruits seemed not possible and potentially the former could have been a result of greater rate of maintenance respiration under hot and humid greenhouse conditions (Wien *et al.*, 1989a; Aloni *et al.*, 1994).

Supplemental lighting used under cloudy condition (T_2) showed significantly higher yield per plant, compared to supplemental lighting used to increase day length (T_1) (Figure 2). However, there was no significant difference in yield per plant between the supplemental lighting used treatments and control (Figure 2).

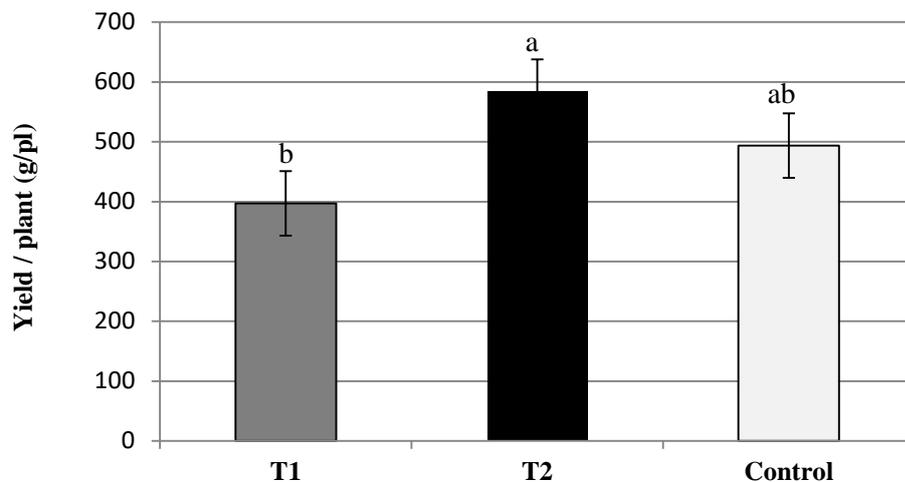


Figure 2. Effect of supplemental lighting on total yield.

Among the two light treatments, supplemental lighting under cloudy/rainy condition (T_2) found as the most cost effective treatment due to the significant yield increase shown in T_2 when compared to supplemental lighting used to increase day length (T_1). Therefore, supplemental lighting under cloudy/rainy weather (T_2) can be considered as the most cost effective solution to address the problem of immature fruit drop of bell pepper.

CONCLUSIONS AND RECOMONDATIONS

Supplemental lighting under rainy/cloudy weather (T_2) significantly contributed to higher fruit yield when compared to supplemental lighting used to extend the day length (T_1). However, no significant treatment effect of supplemental lighting on any of the vegetative growth parameters (plant height, number of leaves, leaf area, number of nodes, intermodal length and stem thickness), cumulative new fruit emergence and fruit drop was obvious in greenhouse bell pepper variety, “Aristotle” used in this study. Cost effectiveness of supplemental lighting under cloudy/rainy condition (T_2) was greater when compared to extended day length using LEDs (T_1). Supplemental lighting under rainy/cloudy weather would be the most cost effective solution to reduce immature fruit drop of greenhouse bell pepper. In future experiments, avenues of enhanced control of environmental conditions inside the greenhouse need to be used in order to limit fluctuations in flowering, fruiting and general growth of the plant. Further improvements for this methodology can be made possible by repeating the study in *Maha* season in Mid-Country Intermediate Zone using different light sources such as fluorescent lamps, metal halide lamps and horticultural grade LEDs that are specially designed for protected agriculture.

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COMPARATIVE STUDY ON PLANT DIVERSITY AND THEIR USES IN HOMEGARDENS OF DELGODA AND KADUWELA AREAS IN SRI LANKA

B. D. Madurapperuma^{1} W. N. Herath² and K. A. J. M. Kuruppuarachchi³*

¹*Department of Environmental Science and Management, Humboldt State University, USA*

^{2,3}*Department of Botany, The Open University of Sri Lanka*

INTRODUCTION

Homegarden system is characterized by multispecies production system on the area of land around the house to meet different physical and economic needs and functions (Kumar & Nair 2007). Homegardens are classified under different terminology, such as mixed, kitchen, backyard, farmyard, agroforest system, horticulture and homestead garden (Bandara, 2015; Mohri et al., 2013, Emmanuel, 1992). Homegarden system is vital for providing supplemental food and nutritional sources for livelihoods. The main economic benefits from the homegardens are food and nutritional security improving a health used by medicinal plants, can generate the income for householders, create environment beauty, and self-satisfactions.

