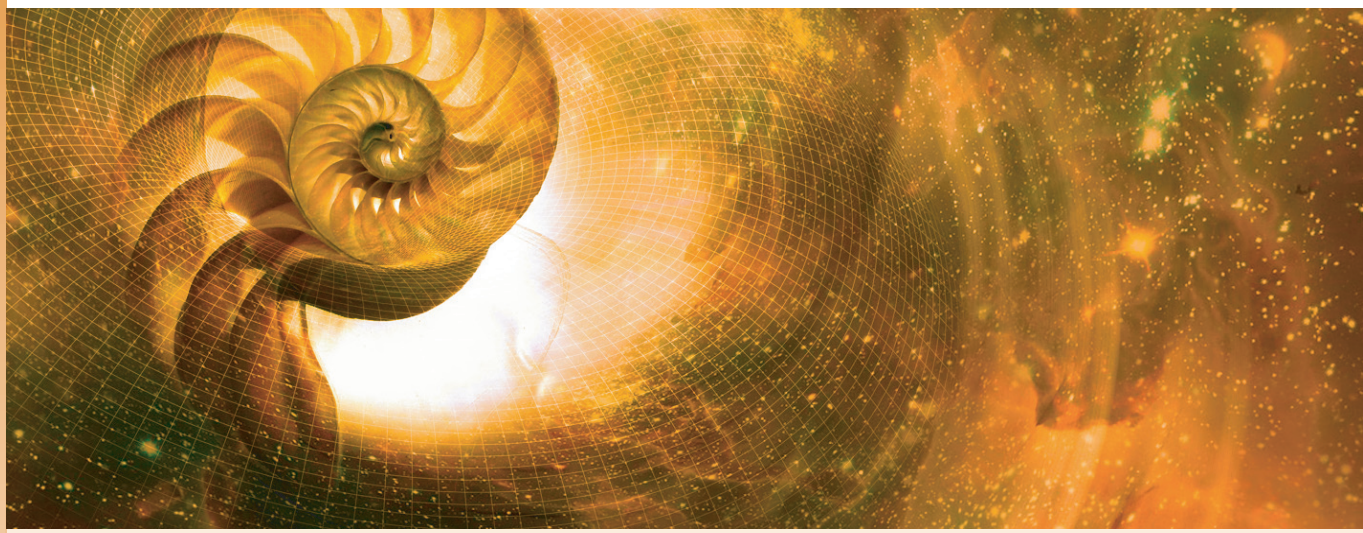
THE OPEN UNIVERSITY OF SRI LANKA



Open University International Research Sessions

iOURS 2018

29 and 30 November

RE-IMAGINING THE FUTURE THROUGH RESEARCH AND INNOVATION

THE OPEN UNIVERSITY OF SRI LANKA

Book of Abstracts

Open University International Research Sessions 2018

*i*OURS 2018

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Re-imagining the Future through Research and Innovation

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MESSAGE FROM THE VICE CHANCELLOR

It gives me great pleasure to send this felicitation message to the Open University International Research Sessions 2018 (*i*OURS 2018) which is an important annual event of the Open University of Sri Lanka (OUSL) that is eagerly anticipated by the university community and other researchers in order to disseminate their research findings.

In the Sri Lankan context, the OUSL has been in a unique position, being the only institute in the country practicing Open and Distance Learning (ODL). However, in recent years, units that offer external degree programmes in the conventional universities have been converted to Distance Learning Centres.

In this scenario, to maintain its competitive edge, the OUSL needs to further strengthen and advance its capabilities and effectiveness by adopting newer ODL approaches. For this purpose, institutional research in ODL practice plays an important role in ascertaining the best practices that are suitable to cater to the needs of our local environment.

Higher education theorists and practitioners claim that institutional research is critical for any university to enhance its effectiveness because institutional research helps the management take appropriate policy decisions to face the various challenges confronting the institute.

Within this context, the University has reinstituted the Committee on Research Advice on Distance Education (*CRADE*), through which I am confident that we would be able to revitalize the culture of academics being involved in institutional research in a more organized manner.

Therefore, may I appeal to all staff members at OUSL to be involved in different types of institutional research that will help our effectiveness and help our students in their learning? The management of the university will take all necessary steps to facilitate your research endeavours.

Let me also take this opportunity to express my appreciation to the Organizing Committee of *i*OURS 2018 and to other staff who have contributed their time and effort to make this event a success. I am confident that *i*OURS 2018 will 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

The Open University International Research Sessions 2018 (*i*OURS 2018) is held from 29- 30 November 2018 under the theme, '*Re-imagining the Future through Research and Innovation*'. It commences with the inauguration on 29 November 2018 followed by academic sessions in six sub themes, Open and Distance Learning (ODL), Education, Engineering and Technology, Health Sciences, Humanities and Social Sciences and Natural Sciences.

This year we received 105 abstracts and extended abstracts in the six sub themes of which 77 were accepted for presentation and publication after a rigorous, double-blind, peer review process which assessed the originality, significance and clarity of the submissions. This volume contains the abstracts accepted for presentation and publication in the conference proceedings. In addition to this publication, the presenting authors will receive a pen drive containing the extended abstracts.

The Chief Guest at the inauguration of iOURS 2018 is Prof. Janaka de Silva who is the Chairman of the National Research Council and Director, Postgraduate Institute of Medicine, University of Colombo while the Guest of Honour is Professor Gananath Obeyesekere, Emeritus Professor of Anthropology, Princeton University. The invited speakers include Prof. K.R. Sinha, the Vice- Chancellor, Nalanda Open University, India, Dr. Rajiv Jhangiani, a Special Advisor to the Provost on Open Education and a Psychology Instructor at Kwantlen Polytechnic University (KPU), Canada, Dr. Radhika Coomaraswamy, former Under Secretary General of the United Nations and Special Representative on Children and Armed Conflict and Dr. Matt Folley, Senior Research Fellow, Marine Research Group, School of Natural and Built Environment, Queen's University Belfast, Northern Ireland. They will deliver keynote addresses under the respective sub themes. The special feature of this series of events is the Pre-Conference Workshop on *Open Science and Open Pedagogy* conducted by Dr. Rajiv Jhangiani.

Organizing an event of this nature and magnitude required the collaborative efforts of all the members of the organizing committee of iOURS 2018. From the advertisement, calling for abstracts to compiling a volume of proceedings and planning the research sessions, everyone worked hard showing the spirit of leadership and teamwork. Therefore, on behalf of the Senate Sub Committee for *i*OURS 2018, I thank all authors who submitted abstracts to the conference, all reviewers who helped us in reviewing abstracts and language editors for editing them. My thanks also go out to the Professors of OUSL for agreeing to serve as Session Chairs at this event. We appreciate the service rendered by the members of the Senate Sub Committee for OUSL Research Awards for selecting the awardees. The secretarial assistance provided by Ms. Hasanthie Chandratilleke is greatly appreciated. Her dedication to the tasks ranging from convening meetings

of different committees and taking follow-up actions to compiling abstracts is acknowledged with gratitude. She was ably assisted by Ms. Shalini Rajasingham in the final compilation of abstracts. We thank Mr. B.D. Dhanushka Premalal of the OUSL Press for final page setting of the volume of proceedings and Mr. Mudith Somaratne, Director Operations and Mr. B.A.D.J. Balachandra, the Acting Printer for printing the books of Abstracts.

I am sure that *i*OURS 2018 will bring you renewed motivations and enthusiasm to engage in more productive research. I wish all of you two days of successful engagement in the research sessions.

Prof. S.S. Iqbal
Professor in Chemistry and Director /Research
Chairman, Senate Sub-Committee on Open University International Research Sessions 2018

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Address by the Chief Guest

Random thoughts on research in Sri Lanka

Universities have two fundamental functions: to generate and disseminate knowledge. Generating knowledge is by research, and one of the ways in which a country's progress is assessed is by measuring how much knowledge it generates. This can be measured by its research output, commonly measured by publications and patents. Sri Lanka has yet to reach the international average, although there are signs of improvement. Research is now given more prominence in university undergraduate curricula and postgraduate courses, and our universities now have more stringent methods by which research is assessed for appointments and promotions. Also, over the years, the number of high quality scientific publications has steadily increased – nearly four-fold over the last 20 years. But this is not so in the humanities and social sciences, and culture of research is still not widespread enough and, with some notable exceptions, research and development remains sluggish in both our state and private sectors.

Sri Lanka has many strengths; a pool of highly trained professionals and academics, many of whom have been exposed to research at centres of excellence and who are convinced of the importance of research and are motivated to find solutions to local problems. There are also weaknesses: there is still a general lack self-confidence to undertake large scale research projects, an aversion to join multi-disciplinary research teams, a suspicion of interventional studies, especially in medical research, and of course we have more than our fair share of cynics and arm-chair critics. They must be overcome if we are to make the paradigm shift in our approach to research – from being solely descriptive to interventional - where attempts are made to solve a problem.

In developing countries maximum use should be made of internal skills and resources, and every effort should be made to prevent wasted effort. For this reason, scientists working in countries like ours should learn to adapt and prioritize, so that a good part of their research is in areas where maximum economic and social benefits can be derived. This is especially so because most, if not all, our research is conducted using public funds. The public also has a right to know how their money is spent. Therefore, while we must continue to build a research culture of high quality, at least in our universities, and encourage more research, the new ethos is that if we use public money to fund research, the public should benefit even if it is in the long term, have free access to and comprehend the research findings. It is then that public support will convince governments to fund research more generously.

Professor H. Janaka de Silva
MD, DPhil (Oxon.), FRCP, FNASSL
Chairman, National Research Council

Address by the Guest of Honour

I am honored that the Open University has invited me to the inaugural session. My talk today will deal with some of the pasts of our nation prior to the advent of the colonial powers (circa 1605/1606). We are all familiar with the great text the *Mahavamsa* composed in Pali from around 250 BCE to our present times, a proud record rarely matched in any other country. In this lecture I will focus on texts written in Sinhala, with the first clear composition written around the 13th century and known to us as the *Pujavaliya,* Garland of Offerings in praise of the Buddha. Since that time many texts have been composed in Sinhala but especially during the long reign of the great king Parakramabahu VI (1411-1466) wherein there began a bourgeoning of texts. A large number of work written in Sinhala by educated literati and sometimes by ordinary villagers suggest very strongly an indigenous writing tradition focusing on what we now know as *vitti pot* (books on events) and *kadaim pot*, (boundary books). These texts deal with among other things, the boundaries of Sri Lanka and its topographies, namely, descriptions of villages and towns, anticipating as it were modern day censuses. The texts were written by educated Sinhala literati and good collections are found in the Peradeniya University library, the Museum Library in Colombo and in the Sri Lanka archives. In my view *vitti pot* and *kadaim pot*, and many related ones give us information on the lives and loves of ordinary people, and this includes a tradition of erotic poetry neglected in the orthodox Pali works written by learned monks, for whom obviously eroticism was a tabooed subject. I shall be happy to give examples of this little known literary tradition during this talk.

A final point: I shall also use the term "nation" in this talk as it refers to periods in our past. Obviously the term "nation" comes from Western discourse but I shall use this term to let us recognize that in both the genres that I have presented earlier and in our historical past, Sri Lanka is often presented as having symbolic unity clearly illustrated in such texts as the Pali Mahavamsa (and in the Sinhala traditions that I have mentioned). This is not to deny periods of practical political fracturing wherein the past appears fragmented. In my view the current popular terms such as *jatiya* (race, nation) and *agama* (religion) simply do not appear in the older texts, at least not with their current meanings. To put it bluntly this latter political language usage represents our contemporary political dilemmas and not to be equated with the past usage of these terms.

Professor Gananath Obeyesekere
Emeritus Professor of Anthropology
Princeton University

Keynote address 1

Climate change and its impact on natural resources and human health

Climate is defined as the long-term, at least a 30-year period, average of weather indicators like temperature, precipitation, etc. The climate system includes many domains such as the atmosphere, the ocean, the cryosphere, and the biosphere. Over many decades, human-caused emissions of greenhouse gases such as CO_2 and changes to natural carbon sinks, through deforestation and loss of green cover, have been changing the climate by increasing the temperature, altering precipitation patterns and changing the water balance.

Global warming describes increase in global average temperature in the 20th and 21st centuries. Both observations and models are used to estimate temperature changes. Global temperature is calculated by combining measurements across most parts of the globe using satellites, weather stations, ships and buoys. Several large international climate research centers analyze and combine this data to estimate average global temperature and how it is changing. The number of readings has increased over the past decades, which improves the accuracy of present-day estimates.

Climate change refers to changes not only in temperature but also in other properties of the climate system such as precipitation, sea level, extremes and wind speeds. Climate is the long-term average temperature and precipitation conditions of a certain place. The most recent Intergovernmental Panel on Climate Change (IPCC) assessment, the Fifth Assessment Report (2013/2014), states that warmer global temperatures are already impacting the climate and natural systems. It concluded that: atmosphere and oceans have warmed, snow and ice have diminished, precipitation patterns have changed, sea level has risen, heat waves are more frequent, heavy rainfall incidence has increased, arctic sea ice extent is decreasing, and permafrost temperatures have increased. Thinning Arctic sea ice allows the ocean to absorb more heat, causing even more ice loss and diminished reflectivity in the region. Although the average global temperature varies significantly from year to year due to phenomena such as El Nino or volcanic activity, the long-term trend over the past 30 years has shown significant warming. The world's nine warmest years have all occurred since 2005, and the five warmest since 2010.

Impacts generally refer to effects on lives, livelihoods, health and wellbeing, ecosystems and species, economic, social and cultural assets, services (including ecosystem services), and infrastructure. In response to ongoing climate change many species have already shifted their geographic range, seasonal behavior, migration patterns and abundance. Changing precipitation or melting snow and ice are affecting people's access to fresh water. Negative impacts of climate change on crop yields have been more common than positive impacts. Impacts from recent climate-related extremes, such as heat waves, droughts, floods,

cyclones, and wildfires, reveal significant vulnerability and exposure of some ecosystems and many human systems to current climate variability.

Impacts on human health includes increases in malnutrition and diarrhoeal diseases; increase in death and injury from heat waves, floods, storms, fires, and drought; and changes in the distribution of infectious disease vectors.

The United Nations climate report released in the first week of November 2018 predicts that by 2040 there could be global food shortages, the inundation of coastal cities and a refugee crisis unlike the world has ever seen. 'IPCC 1.5 ^{0}C Special Report' emphasizes that Global warming of 2 degrees Celsius above pre-industrial levels poses greater risks than previously believed. These risks can be substantially reduced by limiting warming to 1.5 ^{0}C which requires dramatic emission reductions by 2030 and carbon neutrality by around 2050. This would involve unprecedented transformations in energy, land, urban, and industrial systems, including measures to achieve "negative emissions" by removing carbon from the atmosphere.

Prof. R.K. Sinha
Vice Chancellor
Nalanda Open University, India

Keynote address 2

Developing wave energy in Sri Lanka

The demand for renewable energy is growing as both the global demand for energy increases and the impact of climate change due to the burning of fossil fuels is more fully understood. The challenge for Sri Lanka is that the growth of the country's Gross Domestic Product (GDP) demands an increase in the production of energy, which must be met by the construction of new power plants. Moreover, this needs to be achieved at the lowest cost in order to maximise the potential for economic growth, which will result in an increase in the standard of living for Sri Lankans in general. An added requirement is that this economic growth should not put at risk tourism in Sri Lanka because of its importance to the economy of the country. This means that renewable energy technologies such as wind turbines are not suitable for large-scale deployment in Sri Lanka due to the potential impact on the tourist industry.

Wave energy is an emerging source of renewable energy, which has not yet reached the commercial status of wind and solar energy. This means that wave energy converters cannot be bought as turn-key solutions but remain at the prototype phase of development. However, unlike wind turbines, they have the potential to product renewable energy without a significant impact on the tourism industry, which makes them particularly attractive for Sri Lanka. In addition, Sri Lanka has a reasonable wave energy resource, especially along the south coast where waves from the Indian Ocean arrive. The challenge is, how does Sri Lanka develop wave energy whilst not putting at risk its economic growth? Or even better, how can the development of wave energy in Sri Lanka support economic growth?

Key to the development of wave energy in Sri Lanka is the recognition that a plurality of energy sources will satisfy the energy demands of the future. Currently, fossil fuels provide the lowest cost of energy and so will naturally continue to provide the main source of energy for Sri Lanka. However, these costs will continue to rise as fossil fuels become less acceptable and global availability declines, so there is a need to plan for a future scenario where renewable energy is the cheapest source of energy. Relatively small-scale investments in renewable energy, including wave energy, can support this so that when fossil fuels are no longer the cheapest solution, Sri Lanka has the knowledge, skills and infrastructure to transition smoothly and effectively to these alternative sources of energy. If Sri Lanka does not make this investment then it risks facing future additional costs, far larger than the initial investment, due to inappropriate renewable energy technologies being deployed in the country.

Another key to the development of wave energy in Sri Lanka is providing an attractive environment for the inward investment of wave energy technology developers. These developers may come from Europe or USA or Australia or

somewhere else in the world, but they all have three things in common; they want to develop their technology, they want to develop their markets and they want to do this spending the least amount of money possible. Sri Lanka will be attractive to these companies because there is a potential market and they may have access to development funding through their governments; however, this will be true for many other countries. So, the fundamental question is how does Sri Lanka make itself more attractive than other countries like India, or Indonesia?

Sri Lanka can make itself attractive to wave energy developers, who would then support the development of wave energy in Sri Lanka, using a range of political and organisational actions. These actions could include; demonstrating clear and unambiguous support for wave energy development, providing development zones where developers can deploy their technologies with a minimum amount of additional bureaucratic requirements and ensuring that there is a skilled and knowledgeable work-force. One method of achieving this would be the creation of a wave energy test centre and a wave energy research programme, but other options would also be possible. The important point is that these can all be done with a relatively small amount of investment and the potential benefits are significant from both the direct investment of overseas companies in the development of their technologies in Sri Lanka and the future export of these technologies to other countries.

In summary, support and investment for the development of wave energy in Sri Lanka has the potential to not only provide a clean, tourist-friendly source of renewable energy, but also contribute to the economic development of the country in the medium to long-term.

Dr. Matt Folley
Senior Research Fellow
Marine Research Group
School of Natural and Built Environment
Queen's University Belfast
Northern Ireland

Keynote Address 3

Open: The Philosophy and Practices That Are Revolutionizing Education and Science

The opposite of open is not closed; the opposite of open is broken (Wilbanks, 2010).

Scholarly publishing is certainly broken. Here, the farce that passes for tradition supplements public funding for researchers with (publicly subsidized) voluntary peer review and editorial work. The taxpayer is then asked to provide additional funding for database subscription fees so that institutions can access the very research they produce. And as if paying three times was not enough, if the very same taxpayer wished to access the fruits of all this labour, they would instead find a paywall. That is, unless the researcher had access to even more public funding to cover exorbitant article processing charges.

Science is arguably broken. Here, tradition incentivizes trading off unsexy but cumulative research for flashy but non-reproducible findings. Worse still, the prevailing system encourages questionable research practices like p-hacking and withholding disconfirming data. Every new generation of scholars learns that prestige is associated with communicating in the least accessible style through the least accessible and impactful channels.

Pedagogy too reveals many chips and cracks. Here, faculty routinely adapt their courses to map onto the structure of textbooks instead of the other way around. Lecturing remains popular, despite masses of empirical evidence that unequivocally show the advantages of higher impact practices such as active and experiential learning. Instructors still regularly assign 'disposable' assignments in which students produce work for one person while they in turn take pains to provide thoughtful feedback that is almost immediately recycled at the end of the term. And a great many educators continue to teach in a manner that assumes their principal role is that of content delivery, despite living in an age of unparalleled access to information.

Higher education, itself − if not broken − is certainly delusional. It presents itself as a vehicle for economic and social mobility, yet it is often structured in ways that reinforces existing inequalities. Moreover, it continues to shift in many countries from being considered a public good worthy of societal investment to an individual choice available only to those who enjoy significant privilege.

It is against this backdrop that the open education, open access, and open science movements have been running separate—if parallel—courses, steadily working to transform the higher education landscape in the process. In each case, digital technologies are being leveraged to enhance access, agency, and rigour in the service of both justice and progress.

Despite this progress, it is important to recognize that open is not a panacea. Not everything should or even could be open, and a critical approach is necessary if the open movement is to avoid perpetrating harm despite the best of intentions.

Rajiv Jhangiani
Special Advisor to the Provost on Open Education & Psychology Instructor
Kwantlen Polytechnic University, Canada

Keynote address 4

Value Education and Literature

Over the last forty years tertiary education has moved from academic and theory based education to a technically minded education. When I was in University in the west the vast majority of students were in the arts or social sciences and a small percentage in management and business. Today I hear that business and management are nearly fifty percent of the majors that people take with science and the liberal arts dividing the rest. With the decline of what we once knew as an academic education we have seen a decline in value based education and a value based society. This lecture will present a case for all students. regardless of their discipline to be exposed to national and international literature as a means of recovering and strengthening value based education.

Dr. Radhika Coomaraswamy
Former Under Secretary General of the United Nations and
Special Representative on Children and Armed Conflict
Former Global Professor at the New York University School of Law

PROCEEDINGS

OPEN AND DISTANCE LEARNING

EDUCATION

ENGINEERING AND TECHNOLOGY

HEALTH SCIENCES

HUMANITIES AND SOCIAL SCIENCES

NATURAL SCIENCES

OPEN & DISTANCE LEARNING (ODL)

REFLECTIONS ON THE DESIGN AND DEVELOPMENT OF SCENARIO-BASED VIDEOS IN MOOCS

I.A. Premaratne[1*], T.C. Sandanayake[2], Samanthika R. Hettiarachchi[3], S.A.S. Kaushalya Perera[4], Shironica P. Karunanayaka[5], Som Naidu[6]

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Massive Open Online Courses (MOOCs) are increasing in popularity mostly because they offer free and open learning opportunities for large numbers of participants. A major feature of contemporary MOOCs is their use of videos to present subject matter content. Very often this appears very monotonous and uninspiring and is not very different from lecture capture, where it is not certain to what extent learners are engaging with the presentation and its content. This paper reports on a different use of videos in the context of four MOOCs developed to promote Continuing Professional Development (CPD) of practitioners in Open Educational Practices (OEP). These videos are scenario-based and they serve to situate the learner in authentic learning situations for meaningful learning to take place. The primary purpose of these Scenario-based Videos (SBVs) was to provide the learning context as well as the triggers to activate learning, by gaining learners' attention and situating them in an authentic learning context. The skills required for the creation of these SBVs included script writing, video shooting, and video editing. This study focuses on the challenges faced by the MOOC design team who functioned as creators of SBVs, and strategies used to overcome those challenges, based on their reflections during the video creation process. It also discusses the similarity of movie or stage-play production with scenario-based video production and the advantage of integrating SBVs in a MOOC. The advantage of SBVs is that they seek to place the learners in authentic and real-world situations where they are required to think through a real-world problem and use the lesson content to solve that problem, as opposed to listening to someone telling them about the solution as is usually the case in most videos that we see in MOOCS.

Keywords: MOOC Design, Scenario-based Videos

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A SURVEY ON ADOPTING A CLOUD-ENABLED MODEL FOR THE OPEN UNIVERSITY OF SRI LANKA

Jasmine Nanayakkara[1], Asanka Senevirathne[2*], Janaka Heenkenda[2]

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University World News reports that by 2025, "the global demand for higher education will double to approximately 200 million students per year, mostly from emerging economies." In Sri Lanka, 86,321 undergraduates were enrolled in the 2015 intake under the University Grants Commission and 345,744 Open & Distance Learning (ODL) undergraduates were enrolled for higher education. The Open University of Sri Lanka (OUSL) was established in 1980, under the purview of University Grants Commission of the Ministry of Higher Education, to promote Open & Distance Learning in tertiary education. It is a member of Asian Association of Open Universities and The Association of Commonwealth Universities. The purpose of this study is to identify the possibility of adopting a cloud-enabled model for OUSL, based on perspectives of staff at the university. An online survey was conducted in the Departments of Electrical and Computer Engineering, Computer Science and the IT Division. There were nine quantitative questions and one qualitative question included in the survey to collect respondents' experience and perspectives. The findings revealed that there was interest in moving to a cloud-based model due to the mobility and recovery options it offered. These advantages of a cloud-based model respondents felt will provide an extensive learning support environment to registered students and flexibility to the staff to extend their core services. The OUSL staff, could, with a clear understanding of cloud computing, move to a cloud-enabled model for LMS and remain in the communication platform of the cloud. However, IT skills and infrastructure are pre-requisite for the successful implementation of a cloud-based model within the OUSL.

Keywords: Cloud Computing, Open & Distance Learning, Higher Education, Sri Lanka

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OER-INTEGRATED ONLINE COURSE DEVELOPMENT BY INCORPORATING APPROPRIATE INSTRUCTIONAL DESIGN FEATURES

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The Open Educational Resources (OER) movement promotes providing free and open access to high quality digital educational materials for teachers and learners. Creating OER-integrated courses requires moving beyond the traditional teacher-centred learning methods, integrating OER into online course development which provides more freedom for both teachers and learners to become more creative and innovative. Use of appropriate Instructional Design (ID) features such as a systematic approach to organizing the teaching-learning process allows course designers to make the learning experience more efficient, effective, and appealing to learners. This research study focused on identifying appropriate ID features in the development of OER-integrated online courses for undergraduate learners. It adopted a Design Based Research (DBR) approach and this paper focuses on the first two phases of the DBR process:1) analysis of the problem and 2) design of solutions in the form of an intervention. Initially, desirable ID features were identified by reviewing existing OER-integrated online courses. An intervention was designed incorporating these identified ID features and implemented as an OER-integrated online course to support the learning process of undergraduate learners. Based on learner perceptions and learner performance during this intervention a set of ID features were identified under four ID aspects – information, instruction, interface and interaction design, which incorporated in the development of OER-integrated online courses.

Keywords: Open Educational Resources, OER-integrated online learning, Instructional Design

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A COURSE EVALUATION THROUGH NEEDS ANALYSIS BASED ON PERCEPTIONS OF STUDENTS: COURSE IN GRAMMAR AND COMMUNICATION SKILLS

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English language learners, especially at tertiary level, have specific needs in addition to those imposed and catered to by educational institutions, and the incorporation of learners' needs in real life communication is a vital element in a language syllabus. Among the primary responsibilities of an adult education institution are needs analysis and programme planning and evaluation. In the context of evaluating an ongoing course, a needs analysis serves the purpose of adjusting the course to suit the changing needs of learners. The current research focuses on a course evaluation through needs analysis based on the course in Advanced Grammar and Communication Skills (Ad. Gr & Com Skills) as perceived by students of the Diploma in English Language and Literature (DELL) Programme in order to determine what changes best support the development of the course while exploring suggestions for changes in course plans.

The feedback of 50 DELL students registered for Ad. Gr & Com Skills course were gathered through a questionnaire and analysed using descriptive statistics. Frequency distribution, percentages and Mean values were calculated in order to analyse the students' perception on interest and importance and usefulness of and satisfaction with the content of the course. Frequencies for the multiple responses were calculated in order to analyse improvement to the course according to the point of view of the students. Qualitative data were gathered on the students' overall opinion and suggested improvements and analyzed qualitatively to support the outcome of the quantitative data.

Of the responses regarding the overall opinion on the Ad. Gr & Com Skills Course, the majority were of the opinion that it was useful to develop language skills, enhance knowledge, useful to their day-to-day life and profession. As suggestions for the improvement of the course, increase in content, time allocation and course material were identified. Multiple responses of the students regarding improvement to the course indicated that for Grammar skills, content is the area which needs most improvement whereas for Presentation, Speaking and Listening skills time allocation is important. Improvement in time allocation and course material is equally important for Communicative skills in writing.

According to the demographic data, the majority had enrolled for the DELL Programme with the intention of registering for the B.A. in English and ELT. Therefore, the current study reflects their expectations for future studies. This may explain the positive responses of the majority towards the interests, importance, usefulness and satisfaction of the current course. The expectation of

the study was to utilize the outcome of the study to adjust and enhance the current Ad. Gr & Com Skills course to suit the changing needs of learners. Thus, the outcome of the study has helped determine the prospective professional requirements and further improvements in course content, teaching materials and methods.