Homegardens are found in both rural and urban areas. Rural homegardens have space to cultivate multipurpose big trees, such as Jackfruit, Breadfruit, Nadun, Teek, and Halmilla. In contrast, semi urban homegardens have limited land space and therefore small budded plants and ornamental plants are grown in those gardens using racks, pots, bags and rooftop garden. Understanding how homegardens represent green infrastructure and food security is vital for city planners to make pragmatic urban planning. This study examines the plant diversity of homegardens in Delgoda and Kaduwela areas corresponding to their role in plant uses.

METHODOLOGY

The study area is located in western province spanning over Gampaha and Colombo Districts representing rural and semi-urban areas respectively. The homegardens were assessed through field observation and discussion with households using semi-structured questionnaire. Fifty randomly selected households from Delgoda area and thirty randomly selected households from Kaduwela area were analyzed. This study surveyed ethnobotanical values of plants in the homegardens. A datasheet was compiled to gather the information on plant species grown, plant products, and size of homegardens.

RESULTS AND DISCUSSION

This study presents the ethnobotanical values of the cultivated crops in the homegardens of rural and semi-urban landscapes. For example, plant utilities, average species richness, and dominant species in the homegardens of Delgoda area (i.e. rural landscape) are shown in Table 1. Fruit crops are the mostly seen crop species (7 spp.) in homegardens in the area. The main purpose of cultivation of fruit crops is for supplementary income for the household. In addition, vegetables are cultivated in the homegardens especially for home consumption.

We compared the cultivated crops in rural (Delgoda) and semi-urban (Kaduwela) areas to understand the regional diversity of cultivated crops (Table 2). We recorded 176 plant species belonging to 138 genera and 65 families in Delgoda area, while a total of 58 species belonging to 49 genera and 36 families were recorded in Kaduwela area. Of the recorded species 42 species were common for both areas. The majority of plants in Delgoda area are used for medicinal (24% or 43 spp.), fruits (22% or 39 spp.) and vegetables (20% or 36 spp.) purposes. The medicinal plants are grown only for self consumption and traditional medical practices. The household income is mainly gained from fruit and vegetable crops such as, Rambutan, Banana, Amberella and Bird pepper in Delgoda areas. Of the recorded plants, 19 species were used for fruit crops followed by 10 vegetable crops and 8 beverage/sap-yielding

* Corresponding author: Email – bdm280@humboldt.edu

crops in Kaduwela area (Table 2). The main household income generated crops in Kaduwela area were Jak, Coconut, and Rose apple.

Table 1. Current crop species diversity in homegardens in Delgoda

Plant products	Average per homegarden	Mostly seen species
Fruit	7	<i>Nephelium lappaceum</i> (Rambutan), <i>Mangifera indica</i> (Mango)
Vegetable	4	<i>Moringa oleifera</i> (Murunga), <i>Luffa acutangula</i> (Vetakolu)
Spices	2	<i>Piper nigrum</i> (Pepper), <i>Zingiber officinale</i> (Ginger)
Medicinal	2	<i>Azadirachta indica</i> (Neem), <i>Asparagus falcatus</i> (Hatawariya)
Masticatories	1	<i>Piper betle</i> (Betel pepper), <i>Areca catechu</i> (Areca-nut)
Beverage	1	<i>Coffea arabica</i> (Arabian coffee), <i>Cocos nucifera</i> (Coconut)
Ornamental	1	<i>Bambusa vulgaris</i> (Bamboo), <i>Ixora coccinea</i> (Ratambala)
Tuber	1	<i>Xanthosoma sagittifolium</i> (Coco yam), <i>Manihot esculenta</i> (Cassava)
Timber	<1	<i>Swietenia mahagoni</i> (Mahogany), <i>Tectona grandis</i> (Teak)