Keywords: Course Evaluation, Needs Analysis, Grammar Skills, Communication Skills, Multiple Responses

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A PRELIMINARY STUDY ON ONLINE SUPPLEMENTARY COURSES IN B.Sc. DEGREE PROGRAMME AT LEVEL 3: STUDENT PARTICIPATION AND ASSOCIATIONS WITH LEARNER SUPPORT PROGRAMME & REGIONS

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The Open University of Sri Lanka (OUSL), the only national university in Sri Lanka which delivers its degree programmes through the open and distance mode, has also accepted the importance of promoting E-learning. The Faculty of Natural Sciences (NSc) of the OUSL has implemented On-Line Supplementary Components (OLSC) for most of the courses offered by the faculty for its B.Sc. Degree Programme (BSDP). The objectives of this study were to identify student views on the importance/usefulness of OLSC to their educational experience, identify student participation in OLSC offered by the Faculty of NSc, identify any associations between the learner support programmes and student participation in OLSC, and identify any associations between regions and student participation in OLSC, at Level 3 in BSDP. The study was conducted through a questionnaire-based sample survey. The population of this study were the active learners in the academic year 2016/2017 at Level 3 (L3) in the BSDP. In this study, the OLSC offered in the discipline-based courses at L3 in the BSDP were considered. In the academic year 2016/2017 BSDP was conducted in the regional centres at Colombo (CRC), Kandy (KRC), Matara (MRC), Jaffna (JRC), Anuradhapura (ARC), and Batticaloa (BRC). The faculty learner support programme, Peer Assisted Study Sessions (PASS), was conducted, in all disciplines only at CRC and KRC**.** Randomly selected 107 students, comprising 42 L3 students (KRC-12, CRC-30) who attended the PASS and 65 students (ARC-3, BRC-4, CRC-30, JRC-5, KRC-17, MRC-6) who did not attend the PASS, were interviewed over the phone and responses to the following questions were recorded. Q1: Do you think that adding an online component to a L3 discipline-based course is important/useful to your learning/academic work in OUSL? The answer was recorded on a five-point Likert scale: strongly disagree, disagree, no idea, agree, and strongly agree. Q2: Have you used any online component of L3 discipline-based courses offered in the academic year 2016/2017? If the answer for Q2 is 'yes' the response for Q3: Type of participation ('downloaded the past papers', 'scheduling/administrative matters', 'used online supplementary materials', 'answered for quizzes', 'interact with the teacher for academic matters', 'interact with the peers for academic matters') in the OLSC in discipline-based L3 courses were recorded. A stratified random sampling technique was used to select the sample. Overall, 94% of the students think that OLSC are important/useful for their educational experiences. However, the majority of students have used the OLSC for 'download the past papers' (82%) and 'Scheduling /Administrative matters' (67%). Using 'Fisher's Exact Test' associations ($p < 0.05$) were found between 'attendance to PASS' and

student online participation in 'download the past papers', 'scheduling/administrative matters', 'used online supplementary materials', 'answered for quizzes', 'interact with the teacher for academic matters'. Also a regional difference ($p < 0.05$) was found between CRC and KRC in student online participation ('downloading the past papers' & 'scheduling/administrative matters'), out of the students who attended PASS. Further large-scale studies on participation in OLSC and factors behind the participation in OLSC in BSDP, motivating the students in using Educational Technology (ET), developing the necessary skills for using ET in students and introducing OLSC to learner support programmes are recommended.

Keywords: On-Line Supplementary Components (OLSC), student participation, significance

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LEARNER VIEWS ON DISTANCE LEARNING

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The learning modalities of higher education institutes (HEIs) in Sri Lanka include face-to-face, open and distance, and online modes of delivery. Many HEIs practice face-to-face learning while some institutes utilise the open and distance learning mode. Further, only a few institutes have launched online learning facilities. The Centre for Distance and Continuing Education (CDCE) at the University of Peradeniya is one such centre in the university system in Sri Lanka. The CDCE updates and upgrades its existing programmes while launching new online programmes to facilitate online learning. To upgrade and uplift the educational programmes offered through the CDCE, it is necessary to conduct a needs assessment study to identify demand-driven programmes with special reference to enrolment, content, student support services, the use of ICT, the mode of delivery, the teaching-learning process, learning outcomes, employability and so on. Thus, the aim of this study was to investigate the suitability and quality of the existing educational programmes administered by the CDCE, while paying special attention to the mode of delivery, employability of students and the new programmes that are to be launched to facilitate learners through the distance mode.

This study used a quantitative approach and the sample consisted of 534 Sri Lankans. The respondents included school teachers, high school students, current CDCE students, current undergraduates, staff members at the university, bank officers and the general public. A survey questionnaire was used to collect data on three factors: need, job-oriented nature and the mode of delivery. Each factor was measured through five items on a six-point Likert scale. The data was then analysed through quantitative analytical methods using SPSS 17.0. The learners' preferences on different courses were tested on 11 programmes. The results demonstrated acceptable reliability on the job-oriented nature and mode of delivery in Chronbach's alpha statistics. Results on the factor "need" showed the requirement of offering more diversified new programmes. According to the results for the factor 'job-oriented nature', the demand in job-related courses and the programmes' suitability for social development is very high. The results on the factor 'delivery mode' suggested the need to offer academic programmes in both the face-to-face and online modes to facilitate learners effectively. It was also suggested that online programmes are more suitable for the future. Of the three factors, the strongest factor was the mode of delivery. The highest correlation (.635) was observed between the factors of 'job-oriented nature' and 'mode of delivery'. This indicates that the mode of delivery expected by learners demands high consideration and that there is much concern about the nature of employment. Moreover, the strongest regression (.404) was between the factors 'job-oriented nature' and 'mode of delivery', indicating that the mode of delivery

expected by learners is predicted by their employment status. Since learners expect more diversified new programmes through the CDCE, different types of learner supportive and learner matching programmes are to be launched. These are expected to meet the needs of learners to facilitate their ability to face challenges successfully in their day-to-day life. Further, more learners prefer a hybrid mode in which both online and face-to-face sessions are included. The CDCE should launch new programmes on the disciplines of English language and computer-related courses as the demand for such courses is very high. The CDCE must also promote the designing of innovative, entrepreneur-oriented and skill-based online courses.

Keywords: Distance Learning, Need, Job Oriented nature, Mode of delivery

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REASONS FOR UNDERGRADUATES NOT ATTENDING DAY SCHOOLS IN THE FACULTY OF HEALTH SCIENCES, OUSL

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Though attending day schools (DSs) is not compulsory according to the Open Distance Learning concept, it is always promoted. Recently, there were some concerns about low attendance of students for most DSs conducted for the Bachelor of Science Honours in Nursing degree programme at eight Regional Centres (RCs) of the OUSL, and for Bachelor of Medical Laboratory Sciences (BMLS) Honours and Bachelor of Pharmacy Honours degree programmes at the Colombo RC (CRC). Therefore, this study was aimed at investigating the reasons for non-attendance of DSs by undergraduates of respective degree programmes and to identify their preferences regarding attending DSs with regards to days and time.

This was a descriptive cross-sectional study conducted among all undergraduates who sat for the final examination of semester one during the period of December 2017 to January 2018. Data were collected using a content-validated, self-administered questionnaire, which consisted of socio-demographic information, academic and work-related information and reasons for not attending DSs. A total of 1672 undergraduates (Nursing n=1397; Pharmacy n=127; BMLS n=148) participated in the study. Among them, the majority were females, were married and had children. The findings show that most of the undergraduates preferred to attend DSs during weekdays while the majority of nurses preferred attending DSs from 10.30am to 2.30pm (66%) whereas most of the Pharmacy and BMLS students preferred attending DSs from 8.00am-10.00am. This difference may possibly be due to the nature of the duty and changes of their duty shifts among undergraduates. A considerable proportion of Nursing and BMLS undergraduates did not attend DSs as they were not compulsory. Most of the Nursing, BMLS and Pharmacy (30%-50.4%) students did not attend DSs due to family reasons. Difficulties in traveling and distance from CRC were reasons for non-attendance among BMLS and Pharmacy students. A high workload due to the shortage of staff (>71%), poor support from peers and superiors (>39 %) and not having enough study leave (Pharmacy 51.1% and BMLS 36 %) were other reasons. With regard to university factors, most of the undergraduates have accepted that course timetables were not appropriate for them. In comparison to the Pharmacy and BMLS students, a higher proportion of Nursing students have accepted that they did not attend DSs as they had good course materials to self-learn and they received good support from learning materials download from My OUSL. It shows that the availability of alternative resources is a key reason for students not attending DSs.

The most common reasons for not attending DSs found in this study were family commitments, difficulties in travelling, a high workload, and inappropriate course time tables, DSs not being compulsory, availability of good course materials to self-learn, good support received from the learning materials downloaded from the MyOUSL. Thus it is essential to consider some of these modifiable reasons when planning the delivery of undergraduate degree programmes by the Faculty of Health Sciences in the future.

Keywords: Open Distance Learning, Undergraduates, Reasons for absenteeism, Day schools

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LEARNERS' PERCEPTION ON OPEN AND DISTANCE LEARNING VIA ONLINE: A CASE FROM OUSL

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The adoption of Information and Communication Technology (ICT) has strengthened the modes of deliveries to achieve the core values of Open and Distance Learning (ODL). Among other departments of the Faculty of Humanities and Social Sciences of the Open University of Sri Lanka (OUSL), Department of Social Studies (DSS) has been able to attract quite a large number of learners due to its multi-disciplinary nature and the different delivery modes of courses which come under the Bachelor of Arts Degree in Social Sciences. The DSS uses basically two modes of delivering courses to learners: traditional and online. In the traditional mode, courses are offered through printed study materials with face-to-face classroom discussions. When it comes to the online mode, there are two methods. In the first method some of the undergraduate courses are entirely facilitated through a Learning Management System (LMS). In the second method, even though some of the courses are facilitated by the LMS, they are also supplemented with printed materials. Both methods have classroom discussion. This study, focused on the second method of the online mode. This method was used to offer a course to the final year learners of the 2017/2018 academic year and those learners were considered as the focus group of the study. According to the data from the LMS, even though the learners were advised to build connections with the course teacher and colleagues by conducting the assigned activities of the selected course of this study, it was identified that there was low participation. Therefore, the main objective in conducting this research was to examine the learners' perceptions of studying a course via the online mode of delivery and thereby to observe their perceptions about the course content, course activities, continuous assessments, final examinations, marks, feedback on assignments, teacher's responses, access to internet and login status, availability of resources, course administration, classroom discussions, etc. Both primary and secondary data were collected using the quantitative and qualitative methods. A survey was conducted through an open-ended questionnaire, and the interview method was also used to observe the learners' perception on studying a course via the online mode. The sample size for the questionnaire survey was 112 learners from the total number (125) of eligible learners for the final examination of the selected course of this study from seven regional centres. A total of 30 learners were interviewed. For the content analysis, log reports from LMS, books, journal articles and websites were used. A purposive sampling technique was followed in selecting the sample for the questionnaire survey and the interviews. In the questionnaire survey, a Likert Five-Point Scale was also used to collect learners' perceptions on some of the given statements. In analyzing the quantitative data, simple statistical methodology –frequency analysis, descriptive statistics and crosstabs were used

with Statistical Package for Social Sciences (Version 20). The findings of the survey revealed that low participation was not because of inadequate support from the course teacher or the way that the online course was organized. E-learning is encouraged by an e-culture at the institutional level or a societal level in most of the developed countries and therefore learners are active and benefit a lot. However, e-culture in a society like Sri Lanka is yet to develop—especially in remote areas, the life-style of the people is being very slowly changed by ICT. Therefore, the learners' dynamic passion towards e-learning is low and this attitude has also negatively affected open and distance learning in Sri Lanka.

Keywords: Open and Distance Learning, Online mode of delivery, Learners' perception, Undergraduates, Sri Lanka

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OPEN SCHOOL LEARNERS: LEARNING DIFFICULTIES IN SCIENCE COURSES OF SECONDARY SCHOOL CERTIFICATE PROGRAM OF BANGLADESH OPEN UNIVERSITY

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There are three different backgrounds existing in the Secondary School Certificate (SSC) program: Science, Arts, and Commerce of the Bangladesh Open University (BOU). In the science group out of four courses (Physics, Chemistry, Biology and Higher Mathematics) at least three are compulsory in the national curriculum as well as the BOU curriculum and each course is marked out of 100 (theoretical 75 marks and practical 25 marks). For higher education, all science courses are very important for learners. Science courses have always been a challenging academic subject, particularly in schools. When students encounter difficulties in learning science courses, the common reaction to resolve the issues is to get them to practice more because of the belief that practice makes perfect. In a distance-learning class, students must be committed to their own success. In a distance-learning class, these behaviours are necessary but the social pressure to comply is absent.

The current research project aimed to investigate what problems the Open School learners encounter when trying to be successful in Science courses of the SSC program. In the SSC program 33,347 learners admitted beginning in 2018 and last year in 2017 there were 46,592 learners. In the SSC program of Open School, the total learners in Science, Arts, and Commerce was 79,939. Out of these (2,456+3561 = 6,017) learners are taking the science group, which represents the total population. A survey was conducted among 350 learners in 4 focus group discussions. The participants were randomly selected from 4 different Regional Centers (RCs) under a project funded by the UGC of Bangladesh via BOU. Most of the students are from the same ethnic background. Therefore, they represent a homogenous population.

The results found that most of the sections of the Science curriculum of the Bangladesh Open University (BOU) have been difficult for learners and they mostly relied on print materials which are provided by Open School and also depend on shadow teaching for both theoretical and practical learning rather using video materials. Shadow teaching is a big problem not only for Open and Distance learners but also for conventional learners as well.

Attitudes are deeply related to motivation and social support; we recommend that developing strategies in educational contexts, to improve teacher support and student engagement could be of vital importance in improving not only attitudes but also science performance among learners throughout their schooling.

Keywords: Learning difficulties in Science, Practical of Science, Secondary School Certificate (SSC), Open School (OS).

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EDUCATION

THE IMPACT OF LECTURER-STUDENT RAPPORT ON STUDENT LEARNING

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Interpersonal rapport between the lecturer and the student plays a vital role in the teaching-learning process. This study investigated the effect of lecturer-student rapport on student learning. It examined how lecturer-student rapport and immediacy affect students' attitudes towards the instructor, the course, student motivation, and perceived learning. Data were collected from a convenient sample of 159 medical undergraduates. Participants completed self-report measures on lecturer-student rapport, immediacy, students' attitudes toward the instructor and the course, student motivation and their perceptions of learning. Results revealed that lecturer-student rapport significantly predicted students' attitude toward the course and the instructor, their motivation, and their perceptions of learning for the entire sample. Similarly, lecturer-student rapport significantly predicted students' attitudes toward their course and the instructor, student motivation and their perceptions of learning for groups 1 and 2. Lecturer-student rapport significantly predicted positive attitudes toward their instructor, student motivation and their perceptions of learning except students' attitudes toward the course in group 3. These results suggest that lecturer-student rapport is a significant factor in effective learning.

Keywords: lecturer-student rapport, immediacy, student motivation, student learning

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IDENTIFYING ISSUES IN IMPLEMENTATION OF SUGGESTED ACTIVITIES OF SCHOOL BASED TEACHER DEVELOPMENT (SBTD) PROGRAMME

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This research has been conducted to find out the success rate of the SBTD programme and to identify the issues in the implementation of activities suggested by the Ministry of Education under SBTD. Moreover, this study aimed at identifying the guidelines for the effective implementation of the SBTD programme in Sri Lankan schools. The research sample consisted of ten school principals and twenty teachers of the Borella Education Division in the Colombo Education Zone in the Western Province of Sri Lanka. Ten structured interviews were held with principals of different types of schools and the responses to questionnaires were obtained from 20 teachers of 4 schools in the Borella Education Division. Data collected through the questionnaire for the teachers and interviews for the principals was analyzed separately. The overall success rate of the SBTD programme was about 80%. Most of the suggested activities were implemented at a satisfactory level in the schools. Preparation and usage of teaching-learning materials was implemented successfully and peer coaching was the least successful activity. From the analysis, several issues were identified as contextual barriers that prevented schools from effective implementation of SBTD. Such contextual barriers were the lack of time for SBTD, lack of resources, teachers' inability to devote time during weekends and the negative attitudes of the teachers. In addition to this, lack of direct links between MOE and schools was also a barrier for the smooth flow of information. Based on the analysis and findings, guidelines that are useful for teachers, principals and officials of Zonal, Provincial and Ministry level were identified.