Table 2. Cultivated crops in the homegradens in Delgoda and Kaduwela area

Plant products	Delgoda rural area (50 households)	Kaduwela semi-urban area (30 households)
Medicinal	43 spp.: <i>Citrus aurantifolia</i> (Lime), <i>Asparagus falcatus</i> (Hathawariya)	5 spp.: <i>Azadirachta indica</i> (Neem), <i>Curcuma longa</i> (Turmeric), <i>Cassia auriculata</i> (Matara tea)
Fruits	39 spp.: <i>Carica papaya</i> (Papaya*), <i>Mangifera indica</i> (Mango), <i>Musa</i> spp. (Banana), <i>Nephelium lappaceum</i> (Rambutan)	19 spp.: <i>Carica papaya</i> (Papaya*), <i>Aegle marmelos</i> (Bael fruit), <i>Annona reticulata</i> (Bullock's heart), <i>Averrhoa carambola</i> (Kamaranga)
Vegetables	36 spp.: <i>Capsicum frutescens</i> (Bird pepper), <i>Artocarpus incisus</i> (Breadfruit tree), <i>Basella alba</i> (Niviti*)	10 spp.: <i>Centella asiatica</i> (Gotukola), <i>Basella alba</i> (Niviti*), <i>Sesbania grandiflora</i> (Katurumurunga)
Ornamental	23 spp.: <i>Bambusa vulgaris</i> (Bamboo*), <i>Filicium decipiens</i> (Pehimbiya*)	6 spp.: <i>Bambusa vulgaris</i> (Bamboo*), <i>Filicium decipiens</i> (Pehimbiya*)
Spices	11 spp.: <i>Murraya koenigii</i> (Curry leaf*), <i>Piper nigrum</i> (Pepper*), <i>Pandanus amaryllifolius</i> (Rampe*)	4 spp.: <i>Murraya koenigii</i> (Curry leaf*), <i>Piper nigrum</i> (Pepper*), <i>Pandanus latifolius</i> (Rampe*)

Timber/Tree nuts	11 spp.: <i>Swietenia mahagoni</i> (Mahogany), <i>Tectona grandis</i> (Teak*), <i>Cocos nucifera</i> (King coconut*)	4 spp.: <i>Diospyros ebenum</i> (Kaluwara), <i>Tectona grandis</i> (Teak*), <i>Cocos nucifera</i> (King coconut*)
Tuber	7 spp.: <i>Xanthosoma sagittifolium</i> (Coco yam), <i>Manihot esculenta</i> (Cassava)	--
Beverage/Sap yielding	3 spp.: <i>Coffea arabica</i> (Arabian coffee), <i>Camellia sinensis</i> (Tea)	8 spp.: <i>Caryota urens</i> (Kitul palm), <i>Citrus sinensis</i> (Orange)
Masticatories	3 spp.: <i>Piper betle</i> (Betel pepper*), <i>Areca catechu</i> (Areca-nut *)	2 spp.: <i>Piper betle</i> (Betel pepper*), <i>Areca catechu</i> (Areca-nut *)

*Common species recorded in the homegardens of two areas

Of the recorded species, 57 % and 76% of the species cultivated in homegardens are edible in Delgoda and Kaduwela area respectively. Of the recorded species, 42 species were common for both areas. The most frequently encountered homegarden plants were Mango (*Mangifera indica*), Rambutan (*Nephelium lappaceum*), Coconut (*Cocos nucifera*), and Curry leaf (*Murraya koenigii*).

CONCLUSIONS/RECOMMENDATIONS

The homegarden in Delgoda showed a remarkable proportion of medicinal plants growing spontaneously in the garden. The reason for growing medicinal plants in this area is due to the high demand of the medicinal plants by traditional medical practitioners in the area. In contrast, fruit crop cultivation in Kaduwela area demands for household consumption. In conclusion, homegardens are particularly interesting for *in situ* conservation of diverse plants and it needs to understand the household interest on particular plants to make sustainable homegarden program.

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