Keywords: SBTD, Teacher Development, Guidelines for SBTD, Barriers for SBTD.

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EFFECTIVENESS OF TEACHER CENTERS ON TEACHERS' CONTINUOUS PROFESSIONAL DEVELOPMENT

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This study tries to identify how far Teachers' Centres (TCs) effectively contribute to the Continuous Professional Development (CPD) of teachers. Quantitative and qualitative research approaches were used in this study within a framework of a survey research design. The main objective of the study was to evaluate the effectiveness of Teacher Centers' activities on teachers' CPD. The teachers who follow the Master of Education programme conducted by the Faculty of Education of The Open University of Sri Lanka were selected as a sample. Out of the 98 teachers registered, 70 teachers physically attending the Day School representing various districts of Sri Lanka, on the day the researcher visited were selected as a convenient sample. Primary data for this study was collected through a questionnaire. The questionnaire was of the structured type and focused on collecting data on four identified key areas: (1) training opportunities organized by the TCs for teachers CPD (2) identify teachers' expectations from TCs for their CPD (3) teachers' perceptions on the services rendered by TCs in relation to their CPD (4) Teachers' suggestions to improve the effectiveness of the Teacher Centers. All seventy (70) respondents are graduate teachers and they have completed their initial teacher education programme for their professional development. Of the 70 respondents 82.9 % of the teachers mentioned that TCs are not functioning effectively. Findings revealed that TCs are not functioning in an effective way in relation to teachers' CPD and that they do not effectively organize the workshops for teachers' CPD. But teachers have high expectations from TCs to develop their professional competencies to meet the demand of the modern professional world. Further, Tamil medium teachers expect that TCs should conduct the workshops in their mother tongue and enable them to obtain a clear understanding and also derive the maximum benefits from the training. Overall, the analysis appears to suggest that teachers have various expectations from TCs for their CPD. Therefore, Ministry of Education and other relevant authorities involved in policy making and educational decision making have to consider the importance of the effective functioning of the TCs and have to take necessary measures to monitor the effectiveness of the TCs.

Keywords: Teachers' Centres, Continuous Professional Development and Teacher Development.

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STRENGTHENING OF FORMAL EDUCATION FOR SUSTAINABLE DEVELOPMENT OF SRI LANKA THROUGH NON-FORMAL EDUCATIONAL PROGRAMS AND ACTIVITIES

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Education is one of the important determinants of economic performance. Sri Lanka enjoys a remarkable status, in terms of basic education indicators. However, the present education system faces several major challenges. One of the methods to overcome these challenges in formal education is to use non-formal educational programs and activities. Using non-formal educational activities in parallel with the formal education system will accelerate the achievement of sustainable development goals in the education sector in Sri Lanka.

Various methods have become popular in recent years in order to endow individuals with sustainable development in education. One of these methods is field tours to science institutes. Throughout the world, and for many decades, science institutions such as Science Centers, Museums, Planetariums, and Zoological gardens have collaborated with schools to provide professional development support for teachers as well as students. These tours open a new window for teachers and students of the school for conceptual understanding in Science and Technology.

Many school managements promote visits to the Arthur C Clarke Institute for Modern Technologies (ACCIMT) and this paper discusses the adaptation of effective steps which have been practiced from 2015, to improve the non-formal educational programs which cater to visitors in the field of Modern Science and Technology providing hands-on experience. Visitors are basically from three groups which are primary and secondary school children, science teachers, and visitors representing the military. Solar observations through the telescope with different filters and demonstration sessions using the largest telescope in Sri Lanka which has a 45 cm mirror size is the most attractive practical session for the visitors. The lecture materials of the introductory session of the program are based on government textbooks and new techniques and future trends given in reputed websites, media reports, information brochures etc. The flow of the lecture materials and presentations are initiated from known theories in the classroom and finally focus on the future trends and developments in the world. The program has revised continuously from 2015 based on analysis of gathered questionnaire, interviews and feedback from educational specialists, school teacher and students. Rapid improvement of the number of visitors to the ACCIMT in 2017 indicates the success of the adapted steps taken to improve the non-formal activities from 2015.

Apart from this program, the annual donation of a reflector type telescope to the school program from our own financial support was initiated in order to enhance the non-formal activities. This will give the opportunity to share with other colleges who have gained through hands-on experience during our programs. The first program was conducted at the Piliyandala Central College, in commemoration of Sir Arthur C Clarke's death anniversary on 19th March 2018.

Keywords: Formal education, Non-formal education, Field visit and Sustainable development

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EXPLORING THE EFFECTS OF EMOTIONAL INTELLIGENCE AND RESILIENCE ON TRAUMA COPING AMONG UNIVERSITY STUDENTS IN GERMANY AND SRI LANKA

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Exposure to natural or human-made disasters is associated with long-term health consequences including mental health issues. Trauma can be considered as the severe mental health outcome of such kinds of disasters. University students as an academic population can also be exposed to different types of disasters. However, most students tend to remain within the academic society due to their coping capacities. It is possible that some students who are suffering from trauma may not have been identified and that some may even have healed due to individual resilience. This study investigates samples of German and Sri Lankan university students (N = 356) to identify the relationship between emotional intelligence and its impact upon trauma comparing with resilience capacities. A purposeful sampling method was used for data collection. Independent sample t-test and hierarchical multiple regression analysis demonstrated that German students and Sri Lankan students used different levels of resilience capacity and emotional intelligence for trauma coping.

Keywords: trauma, emotional intelligence, resilience, approach coping, avoidance coping

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COMMON PROBLEMS IN PROPOSAL WRITING: EXPERIENCES OF MASTER OF EDUCATION STUDENTS

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Educational research is a critical, reflective and professional-oriented activity aimed at improving professional practice. It has a wide scope, ranging from the psychological, philosophical, sociological, economic, and political foundations of education to its application at the classroom level. No matter how big or how small a research is, it must delineate a significant contribution to existing knowledge. The research proposal is the first and the most important step in conducting a research study. It is a formal written plan which communicates ideas about a proposed study in order to obtain approval to conduct the study or to seek funding. The goal of a research proposal is to present and justify a research idea you have and to present the practical ways in which you think this research should be conducted. Further, the proposal offers a justification for the study, indicating why the research is worth doing and how it will be carried out.

Writing a research proposal prior to conducting a research study is an integral part of any post graduate study programme. The Department of Secondary and Tertiary Education, OUSL provides opportunities for teachers, principals, teacher educators and officers of education, through the conduct of a Master of Education programme, to earn a post-graduate qualification and to develop self-confidence towards designing, conducting and compiling research in their own fields.

The overall objective of this study was to investigate the critical problems faced by students in the M.Ed programme in writing and presenting their research proposals in order to strengthen the strategies adopted by the department to facilitate the process. Further, it aimed to explore the research areas and designs selected for research studies by the students, limitations in identifying a researchable problem and research design, formulating objectives, finding gaps in the literature and problems in compiling information pertaining to the background, rationale and significance of the research problems and designing methodology of the study. The sample of the study consisted forty eight students following the Master of Education programme in the Sinhala medium. Both quantitative and qualitative methods were applied for data collection and data analysis of the study.

Overall, there were good proposals submitted by the students though several problems emerged from the analysis of proposals and presentations. Lack of clarity in the overall titles/problems, the vague terms used in the research titles/problems, limited relevance of objectives to the title, objectives moving beyond the scope of the title and poorly worded objectives, limitations in the background of the study and literature reviews, incorrect explanations on

population, sample and sampling design and inadequacies in stating the limitations of the study were identified as problems related to the research proposals.

As recommendations, it is suggested that continuous meetings with the supervisors should take place prior to finalization of the proposals of the research studies. Further, hands-on-experience should be given during day school sessions related to the issues emerging from the study. Students should be thoroughly advised not to change their problems/research areas after receiving constructive feedback for their third assignment.

Keywords: Proposal Writing, Research Problem, Limitations of the Study

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PERCEPTIONS OF NEWLY RECRUITED ACADEMICS IN STATE UNIVERSITIES ON 'QUALITY' TEACHING AND TEACHERS.

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The importance of quality teaching has emerged as a key requirement of higher education due to the dynamic changes taking place in the education context such as geographic and social expansion and diversification, and it has led to the invention of new teaching methods. Education has undergone many changes over time and it can be observed that teaching is becoming more learner-centred. People have different perceptions of quality in teaching and teachers. They have been addressed and defined by many researchers but, there have not been many attempts to assess perceptions about quality teaching and also teachers in the Sri Lankan higher education sector. Thus, the main objectives of this study were to identify the required knowledge, skills/abilities and attitudes to become a quality teacher and to seek the perceptions on quality teaching from newly recruited teachers. This has been done based on the perceptions of twenty-four newly recruited academics from four different universities. According to the findings from this study, the quality of a teacher does not only depend on education qualifications. Rather many other aspects like an updated and deep knowledge, experience, understanding of different learning and teaching styles and their usage (pedagogies) and communication skills also play a role. They should possess qualities like willingness to help, being kind, friendly and the capacity to inspire students. On the other hand, quality teaching is mainly about teaching in a manner which is understood by all students of all competency levels. Doing research is also seen as a part of quality teaching. Moreover, it is believed that assignments and examinations cannot be considered as an effective measure in evaluating the quality of teaching. However, peer–review is believed to be an effective criterion. However, there are also factors that hinder quality teaching. These perceptions of newly recruited academics can be very useful in order to alter and further develop the idea of quality in terms of teachers and teaching. On the other hand, researchers can further develop this study by conducting a comparative analysis of perceptions using permanent and senior academics from other universities as participants.

Keywords: Quality, Teaching, Teacher, Academics, Perceptions

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THE POTENTIAL OF *POWERPOINT* IN ADDRESSING TECHNOLOGICAL PEDAGOGICAL KNOWLEDGE TO SUPPORT STUDENT-CENTERED LEARNING

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The Technological Pedagogical Content Knowledge (TPACK) framework which provides useful guidance for teachers to become effective ICT integrators describes how three broad knowledge bases – knowledge of technology (TK), pedagogy (PK) and content (CK), interact to create several forms of new knowledge (Mishra & Koehler, 2006). Among these, Technological Pedagogical Knowledge (TPK) is referred to as the relevant technical knowledge required to implement instructional designs, or an understanding of how teaching and learning can change when particular technologies are used in particular ways. This study was concerned with the TPK required by teachers to implement their instructional designs in ICT-based student-centered learning and the potential of PowerPoint in this regard. The study adopted a mixed-mode research design based on qualitative and quantitative approaches. A purposive selection of 30 teachers were the participants of the study. Using Visual Basic programming facility embedded in PowerPoint, an authoring tool termed Instructional Management Unit (IMU) was created to address TPK. Herein, interactivity was extended by creating slides with sample activities. The teachers had to duplicate a slide and replace sample questions (text and multimedia) with their own material, but it did not eliminate their freedom to be innovative within the given sample activities to implement their own instructional strategies. IMU eliminated the need for programming knowledge, which is a part of TK. It has been found that handling multimedia as TK and how to implement instructional designs using ICT as TPK were the teachers' requirements. An intervention was performed conducting a training programme using IMU as the authoring tool. The effect of IMU on teachers in the development of ICT based student-centered material was evaluated via observations, perceptions and evaluation schemes during and after the intervention. It was found that the PowerPoint-based authoring tool IMU was successful in addressing TPK of the teachers to support student-centered learning.

Keywords: Technological Pedagogical Knowledge, Student-centered learning, ICT in instruction

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ADDRESSING THE NEEDS OF STUDENTS WITH SPECIAL EDUCATIONAL NEEDS THROUGH LESSON PLANNING

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This small-scale study explored how teachers used lesson planning to address the needs of students with special educational needs in an inclusive setting. The main research question of the study was, do teachers identify the special educational needs of students and how do they adapt lesson planning to suit the needs of these students. The purposive sampling method was used in this study to access 250 lesson plans of 50 student teachers. A document review was the main data collection method. It was found that all teachers had identified the student with special educational needs in their classrooms and that the majority of them were slow learners. The teacher used a variety of accommodation and modification strategies which had been mentioned in the lesson plan. The use of accommodation and modification strategies depended on the nature of the students and their needs. It can be suggested that a more comprehensive lesson plan preparation programme be introduced which would enable the teachers to use a wide range of accommodation and modification strategies in planning lessons.

Keywords**:** special educational needs and Lesson Plan

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AN ANALYSIS OF CLASSROOM TEACHING IN BILINGUAL EDUCATION IN SRI LANKA

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The Bilingual Education Programme (BEP) was initiated in the general education system in Sri Lanka in 2001. From the Science stream in G.C.E. (A/L) classes it was brought to grade 6 in 2002, not under the term "Bilingual education" but with different labels such as "Teaching selected subjects in English medium", "Amity Schools Project" etc. BEP is optional from grade 6 onwards for both Sinhala and Tamil medium students to learn selected subjects in the secondary curriculum in English. In the Sri Lankan programme, Content and Language Integrated Learning (CLIL) is used as the teaching methodology under the umbrella term of Bilingual Education (BE). The key concept in CLIL is 'integration' between the subject content and the target language. Therefore, it should be explored through a magnifying lens of high power to identify the interwoven relationships and internal connections between content and language. A 'triptych approach (language of, for and through learning)' in relation to the component 'communication' of the 4Cs framework provides a foundation to discuss the role of the language, interconnecting it to the content and cognition. To understand how learning happens in a BE classroom these three components play an important role. Hence, the BE teacher should be conscious of language production as well as concept development in the classroom, creating opportunities for learner interaction through dialogic approaches. Hence, the objective of this study was to identify the actual teaching learning process in a BE classroom as an attempt to gather insights for designing a broader future research project.

This study is twofold: a qualitative study; a case study to understand the prevailing situation in the BE classroom and document analysis of (TGs), syllabi and textbook of grade 7 and 11 (hereafter referred as curriculum materials) and to analyze the relevant content. Three Mathematics teachers (MT1, MT2 and MT3) and one citizenship Education teacher (CE1) in two National schools and one provincial school of type 1AB in the Western Province were observed in the case study. One lesson of each teacher was observed. Data recording was done in a transcript mode and coding was used for analysis. In all the observations, the researcher remained a passive observer. Two teachers had participated in BE training and only one teacher had heard about the term CLIL. None of the teachers had sufficient knowledge of BE and any knowledge or know how of CLIL. All of them, despite their subjects were conscious of content teaching only and had no idea about the role of language in concept building and meaningful learning. They used a very limited vocabulary mostly based on the textbook. Though they used code mixing (rarely code switching) they used it without any

understanding and not with the intention of developing meaningful learning in the BE classroom.

Mostly, discourse was one way, i.e., from the teacher to the students. Opportunities were very limited for student interaction among peers as well as with the teacher. It was limited to one- or two-word short answers as a response to teacher questions. It is obvious that language of learning (CALP/Cognitive Academic Language Proficiency) and language through learning (CDF/ Cognitive Discourse Functions) do not happen either in L1 and L2. Therefore, content and language integration to develop cognition cannot be seen in the classrooms. The teachers did not promote the second language (L2) even in the language for learning (BICS/ Basic Interpersonal Communication Skills) mode. Support which is expected to be provided by the curriculum materials to harmonize this situation is not at a sufficient level and they are also a mere translation of the Sinhala Medium materials and has not taken into consideration the integration of content and language. This study reveals that the teaching process observed in BE classrooms does not consider the integration of content and language under the umbrella term of BE. Therefore, BE classrooms are mirror images of monolingual medium (ME) classrooms where L1 and L2 are used without proper understanding of their power in concept building and developing metacognitive skills. The relevant curriculum materials are also prepared within a monolingual perspective and cannot be used by teachers as well as students to get more insights into the bridging of thinking and learning with the language.

Keywords: CLIL, language tryptic, cognitive discourse functions, cognition, dialogic

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EFFECTIVENESS OF THE USE OF TECHNOLOGY IN THE SECOND LANGUAGE CLASSROOM: A STUDY BASED IN THE UNIVERSITY OF KELANIYA

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Modernization has introduced many technological aids into classrooms. Thus, Blackboard/Whiteboard and paper oriented teaching and learning methods have become outdated. Present classrooms are equipped with a number of modern technological aids such as computers, projectors, speakers, interactive white boards, audio players, mobile phones and tabs, to make teaching and learning more effective. Second Language classrooms are especially technologically equipped, to make students more familiar with the pronunciation, culture and the background of the target language. However, still, in Sri Lankan in second language classrooms, the usage of technology is at a minimum level compared to other countries in the world. Thus, with the aim of familiarizing technology in language classrooms in the Sri Lankan context, the research study tries to investigate how effective the use of technology is in a second language classroom. Two Language Classrooms from the Faculty of Humanities of the University of Kelaniya were selected for the research study. The two selected language classrooms are from the Department of English Language Teaching and the French Unit of the Department of Modern Languages. The two teachers from the respective classrooms were interviewed while the students were given a questionnaire to collect data regarding the effectiveness of technology usage in the language classroom. The collected data from interviews and questionnaires was analyzed using statistical analysis and thematic network analysis. According to the findings the use of technology in the second language classrooms can be considered to improve the effectiveness of teaching and learning. Further the study reveals that the use of technology makes second language learners participate in lessons and there is evidence that their language acquisition increases.

Keywords: Modernization, technology, technological aids, Language classrooms, effectiveness

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ACHIEVEMENT LEVELS OF GRADE THREE SRI LANKAN PRIMARY SCHOOL STUDENTS IN FIRST LANGUAGE AND MATHEMATICS

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The present primary education system in Sri Lanka introduced under the Education Reforms of 1972 was implemented with modifications over the years. The primary school curriculum in Sri Lanka is considered well planned and structured and many of its features are on par with world accepted primary school curricula. This study is focused on the learning achievement of Grade 3 students and attempts to assess the level of students' achievements in relation to the subject competencies of First Language and Mathematics at Grade 3. The research design was a survey. The sample was selected using the random sampling method, in mixed schools. A total number of 10,140 students were included in the target students' sample. The sample was selected from 507 schools from all 9 provinces, representing 25 districts as well as the 92 educational zones in the country. The quantitative method was applied to analyze the achievement levels of Grade 3 students in selected competencies of the First Language and Mathematics and to find out their levels of achievement at Grade 3. Data were analyzed using SPSS on a national, provincial, and district basis. Quantitative techniques were used for analysis of students' achievement and qualitative techniques were used to analyze the data obtained from teachers and ISA's interviews. Achievement levels of the students were measured using a written and practical test in the First Language (Sinhala/Tamil) and Mathematical competencies were measured using a written test.

The findings showed the existence of gaps in expected and achieved levels of students at Grade 3. In Mathematics, attention should be focused on the aspect of number especially in the districts in Central and Northern Provinces and the aspect of Money, especially in the Central, Eastern and North-Western Provinces, in considering the percentages that have given correct answers. Performance of male and female students varied across provinces and districts in the areas evaluated in Mathematics. In the Sinhala Language, female percentages were higher generally except in Comprehension and Listening and in Vocabulary, Grammar and Listening in certain provinces. In the Tamil language, it is significant that in the total sample in all the areas tested higher percentages of female students have given correct answers for the questions and that the mean scores of female students are higher than that of males in the total sample. Thus the gaps appear to exist in the performance of male students.

Keywords: Primary education, Education Reforms, Achievement level, Competencies

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ENGINEERING & TECHNOLOGY

THE DESIGN OF AN IMPROVED INDOOR POSITIONING ALGORITHM WITH NEIGHBOUR FUSION

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The estimation of the position of a mobile device is known as mobile positioning/localisation. Mobile positioning has attracted considerable research interest in recent times, with a wide array of applications using the obtained position estimates. Among the multiple techniques used for mobile positioning, geometry-based positioning and database correlation-based positioning are very popular. Together with the global positioning system (GPS)-based localisation, cellular mobile systems-based positioning can produce high accuracies. However, GPS-based positioning lacks much-needed indoor coverage while cellular mobile-based positioning suffers from severe fading in indoor environments. Thus, in indoor positioning, fine-tuning techniques are used to attain high accuracies. Temporal correlation is widely explored in improving the positioning accuracy. However, with new technologies, such as fifth generation (5G) cellular mobile systems or the latest wireless sensor networks, mobile device to device (D2D) communication is possible. Together with the relaying function that is provided, D2D communication produces redundant information on location estimates. Note that with D2D communication, the location of a device/node in a network can be estimated with respect to many other nodes communicating with the considered node. Thus, these multiple estimates can harness the diversity of information that is available to produce a more accurate estimate. This technique can be viewed as a utilisation of space correlations of nodes in the network, as the position is estimated with respect to many distributed nodes communicating via differently faded channels.

In this research, we proposed a technique to harness the space correlation in multiple estimates. We took multiple estimates and averaged the readings initially. The motivation behind this scheme was that the estimation errors are observed to be Gausian distributed with zero mean and hence, an averaging of results in an error cancellation. However, a serious drawback of this scheme is that it does not consider the differences of variance in different estimates. It is worth noting that the estimates with respect to nodes that are far away, and usually associated with poor quality signals, are distributed with higher variances than that of closer nodes. Thus, by weighted averaging of estimates, a better accuracy can be attained. For three location estimates for a node given by (x_i, y_i), (x_{i+1}, y_{i+1}) and (x_{i+2}, y_{i+2}), the fine-tuned estimate $(x_{\text{fin}}, y_{\text{fin}})$ is given by,

$$x_{\text{fin}} = \frac{w_1 x_i + w_2 x_{i+1} + w_3 x_{i+2}}{w_1 + w_2 + w_3} \quad (1)$$

$$y_{\text{fin}} = \frac{w_1 y_i + w_2 y_{i+1} + w_3 y_{i+2}}{w_1 + w_2 + w_3} \quad (2)$$

where w_1, w_2 and w_3 weights are pre-selected proportional to the received signal strength to minimise localisation error. With unity weighting factors, this scheme converges to a simple averaging scheme. The RMSE was observed and weighted average results will only provide the least RMSE value.

A three raw estimate-based MATLAB simulation demonstrated a higher accuracy in the averaging scheme than in raw estimates. Furthermore, the weighted averaging technique produced even better accuracies and, in average, the fine-tuned estimate happened to be the closest to the actual position. This research only considered estimations in a snapshot of time. Extending the same algorithm to exploit the correlation in time-domain estimates can be expected to produce even better accuracies, which is a possible future research avenue.

Keywords: Indoor positioning, Space correlation, Weighted averaging, Diversity estimates

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PORTLAND COMPOSITE CEMENT AS AN ECONOMICAL SUBSTITUTE FOR ORDINARY PORTLAND CEMENT

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Ordinary Portland Cement (OPC) is manufactured by heating limestone and clay to a very high temperature (1450 ^{0}C) to produce clinker and grinding clinker with gypsum in order to control the rate of the hydration process. The clinker production process emits a very high amount of carbon dioxide (CO_2) to the atmosphere and hence any reduction in the clinker percentage reduces the environmental pollution caused by cement manufacturing process. This can be achieved by mixing cement replacement materials such as limestone, fly ash and slag. Cement thus produced is termed Portland Composite Cement (PCC). Fly ash and slag being waste by products of coal energy and steel manufacturing processes respectively help to recycle the otherwise problematic dumping of those materials.

In this study, 35% of clinker was replaced with a combination of limestone, fly ash and slag mixed in different percentages. Five different mixes of PCC were prepared carefully simulating the cement manufacturing process. All five mixes of PCC were cheaper than OPC. Concrete cubes manufactured using OPC and the five mixes of PCC were prepared and subjected to compressive strength test, slump cone test, slump flow test, concrete density test and water permeability test.

Test results achieved for concrete made with OPC and all five mixes of PCC were acceptable according to the applicable standards. Cube strength results obtained after 28 days were satisfactory for all six mixes but PCC mixes showed a lower strength than OPC. However, they all produced almost the same strength after 90 days indicating a continuous strength gain in PCC mixes after 28 days.

Further, all five mixes of PCC produced high values of initial slump thus making them more suitable for pumping into higher elevations. Slump retention, initial flow and flow retention showed mixed values all within the acceptable ranges. Dry and wet densities of all six mixes were also acceptable. Measured water penetration values for all six mixes were less than the minimum concrete cover (20 mm) recommended in Tables 3.3 & 3.4, BS8110:1997.

Production cost calculated using raw material costs for all five PCC mixes are less than that of OPC making them more financially feasible than OPC. Out of the five different mixes tested, there is no overall best performer in every aspect. However, depending on the type of application, one of the five mixes can be

selected to better suit the requirement. Considering the reduction of damage to the environment in producing PCC this study shows that PCC is more financially feasible and environmentally friendly.

Keywords: Cement, OPC, PCC, Clinker

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MANUFACTURE OF CARBOXYMETHYLCELLULOSE USING WHITE WASTE PAPER

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CarboxyMethylCellulose (CMC) is one of the derivatives of cellulose and linear, long chain, water soluble, anionic polysaccharide. CMC is prepared by substitution of MonoChloroacetic Acid (MCA) or its sodium salt (NaMCA) to hydroxyl groups in cellulose Anhydroglucose (AGU) units. The average number of carboxymethyl groups per one AGU group of cellulose is defined as the degree of substitution (Ds). Ds value is a good indicator to identify solubility characteristics. CMC is one of the major ingredients widely used for different applications in food industries. Non-food application of CMC includes its usage in formulations for cleaning products such as detergents and co-binders for paper making, formulation of oil drilling solvents and in some textile and cosmetic industries. The process of preparation of CMC consists mainly of two steps. First step is Mercerization with aqueous sodium hydroxide (NaOH) at room temperature and the second step is etherification with MCA/NaMCA for 3½ hours at 60 ºC to form CMC/NaCMC; sodium glycolate is produced as a by-product. In the industry, CMC is prepared by various methods which include the fluidized bed technique, sheet carboxymethylation, rotating drum technique, solvent-less method using a double screw press and paddle reactor, etc. The present study was focused on the preparation of NaCMC for non-food applications using white waste paper as raw material to extract cellulose. In addition, the main manufacturing unit was designed using a steel rotation drum by adding ceramic balls into the inside of the drum. This technique allows generation of heat from the impact of ceramic balls on the walls of the rotating drum for the Etherification process without further use of an external heat source. Cellulose from white waste paper was extracted by soaking it in 1% w/v NaOH and Hydrogen peroxide (alkaline peroxide pre-treatment) for 8 hours and allowing a few hours to drain the water. It was dried at 60 ºC until the moisture content became 40%. The cellulose percentage was determined using the chlorination method. Sufficient amount of water, 50 kg of cellulose, 10 kg of NaOH and 200 ceramic balls (diameter 5 cm) were added to the rotating drum. The drum was allowed to rotate for 1 hour for Mercerization. 22 kg of NaMCA was added to the drum and it was once again rotated for 3½ hours for the process of etherification. Temperatures were measured at the end of these two processes using a digital thermos-sensor. Fourier Transform Infrared (FTIR) spectroscopy was used to confirm that the developed product is NaCMC. IS3520 methods were used to determine the Ds and active matter content of the developed product. Furthermore, water solubility in tap water and colour of developed product were observed. The result of the chlorination method indicated that the cellulose sample extracted from white waste paper contained 77% cellulose. The results of FTIR analysis confirmed that carboxyl groups were substituted onto the cellulose

backbone when carboxymethylation reaction occurred and NaCMC was produced. The average Ds value was 0.49 and it was in the recommended range of 0.4 to 1.5 which is used in the export market. The average temperatures at the end of Mercerization and Etherification process were 41 ^{o}C and 74 ^{o}C respectively inside the rotating drum. The active matter content and water solubility were 58.5% and 68.2% respectively and it was of whitish to ash in colour. The results of the present study concluded that white waste paper could be used as a raw material for processing of NaCMC. The addition of ceramic balls into the rotating steel drum eliminates the use of an external heat source required for etherification to produce NaCMC. The characteristics of the developed NaCMC are suitable for use in industries with non-food applications.

Keywords**:** CarboxyMethylCellulose, White waste paper, Impact of ceramic ball

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ROAD TRAFFIC VIOLATION MONITORING SYSTEM TO INCREASE LAW-ABIDING CITIZENS IN SRI LANKA

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Sri Lankan society still has traditional social attitudes rooted in it. At the same time, most of the rules and regulations are not internalized by our citizens. This proposed system addresses a requirement of our society pertaining to road traffic violations. The increase of vehicles and traffic increases road traffic violations. In Sri Lanka, there is no effective system to monitor road traffic violations due to the lack of human resources and funding for the development of such a system. The Sri Lankan Police takes various actions to reduce road traffic violations. But, it is very difficult for them to cover the whole road system to track road traffic violators. Therefore, drivers (citizens) are able to violate road traffic regulations indiscriminately. Such behaviour increases road accidents, deaths and injuries to pedestrians and motorists.

Hence, the relevant authorities require a system to monitor road traffic violations to identify law breaking citizens and to take necessary legal action against them. To overcome this issue, the Road Traffic Violation Monitoring System (RTVMS) has proposed the theme "**Good Citizens to Action".** It will reduce road traffic violations and increase the practice of being law-abiding citizens. This system is cost effective and volunteer man power will play a vital role. Further, the road traffic rules and regulations should be updated in order to derive the maximum benefits of this system for the betterment of the society.

*K*eywords: Road Traffic Violations System, RTVMS, citizens

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A STUDY TO INVESTIGATE THE EFFECT OF FABRIC DUST ON THE HEALTH OF WORKERS IN THE CUTTING AND SEWING DEPARTMENTS OF A SELECTED GARMENT FACTORY IN SRI LANKA- A CASE STUDY

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Fabric is the main raw material used in garments. During the fabric manufacturing process various types of chemicals are used. Some chemicals are used to produce fibers and some are used in subsequent processes like bleaching, scouring, finishing, coloration, etc. As per the previous research studies done in other countries, the workers in garment manufacturing organizations are exposed to airborne natural fiber particles as well as synthetic fiber particles, which are present in the working environment. Some of these particles are harmful to the health of the workers. Though garment manufacturing is the biggest manufacturing industry in Sri Lanka for the last few decades, little research has been carried out so far to evaluate the quality of the working environments inside these manufacturing organizations. The main objective of the research was to find out the presence of fabric dust and its impact on the health of the workers in the cutting and sewing departments of a selected garment factory.

At the initial stage of the research, a questionnaire was designed to check how the workers in the cutting and sewing departments felt about the presence of fabric dust in the working environment and how they felt about its effects on their health. For the survey, 80 out of 800 and 20 out of 100 workers were selected from the sewing and cutting departments respectively. The random sampling technique was used for the selection of workers. To find out the effect of fabric dust on the health of the workers, dust samples were collected at various locations of the cutting and sewing departments for testing purposes. They were examined using the X-Ray Florescence (XRF) technique, Fourier Transform Infrared (FTIR) Spectroscopy, Particle size analysis and Microbiological analysis. As per the results of the questionnaire survey, seventy-one (71%) percent of the workers who participated in the survey believed that the fabric dust in the working area is a problem and it influences their health. According to the XRF results, Z, K, Ca, Ti, Fe and Zn were present in the tested dust samples. As Zn could have been a coordinating material in textile chemical processing, it can be considered a significant factor in the health of the workers. As per results of the Fourier Transform Infrared (FTIR) Spectroscopic analysis, functional groups C=O, C=C, C=N, C-C, C-N or C-O are present in the dust samples. These findings could be used to establish the molecular structure of chemical compounds in the tested dust samples. As per the results of the particle size analysis, the particle sizes ranged from 200 nm to 600 nm (0.2 μm to 0.6 μm). This range belongs to the category of small particles (less than 1 μm). The range also belongs to the category of respirable dust (less than 5 μm). They can also penetrate deep into the lungs, therefore they are generally hazardous to human

health. As per the results of the Microbiological analysis, the concentration of the Aerobic colony and mould counts were also very high. These could be harmful to the workers. With the results of this research, it can be concluded that the fabric dust in the selected garment manufacturing organization has an impact on the health of the workers. Further studies should be carried out to better identify the relationship between fabric dust and the health of the workers.

Keywords: Fabric dust, Particle size, Microbial analysis, Aerobic colony count, mould count

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DESIGN OF AN AUTOMATIC SATELLITE TRACKING SYSTEM

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This research proposes an automatic satellite tracking system that tracks the target satellites by automatically positioning the satellite dish. A major aspect of the research is to develop a low cost and highly effective product for automatically positioning the satellite dish to the target satellite to receive the peak satellite signal as receiving the maximum signal strength from the satellite is useful. This research is mainly focused on digital television transmission and very small aperture terminals (VSAT). The proposed system will track geographically synchronized satellites.

The system is designed with a Satellite Dish Control Unit (SDCU), a Signal Detection Tuner Unit (SDTU), Raspberry Pi (RPI), DC motors, motor control circuits and display units. The SDCU unit consists of a Satellite Position Finder Unit (SPFU) and a Motor Control Unit (MCU). The dish antenna attached to the motors rotates either in the clockwise or counter-clockwise direction. Tracking is carried out according to the satellite signal reception. Angle and azimuth is calculated based on the location (longitude and latitude). To satisfy these parameters, the system will drive the actuators. Once the above parameters are satisfied, the system will be able to track a verified satellite searching known frequencies.

In order to track the satellite of interest, the mechanical and electrical sub systems provide the physical capability while the software provides easy and accurate pointing as well as safe operation. In the basic method of satellite finding, the satellite receiver should know the required satellite signal information. Satellite signal information consists of transponder frequency, symbol rate, forward error correction (FEC) ratio and polarity of the signal. Selected satellite search parameters should be fed to the receiver. The system will calculate the approximate azimuth angle and elevation to the respective satellite from the current position. The RPI will enable the general purpose input and output (GPIO) pins according to the calculated data. Motors drive the satellite dish to point to the respective satellite.

When the tuner receives the correct signal, automatic gain control (AGC) voltage will be increased proportionate to the reception signal. Thus, we need to measure the peak AGC voltage location of the signal. This measured voltage will be converted into a digital value and the digital value will be an input to the RPI. The display unit provides information regarding satellite signals (strength, quality), motor position, and LNBF skew position and detects satellite information. The information which was provided by the sensors and tuner are captured in the RPI as the main control mechanism.

We have designed a prototype system and tested it successfully by tracking two satellites (ABS2, and NSS6/ 95E). We were able to successfully find and tune the satellite dish based on received signal strength using a specific servo motor mechanism and an actuator system. The system successfully found the geographically synchronized satellites by receiving maximum signals from the target satellite. The proposed system finds known satellites easily by capturing peak signals (signal strength 85-95%). The system carries out automated calibration. Therefore, no calibration after maintenance and human intervention are necessary for satellite finding. The system also satisfies the requirements of simplicity and low cost.

Keywords: Satellite tracking, AGC Voltage, Raspberry Pi (RPI), GPIO, Servomechanism

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NONINVASIVE AUTOMATED SYSTEM FOR IDENTIFICATION OF DIABETIC PATIENTS

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Diabetes has become one of the main health issues that people are facing due to changing life styles, eating habits and level of stress encountered each day. According to the year 2016, statistics of the World Health Organization 8.5% of the adult population of the world are suffering from Diabetes. In Sri Lanka as well, 8.5% of the adult population is suffering from diabetes according to year 2015 International Diabetes Federation reports and these numbers are on the rise. Diabetes causes many health issues with damage to blood vessels of the heart, brain, legs, eyes, kidneys and the nervous system, etc. In addition, Diabetes is one of the major causes of blindness and kidney failure as well. According to the year 2016 report of the world Health organization, 7% of total deaths in all age categories in Sri Lanka were due to Diabetes and related complications.

Diabetes can be successfully identified through present day medical tests such as checking blood pressure, random/fasting blood sugar tests and oral glucose tolerance test etc., after the disease reaches a certain level of maturity. At this stage management of the disease is a tedious life long process and it is often incurable. Therefore, early detection of Diabetes is one of the most sought after health requirements at present.

This paper explores a medical imaging method for the identification of Diabetes by analyzing the iris of the human eye related to the pancreas of the human body. The iris is the greenish-brown-yellow area surrounding the transparent pupil of the human eye. Since human eyes have the highest connection with the central nervous system compared to other organs of the body any changes in the organs of the body are clearly reflected in the iris. The Pancreas generates insulin and if this insulin is not properly utilized by the body it leads to Type 2 Diabetes.

The proposed method transforms an image of the iris into a new representation using image processing algorithms and analyses changes in patterns like colour pattern changes and broken tissues in the region of the iris corresponding to the pancreas. The obtained results are then compared with the iris chart and can make a diagnosis as to whether a patient has diabetes or not. The Regions of Interest (ROI) related to pancreas are on the position of 01:45 – 02:15 for the right eye and 07:15-7:45 for the left eye.

Localization of the boundaries of the iris will be done by active contour approach. Normalization will be done to transform the iris region into fixed dimensions. The center of the pupil will be considered as the reference point.

Image enhancement will be done to improve the clarity of the segmented iris and after that the corresponding features will be extracted. The classification will be done with the neural networks with back propagation. In the mean time for comparison purposes support vector machines too will be applied for classification.

Since there are no localized image databases in Sri Lankan context, it is planned to freshly collect a set of iris images of patients with and without diabetes because the colour of the iris of Sri Lankans varies from that of western people. Until the equipment are purchased, the proposed methodology will be tested with the UBIRIS free database.

Keywords: Diabetic, Feature extraction, Iris, Segmentation, alternative medicine, Artificial Neural Networks, Support Vector Machine, Computer Vision, Image Processing, Iridology

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NEW TECHNIQUE FOR OBSERVING SLOW TRANSIENTS ON CATHODE RAY OSCILLOSCOPE

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Electronic circuit testing is one of the most important areas in electronics design and fault diagnosis. Among the widely used testing methods, signal analysis using the oscilloscope is the major technique for time and frequency related circuitry. The two types of oscilloscopes available have different features. Since the analog oscilloscope display works as a continuous sweep tracing of a waveform, it cannot trace transient conditions in signals. A stable waveform plot in the screen requires a steady waveform. Therefore, transient signals cannot be monitored with regular analog oscilloscopes. The digital counterpart has the ability to record waveform data and plot them at a later time. Therefore, transient signals can be monitored only with expensive digital oscilloscopes. In this research, a new concept is introduced to display the aforementioned transient signals on analog oscilloscope which can be produced at a lower cost. The proposed system can record waveform data external to the oscilloscope and re-generate a waveform with the same shape of the transient signal repeating continuously. Since the same cycle is repeating, the analog oscilloscope can display it as a regular repeating waveform; in fact, the shape of one cycle is similar in shape with the transient signal. The designed system is an intermediate device connected between the test probe and the oscilloscope. Data is acquired via an analog to digital converter and stored in a memory. After the acquisition, the data is processed and sent to digital to analog converter sequentially. The same data set is repeated to obtain the signal. The new device has been tested with resistor – capacitor and resistor – inductor, first order circuit excitations, to plot the transient waveform of voltage variation. The results show that, the system can be used with circuit testing and further improvements to data acquisition rate and storage memory expansion can develop the system to be used with complex signals such as those in motor drives and inverters.

Keywords: Slow-transients, oscilloscope, signal analysis

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HEALTH SCIENCES

VIEWPOINTS OF MOTHERS WITH GESTATIONAL DIABETES MELLITUS REGARDING A POSTPARTUM LIFESTYLE INTERVENTION TO ATTENUATE THE DEVELOPMENT OF TYPE 2 DIABETES MELLITUS: A QUALITATIVE STUDY

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Gestational Diabetes Mellitus (GDM) is a challenging health issue. Women with a history of GDM have a high risk of developing Type 2 diabetes mellitus (T2DM), metabolic syndrome and recurrent GDM in their future life. Lifestyle interventions are known to attenuate the progression of GDM to T2DM and the feasibility of the programme is important to get maximum benefits. Women who have undergone a lifestyle intervention programme are considered the best to discuss the feasibility of a programme. Therefore, the aim of this study was to explore the views of mothers with GDM about a dietary and exercise intervention they have undergone during the postpartum period.

This qualitative phenomenological study was carried out in selected Medical Offices of Health areas in Gampaha, Colombo and Galle districts. Postpartum mothers with a history of GDM who have undergone a comprehensive, supervised life style intervention program for one year were recruited for this study. Focus group discussions were carried out till the data saturation point was achieved. Framework analysis was used for analysis of data.

A total of 45 mothers participated in focus group discussions. Mean age ±SD of the participants was 31.2±4.7 years. About half of the sample (58%) were educated up to GCE Ordinary Level (O/L). A majority (68%) of the participants' average monthly income ranged between 20,000.00 and 50,000.00 LKR. Sixteen sub themes emerged under the following four domains: (1) feelings and experiences about the lifestyle intervention programme for postpartum mothers with a history of GDM (2) facilitating factors (3) barriers for implementation (4) suggestions for improvement. The programme was viewed by the mothers as essential, costless and user friendly. Continuous follow up and positive extrinsic motivation were identified as major facilitators whereas negative influence from health care workers and social and environment constraints were identified as major barriers to the success of the programme. Enhancing awareness among health workers and general awareness of the public were suggested as measures for improving its acceptability.

This study concludes that women with a history of GDM need support and continuous follow-up in the postpartum period to assist them to develop self-

management, autonomy, inner motivation and prioritization skills to undergo lifestyle interventions with a view to reduce future complications.

Keywords: Gestational Diabetes, Mellitus, Diabetes Mellitus, view point, postpartum lifestyle, mothers

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EFFECT OF DIFFERENT COOKING METHODS ON ANTIOXIDANT AND ANTIMICROBIAL ACTIVITIES IN SELECTED SPECIES OF MUSHROOMS

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Mankind consumes numerous natural products which are rich in nutrition, antioxidants, and antimicrobials. Most of them go through a cooking process which can alter the natural composition of metabolites. In this research, the effects of two different cooking methods (boiling and microwaving) on the antioxidant and antimicrobial activities of four different types of mushrooms, Makandura White [*Calocybe alpestris*], Bhutan Oyster [*Lentinula edodes*], American Oyster [*Pleurotus ostreatus*] and Button Mushroom [*Agaricus bisporus*] in Sri Lanka were assessed.

This research is to detect the effect or influence of different cooking methods on antioxidants and antimicrobial activities of selected species of mushrooms. Antioxidant activity was measured by Total Flavonoid Content (TFC), Total Phenolic Content (TPC), Total Antioxidant Content (TAC), Ferric Reducing Antioxidant Potential (FRAP) and Free Radical Scavenging Assay (ABTS). Antioxidant composition of the mushrooms was affected after going through culinary treatments. TAC values after cooking were: Makandura White (Raw – 0.041, Boiled – 0.123, Microwaved – 0.170) and Bhutan Oyster (Raw – 0.157, Boiled – 0.157, Microwaved – 0.178). The order is as follows; raw < boiled < microwaved. In the meantime, there was a significant decrease detected in TAC values in Button Mushroom and American Oyster as follows: raw 0.200, microwaved 0.123, boiled 0.107. However, when considering the cooking methods, microwaved extracts had the highest Total Antioxidant Capacity. Microwaved button mushroom extract had the highest scavenging activity percentage (97% after 120 minutes) which was obtained by ABTS. Antimicrobial study was conducted with *S. aureus* and *E coli*.

Microwaved American oyster had the highest inhibition zone against *S. aureus* (1.4 cm) and microwaved Bhutan oyster had the highest inhibition zone against *E coli* (1.4 cm). This can be mainly due to the breakdown of the cell wall and flowing out of the metabolites. This study suggests that among culinary treatments, microwaving is the best method which can preserve the natural antioxidants and antimicrobials which help to cure free radical and microbial related diseases.

Key words: Free radical, Antioxidant, Antimicrobial, Mushrooms, Cooking methods

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PSYCHOSOCIAL AND PHYSIOLOGICAL ADJUSTMENT NEEDS OF MARRIED WOMEN GOING THROUGH THE POSTMENOPAUSAL STAGE IN THE ATHAGAMA MOH AREA IN KALUTARA

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Menopause is a period in the life of women who have experienced cessation of menstruation for one year or more. It can be described as a new phase in their life cycle, characterized by several symptoms due to changed hormonal activity resulting in physiological, psychological and behavioral changes. Therefore, women at this stage need to make suitable adjustments that will enable them cope with the new challenges and achieve their physiological and psychosocial needs successfully. This study was carried out with the aim of finding the psychosocial and physiological adjustment needs of postmenopausal married women in the Athagama MOH area in the Kalutara District.

A quantitative approach and a descriptive design was used on a target population of married menopausal women between 48 to 55 years excluding women with mental illness, cancer patients and women who have undergone major surgeries such as hysterectomy. The data was collected using an interviewer-administered questionnaire consisting of four sections including demographic characteristics, postmenopausal symptoms, physiological needs and psychosocial needs of participants. Data obtained was analyzed using the SPSS software.

Majority of the respondents were found to be unemployed married women in the age of 51 – 55 years with primary education. Most common menopausal symptoms reported in the study are joint pain (80%), back pain (75.5%), hot flushes, (55.5%), muscle pain (50.5%), headache (44.5%) and fatigue (40.5%). Among the psychological needs found, the majority of respondents (95%) are in the need of controlling their anger, 93 % in need of cultivating pleasant dispositions, and 92% in need of obtaining reassurance from fear and worries. In addition, psychological needs such as regaining self-esteem and life satisfaction needed for attending social functions with spouse, having someone to talk to were also found to have a higher percentage. According to the data obtained, the highest important physiological health needs of menopausal women were found to be reduction of joint pain (96%) and back pain (93%) and to have better sleep (81%). In addition, 78.5 % women wanted to avoid fatigue and work normally and 70% of them needed to be free of heat intolerance.

Findings of this study showed that the most pressing psychosocial needs are to have a relaxed mind, to cultivate patience and keep anger at bay, to cultivate pleasant dispositions, to obtain reassurance from fear and worries, to regain self-

esteem and life satisfaction, to attend social functions with spouse, to have someone to talk to and to take a break from their daily routines. Most important physiological health needs of menopausal women included the need to reduce joint and back pain, sleep soundly, avoid fatigue, work normally and be free from heat intolerance. Most common menopausal symptoms reported are joint pain, back pain, hot flushes and muscle pain.

Therefore, individual and group counselling can be recommended for both menopausal women and their husbands for a better understanding that menopause is a natural phenomenon and that there are ways and means of coping with it.

Keywords: Physiological adjustment needs, Psychological adjustment needs, Menopause

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THE EFFECT OF DIFFERENT PROCESSING CONDITIONS ON COCOA BEAN (*Theobroma cacao*) NIBS AND SHELLS: DETERMINATION OF THEIR ANTIOXIDANT AND ANTIMICROBIAL ACTIVITIES

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Interest in polyphenols has increased recently due to the array of possible benefits they offer in regard to human health in relation to cancer treatment and prevention, cardiovascular diseases and other pathologies. This study was carried out to determine the total flavonoid content (TFC), total phenolic content (TPC), total antioxidant content (TAC), scavenging activity (ABTS), Ferric reducing ability (FRAP) and the antimicrobial activity of cocoa bean nibs in comparison to cocoa bean shells in two different processing stages (Roasted and Unroasted) with regards to the solvents (water and Methanol) which were used for extraction. In general, 80% methanol extracts showed higher antioxidant capacity compared to water extracts. It was also concluded that cocoa nibs contain a greater amount of total phenolic and flavonoid content when compared to cocoa shells. Antimicrobial activity was determined by measuring the diameter of the zone of inhibition. It was measured for both water and 80% methanol extracts of the samples on the test organisms *Escherichia coli* and *Staphylococcus aureus.* The 80% methanol extract samples showed higher inhibition than the water extract samples except for the water extracts of unroasted shell compared to the *Staphylococcus aureus*, which showed a higher inhibition zone than the unroasted shell. Results revealed that the inhibition of *Escherichia coli* is higher compared to the inhibition of *Staphylococcus aureus*. Hence it can be concluded that both the cocoa nibs and shells are able to reduce free radicals in our body and thereby demonstrate an impact on human health.

Keywords: Free radical, Antioxidant, Antimicrobial, Cocoa shell, Cocoa nib, Roasted, Unroasted

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ASSOCIATION BETWEEN PAIN COPING STRATEGIES AND DEPRESSION, ANXIETY, STRESS AMONG ADULTS WITH CHRONIC MECHANICAL LOW BACK PAIN IN GAMPAHA DISTRICT

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Chronic Mechanical Low Back Pain (CMLBP) is one of the most common chronic conditions that affect adults at some stage in their lives. Even though biomedical treatment methods for chronic back pain are very well established and documented, the psychosocial aspects of chronic pain are not addressed in the existing treatment protocols and pain management clinics in Sri Lanka. The main objective of the present study was to explore the associations between pain coping strategies, depression, anxiety and stress among adults with CMLBP in the Gampaha District while the translation and validation of the Coping Strategies Questionnaire (CSQ-Original Version) was conducted. The correlation study was conducted on a clinical sample of 150 adults (92 women and 58 men) experiencing CMLBP attending rheumatology clinics in the Gampaha District. The purposive sampling method was used. The Visual Analogue Scale (VAS) was used as screening material. The patients who met the inclusion criteria were given the self-administered questionnaire booklet. The questionnaire booklet consisted of a demographic questionnaire, the CSQ-SIN (translated CSQ Sinhala Version) and the Depression Anxiety Stress Scale-21 (DASS-21) Sinhala version. The Spearmen correlation coefficient and Multiple-linear regression analysis was carried out using the Statistical Package for Social Sciences – version 24 (SPSS - 24). The translated CSQ (CSQ-SIN) revealed eight subscales accounting for 70.6% of the cumulative variance. The translation of CSQ was conducted through a *Delphi process* in which the subject experts' agreement was considered. Based on the data from the pre-tests, reliability analysis and factor analysis, the CSQ-SIN showed satisfactory levels of reliability to measure pain coping strategies among Sinhala speaking adults (45 to 65-year-old) with CMLBP in Sri Lanka. Overall results from this study implied that greater use of diverting attention, reinterpreting pain sensations, coping self-statements, ignoring sensations, praying/ hoping and increased behavioral activities as coping strategies related to lowering the level of depression while catastrophizing as a strategy was related to an increase in the level of depression, anxiety and stress. The coping strategy 'catastrophizing' was found to be the prominent predictor of higher levels of depression, anxiety and stress. The results from the current study implied that it is important to identify coping strategies which lead to low levels of depression, anxiety and stress in CMLBP patients. Thus, catastrophizing was found to be the prominent predictor of higher levels of depression, anxiety and stress while using coping self-statements was effective in reducing these

symptoms reported in patients with CMLBP. Therefore, with more research evidence from further studies, future interventions should identify catastrophizing thinking and coping self-statements as two important thought patterns. When catastrophizing is identified, interventions should help patients to develop methods to manage these negative thought patterns which have the potential to decrease emotional distress and symptoms of depression, anxiety and stress. In identification of coping self-statements, practitioners should encourage the development of these types of self-statements to achieve better pain management in CMLBP. Thus, the importance of understanding the type of coping strategy and assisting accordingly may help to alleviate symptoms of depression, anxiety and stress and manage CMLBP more effectively. In conclusion, treatment plans for CMLBP should consider adopting a holistic approach where physical, emotional and psycho-social aspects are addressed. The findings of this cross-sectional study may not be generalized to the total CMLBP patient population in Sri Lanka until further research from longitudinal and larger scale studies are available.

Keywords: Chronic mechanical low back pain, Pain coping strategies, Depression anxiety stress

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PREMENSTRUAL DYSPHORIC DISORDER (PMDD) AND THE ACADEMIC, EMOTIONAL AND INTERPERSONAL IMPACT ON STUDENTS AT THE UNIVERSITY OF COLOMBO

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Premenstrual Syndrome (PMS) and Premenstrual Dysphoric Disorder (PMDD) are two disorders related to the menstrual cycle which brings physical and emotional changes in the week prior to menstruation, with the symptoms subsiding upon menstruation. PMS requires the presence of one affective symptom and physical symptom for diagnosis while PMDD presents more severe symptoms and is recognized in the Diagnostic Statistical Manual of Mental Disorders 5 (DSM-5). The worldwide prevalence of PMDD varies greatly with some studies reporting rates as low as 1.2% in Japan and as high as 36.1% in Nigeria. These differences in values are mainly due to the various study populations and the difference in age groups of participants and the cultural norms of the study context. Studies also use daily ratings and retrospective symptoms assessment, which also leads to varying prevalence rates. When the impact of PMDD is considered within University cohorts, it has shown to affect them academically, interpersonally and emotionally. A study reports a 22% impact on academic work, and a higher impact on social and sexual life (35% and 32% respectively). The present study investigates the provisional prevalence, impact and associated risk factors for PMDD among students at the University of Colombo.

A questionnaire booklet was used for data collection and the first two sections gathered demographic and menstrual details while the third section contained a checklist for premenstrual symptoms. The last two sections assessed impact in academic, interpersonal and emotional domains. The DSM-5 criteria for PMDD was adopted for constructing an effective/somatic symptom checklist while academic and interpersonal impact was measured by a scale constructed by the Principal Investigator (PI). Negative emotional effect was measured using the Sinhala version of the Depression, Anxiety and Stress Scale- 21 (DASS-21).

A total of 409 female students from six Faculties at the University of Colombo participated in the study and 31.78% of them reported symptoms required for provisional prevalence of PMDD. The most common symptom reported was physical changes while affective symptoms were relatively rare. Academic, interpersonal and emotional impact was shown mostly regarding difficulty in concentrating on studies, anger towards others and stress reactions. A significant

relationship was shown between positive family history of premenstrual difficulties and PMDD among the students (r=0.2, N =409, p<0.001).
In conclusion, results showed that PMDD is related to significant impairment in academic, interpersonal and emotional domains of the students considered for this study. The key outcomes of the study emphasize the importance of recognizing the symptoms of PMDD as it can create awareness of its debilitating impact and for those who have a family history of menstrual conditions to manage their symptoms effectively. The cultural differences in symptom expression found in this study also warrants further studies which may lead to development of culturally adaptable measures for PMDD.

Keywords: Premenstrual Dysphoric Disorder, Emotions, Behaviorus, DASS, DSM-V, University students

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IN-VITRO BIOAVAILABILITY OF TWO COMMONLY USED, POST-MARKETED MEDICINES IN SRI LANKA

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Pharmaceutical care is a key component of the health care service. The bioavailability of a drug refers to the rate and extent of active drug that reaches systemic circulation. The bioavailability and bioequivalence study for orally administered drug products indicates that usage of in-vitro bioavailability as an important parameter for quality assurance, quality control as well as comparison studies of different formularies. Dissolution testing is a very practical and economic approach to identifying bioavailability problems and assess the need for *in vivo* bioavailability. It also serves as an important tool in identifying unacceptable or substandard drug products. Research presented here was carried out to assess the in vitro bioavailability of locally available Paracetamol 500 mg and Losartan Potassium 50 mg and to evaluate the bioavailability difference in branded and generic products.

The experimental quantitative data assessing method was used to compare the in vitro bioavailability behaviour of Paracetamol 500 mg and Losartan Potassium 50 mg that are available in the local market. Four branded drugs of Paracetamol and Losartan Potassium were selected for the study. Branded drugs of Paracetamol 500 mg were coded as A, B, C and the generic drug was coded as D. Branded drugs in Losartan Potassium 50 mg was coded as E, F, G and the generic drug was coded as H. The in vitro dissolution test of each brand and generics was carried out according to British Pharmacopoeia (BP) using a dissolution tester. Tests results were analysed according to Pharmacopeia standards and Food and Drug Administration (FDA) guidelines. The innovator products of Paracetamol and Orange book (United .2018) bioequivalence product of Losartan tablets were used as reference products.

Four Paracetamol tablet 500 mg formularies tallied with British Pharmacopoeia standards for dissolution test since all values were above the limit of 80%. However, in the comparison of innovator with four formularies only sample ‘A’ showed ±15% deviation at 5, 10 and 15 minutes. Therefore, ‘A’ formulary cannot be considered as a bio equivalent as per FDA guidelines. Comparison graph of Losartan Potassium tablet formularies indicated that final dissolution % of all formulas are within th**e** range and therefore complied with BP standards. But the ±15% criteria of FDA are not met by formula ‘E and ‘H’ since negative deviations were observed at 5, 10, 15 minutes than the reference. The formulary ‘F’ showed negative deviation compared to comparator by more than 15% at 5

and 10 minute time intervals. Therefore all ‘E’, ‘F’, ‘H’ formularies were identified as non-bio equivalent formularies with respect to innovator.

Only Paracetamol 500 mg brands B, C and D and Losartan Potassium 50 mg G only complied with FDA bioequivalence criteria. Paracetamol 500 mg brand A and Losartan Potassium 50 mg brands E, H and F deviated by ±15% from innovator dissolution profile graphs. According to the guidelines all tested samples complied with the pharmacopoeia criteria. Therefore, more stringent pharmaceutical bioequivalent consideration should be included in regulation and prequalification levels in drug procurement agencies to ensure safe and effective medicinal usage by the patients.

Keywords: bioavailability, Invitro dissolution, Post marketed

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PREVALENCE OF POLYPHARMACY IN ADULT PATIENTS ATTENDING MEDICAL CLINICS AT THE TEACHING HOSPITAL, BATTICALOA

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Polypharmacy, the use of multiple medications by a single patient, is an important and growing challenge for modern clinical practice, drawing interest from clinicians, guideline developers and policymakers. There is evidence that rates of polypharmacy are increasing. International researches show that polypharmacy is common in older adults. Polypharmacy has been shown to result in increased risk of drug interactions, adverse drug reactions (ADRs) and non-adherence to therapy. There is a scarcity of evidence from Asian countries including Sri Lanka. This study reports the preliminary analysis of data from an ongoing study to present the effects of polypharmacy among adult patients attending medical clinics at the Teaching Hospital, Batticaloa.

A descriptive cross sectional study was conducted. A systematic sampling technique was used. 350 patients >=18 years of age attending medical clinics between the period of September 2017 and June 2018 were included in this preliminary analysis. A pre-tested interviewer-administered questionnaire was used to collect data. Prescriptions containing five or more drugs were considered as polypharmacy. Descriptive statistics and a Chi squared test were used to analyze the data using Statistical Package of Social Sciences (SPSS V. 23). Potential drug-drug interaction was analyzed using the British National Formulary (BNF) 72 and using Drug.com online data base.

The mean age of the participants was 58.07 years. 114 were males (32.6%), and 236 (67.4%) were females. Polypharmacy was present in 235 (67.1%) patients increasing with age ($P < 0.05$) (0.3%, 14.9%, 22.9% and 16% in age groups 18–27, 48–57, 58-67 and 68-77 years respectively). Among the 235 patients with polypharmacy, 71.92% were males and 64.83% were females. Polypharmacy was more common ($P<0.001$) in patients with 3 or more clinical conditions (44.2%) compared to those with at least one clinical condition (7.1%). Of the 495 reported incidents of ADRs, 413 (83.4%) occurred in patients on polypharmacy. Of those on two or more medications, 268 (76.6%) had at least one potential drug–drug interaction (DDI). There was an increase in the number of potential DDIs and therapeutic duplication in patients on polypharmacy.

Polypharmacy is common in medical clinics at Teaching Hospital Batticaloa. The main contributor to this is multimorbidity seen with increased age. This needs to

be acknowledged while prescribing for the elderly to reduce preventable ADRs and DDIs in this population.

Keywords**:** Polypharmacy, Comorbidity, Prescription

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HUMANITIES & SOCIAL SCIENCES

DETERMINANTS OF CUSTOMER SATISFACTION IN FREIGHT FORWARDING COMPANIES IN SRI LANKA

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Despite bringing enormous profit to the company concerned as well as the development of the country, freight forwarding is still considered as a developing field in Sri Lanka. Freight forwarders usually work with agents, forwarders, small or medium sized manufacturers. Therefore, having a close customer relationship plays a vital role in sustaining the competitiveness in the freight forwarding industry.

This study investigated the determinants of customer satisfaction in freight forwarding companies in Sri Lanka. Primary data was collected by means of an online questionnaire from freight forwarders in the Western province of Sri Lanka and overall 258 valid questionnaires were used for the analysis. Besides, an auxiliary analysis was carried out using 19 potential influential factors which derived eight factors to determine the overall customer satisfaction – these were reliability, responsiveness, communication and documentation accuracy, assurance, empathy, branding, technology, efficiency and trust respectively. Hence, in a situation where the growth rate for the logistics industry is drastically increasing, this research will provide insights into the further improvement of customer relationships in freight forwarding companies in Sri Lanka.

Keywords: Freight forwarding, Customer satisfaction, Logistics

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MAKING A LINK BETWEEN THE HOSPITALITY MANAGEMENT HIGHER EDUCATION AND ANTICIPATED INDUSTRY REQUIREMENTS: A LITERATURE REVIEW

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The hospitality and tourism industry has become an emerging industry in Sri Lanka due to its continuous growth. The industry has shown a huge expansion as a result of an unprecedented number of inward tourist arrivals throughout the year. There is a great demand for skilled labor in the hospitality industry to obtain a competitive advantage. Higher education plays a key role in shaping the skilled labor demanded by the industry. Higher educational institutions have the responsibility of educating individuals who can adapt to ever-changing industry needs and who have the skill sets required by each layer of the industry. Hospitality management education is relatively new to Sri Lanka. Nearly two hundred students receive admission to hospitality management undergraduate programs annually in Sri Lankan universities. However, the graduates of hospitality management degree programs find it difficult to find their place in the industry and relatively few graduates settle in the hospitality industry. Industry practitioners claim that graduates do not meet anticipated industry requirements and less than 10% of graduates are currently employed in the industry. The purpose of this study was to explore the gaps between hospitality management higher education and industry requirements through a comprehensive literature review. Furthermore, the extensive literature review answers the question of how to overcome drawbacks in the prevailing hospitality management in higher education system. In this study, relevant secondary sources have been gathered and a descriptive approach is employed, with a comprehensive review of related literature. The literature emphasized that the connection between the educators and industry practitioners is important not only to provide updates on industry changes but also to enhance the opportunities for students to be employed in the industry upon the completion of education. Graduates of the degree programs are lacking industry exposure and this leads to poor professional and personal development. As a result, few graduates of hospitality management degree programs find places in the industry and a majority end-up leaving the industry. The main objective of hospitality management education is to supply skilled labor that possesses transferable competencies. Compared to Management Studies, Hospitality education has its own unique competencies that need technical and vocational training. Hence, hospitality education providers have to identify the anticipated competencies and employability skills that are required by the industry.

Keywords: Hospitality Management Education, Competencies, Human Resource Development, Industry Requirements

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CONCILIATION FOR SETTLEMENT OF INDUSTRIAL DISPUTES: A COMPARATIVE ANALYSIS OF SRI LANKAN AND SOUTH AFRICAN MECHANISMS IN LABOUR LAW

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This research paper aims to review the use of conciliation for resolution of industrial disputes. Special reference was given to the Industrial Disputes Act No 43 of 1950 of Sri Lanka and Labour Relations Act No 66 of 1995 of South Africa. The paper describes the importance of using conciliation for industrial dispute resolution, review the existing legal framework in Sri Lanka related to conciliation under the Industrial Disputes Act, identify the weaknesses of existing law through comparative analysis and finally make suggestions to enhance the effective use of conciliation as an alternative dispute resolution mechanism for solving industrial disputes in Sri Lanka. The normative research method has been used as the methodology. The comparative analysis technique was used to enhance the validity of findings. The International Labour Organization has endeavored to introduce processes for harmonious settlements of industrial disputes in order to uplift industrial peace in the sector. The International Labour Organization recommendation addressing the importance of conciliation in industrial deputes is the Voluntary Conciliation and Arbitration Recommendation No 92. Article 1 of the International Labour Organization Recommendation 92. This recommendation sets out that the disputes management system should be appropriate to national conditions. In fact, suitability to national conditions is essential in a dispute resolution mechanism to ensure that the system is effective and engenders the confidence and trust of society. Drawbacks of national systems, such as less awareness and use of conciliation in industrial disputes, lack of professionalism, misconceptions over conciliation officers and labour departments by employers, non-adoption of innovative industrial dispute settlement approaches, lack of legal binding power over a conciliation settlement, unnecessary legal representation in the process have been identified through research. Corrective measures have been suggested through comparative analysis. Steps to be adopted to ensure that Sri Lanka achieves the optimum utility of conciliation as an alternative dispute resolution mechanism in solving industrial dispute matters under the Industrial Disputes Act has been identified and proposed in this research.

Keywords: Alternative dispute Resolution, Conciliation, Industrial dispute

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MEDICAL JURISPRUDENCE AND JUSTICE ADMINISTRATION: A STUDY ON PSYCHIATRY, TOXICOLOGY, FORENSIC SCIENCE AND THEIR CONTRIBUTION TOWARDS EXECUTION OF JUSTICE

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There is a clear distinction between 'Law' and 'Justice'. Law has a regulatory quality and Justice is seen as a moral yardstick to measure the rightness of a human act. The aim of Law is the attainment of justice. The utilization of the branches of forensic medicine namely forensic toxicology, forensic psychiatry and science are considered predominant in medical jurisprudence. The adoption of developing aspects of medical jurisprudence influences the development of law. The paper studies the nature of administration of law in Sri Lanka, procedures followed, the application of medical jurisprudence and scientific knowledge to legal problems. It analyses the branches of forensic medicine and the significance of each. The study discusses foreign and local cases and local legislations; criminal procedure code, civil procedure code, penal code and the evidence ordinance. The paper suggests developments for the medico legal sphere and the adoption of new technologies to increase the efficiency of administration of justice in Sri Lanka including both criminal and civil law. The imperativeness of medical jurisprudence is not a scarce purview but is far reaching. In the legal sense, 'Medical Jurisprudence' is read by the courts to solve civil or criminal cases. 'Forensic psychiatry' is the study of the subjectivities of the human being and deals with the management and treatment of mentally abnormal offenders and extends to a risk assessment of mentally disordered patients. Forensic toxicology studies poisons. DNA (Deoxyribonucleic acid) techniques are supportive for the administration of justice. DNA in human body is a mode of identification. The study is normative in nature. The author recommends that human and physical resources be developed, prioritizing technology and institutions such as European Network of Forensic Science Institutes (ENFSI), Combined DNA Indexed Systems (CODIS) for the advancement of medical Jurisprudence and the fair and equal dispensation of justice.

Keywords; Jurisprudence, Forensic Medicine, psychiatry, toxicology

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WAYS OF CHALLENGING COLONIAL BINARIES IN A SELECTION OF SRI LANKAN LITERARY TEXTS

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European colonization, which commenced approximately in the Sixteenth Century created a landmark in world history which led to numerous repercussions deeply felt by both the colonized and the colonizer which are prevalent to date. One of the salient features of colonization has been the binaries created by the colonizers to demarcate them from the supposedly inferior colonized. As Edward Said states, 'the Orient' (the East) 'has helped to define Europe (or the West) as its contrasting image, idea, personality and experience' and these binaries affected the two parties politically, culturally, economically and intellectually. Yet, the more crucially affected colonized responded to colonialism through postcolonial criticism in the aftermath of colonialism and literature is one such area in which the said movement was prominently represented. In essence, after gaining independence, the colonized retorted by challenging these colonial binaries in numerous ways and there emerged a spate of postcolonial literary works that backed this movement which showcased how the formerly colonized were diversely affected due to imperialism. Accordingly, this paper will look at the ways in which a short story, two poems and a painting of Sri Lankan origin have challenged these binaries. The selected texts are Simon Nawagattegama's short story *Snehaya* translated into English as *Love*, Regi Siriwardena's *Colonial Cameo* and Vivimarie Vanderpoorten Medawattegedara's *Doppleganger* and David Paynter's mural on *Washing the Disciples Feet* at the Trinity College Chapel, Kandy. Evidently, this is a cross- genre analysis. Therefore, a mixed method will be utilized in the analysis of the material.

Some of the binaries created between the West and the East are civilized-barbaric, strong-weak, superior-inferior, unconventional-conservative and rational-irrational. Further, Western literature has projected the colonized as incapable of being in par with their colonizers. Therefore, there emerged a class among the colonized who tried to deviate from this class by pretending to be closer in ways of living to the British. Siriwardena's poem depicts a similar situation in which a Sinhalese boy, attending an elite school being ashamed of his mother's inability to converse in English in front of his classmates. In the poem *Colonial Cameo* by Regi Siriwardena, the father of the speaker favours English Language urging the latter to accept it as a 'superior tongue' than his own, visibly promoting the colonizer's attitude. The son accepts it since he hero worships the father and feels ashamed of his illiterate mother when she speaks in Sinhala in his classroom which is apparently called the 'servants' language'. Yet, the last line twists this idea and the poem becomes anti-colonial with the son being ashamed of 'his shame'. Basically, with maturity, he realizes his mistake of abandoning his mother tongue and going to the extent of resenting his own mother's inability to speak a foreign language which was due to having been exposed to the language. Basically, the

speaker questions the values he had been venerating since childhood highlighting the importance of one's own language.

The colonizers also stressed on the colonial binary in which the East is considered superstitious, mysterious and queer in contrast to the rational West. However, as a response, postcolonial literature has resisted the dominant by adamantly standing by the customs and rituals of its own culture as in Nawagattegama's short story *Love*. It strongly stands by some of the aesthetic customs and habits of the Sri Lankan rural villagers as opposed to Western customs. There are poems written in the post colonial era which at a glance appear to be pro-colonial but with an intense reading, the hidden sarcasm towards imperialism is brought out and 'Doppleganger' is one such poem. Through the poem, the poet makes a powerful declaration of how racism is a worldwide issue and not segregated to a particular state with the speaker being called a "para lansiya" (a non-native burgher) by the Sinhalese in Sri Lanka for her 'foreign sounding name' and a "Paki Bitch" for having an Asian skin in a Western country. In essence, she challenges the irrational-rational binary of the East and West tattooed in colonial criticism questioning the West's behaviour. She questions the irrational behaviour of the colonizers who supposedly enlightened the colonized.
Amidst such representations, one also witnesses creations such as Paynter's mural on *Washing the Disciples Feet* which is an amalgamation of the Eastern and the Western cultures. The painting, while being a narration of a biblical story, has the faces of the native people on its characters. This is an outstanding example of postcolonial resistance through hybridism and blending the East and the West. As mentioned previously, colonial literature with its binaries demarcating the East from the West had radical effects on both the colonized and the colonizer, mostly negative for the former and positive for the latter. As a result, postcolonial literature made its main concern challenging those binaries to overturn the prevailing worldview. Yet, over the years, it has been proved that the East and the West both have their own unique cultures that deserve their fair share of prominence instead of being treating in segregation. As a result, this paper will explore some of the ways in which literary artists of Sri Lankan origin have subverted the binaries created by the colonizer between the East and the West through a few selected texts.

Keywords: Colonial Binaries, Repercussions of Colonialism, Challenging the Hegemony, Neo-Colonialism

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PADDY LAND CULTIVATION IN THE WESTERN PROVINCE OF SRI LANKA: DETERMINANTS OF ABANDONMENT AND UNDER-UTILIZATION

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Paddy cultivation is the most important subsistence agricultural product in the Sri Lankan economy from ancient times. Apart from being the staple food crop, it occupied a prominent place in Sri Lankan heritage and culture. Ironically, in recent times, there has been a significant reduction in paddy cultivation especially in the Western Province of Sri Lanka. The main purpose of this study is to examine the determinants of abandonment and under-utilization of paddy lands in this province through a study conducted in three districts, namely, Colombo, Gampaha and Kalutara. For this study, a sample of 300 farmers were selected on proportionate sampling from all three districts considering the extent of abandoned and under-utilized paddy lands in the respective districts and D.S. Divisions respectively. The questionnaire was the main method of primary research and focus group interviews, in-depth interviews conducted with 'Krupanisa' officers and self-observation techniques together with secondary data gathered supported the main questionnaire survey.

The analysis revealed important contributory factors which separate paddy farmers from paddy cultivation in the Western Province of Sri Lanka. Among the determinants for abandoning and under-utilization of paddy lands were Irrigation and drainage issues, high cost of production, unavailability of labour, higher income from other occupations, rat fever and animal damage, polluted substances from industries, soil related issues and poor infrastructural facilities. Among other important factors for abandonment and under-utilization of paddy cultivation, were the higher educational standards of the second generation of farmers who moved away for more stable and remunerative employment opportunities, availability of many other employment opportunities, part time farming, land fragmentation, and crop diversification towards better incomes.

The findings may raise many policy implications, and among them, having a stable and strong agricultural policy is shown to be a mandatory requirement. Strong government patronage which will encourage farmers should cover a broader area. Adequate fertilizer subsidy, institutional support including credit, technology, extension, marketing channels, together with realistic 'Guaranteed prices' for paddy are essential. If these are implemented, paddy land abandonment and under-utilization will be reduced to a great extent in the Western Province of Sri Lanka and farming may become a 'viable' occupation once again which will create a true 'livelihood' for poor farmers who are struggling to make ends meet. At the same time, paddy lands which are unused due to unavoidable reasons such as constant flooding, salinity issues, soil related

issues, etc., should be used for other economically viable projects, as the Western Province is the economic hub of the country where land value is considerably high.

Keywords: Abandonment, Under-utilization, government patronage

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STOPPING 'SILENT SALESMAN': AN APPRAISAL OF THE IMPLEMENTATION OF GRAPHIC HEALTH WARNING REGULATIONS ON TOBACCO PRODUCTS IN SRI LANKA

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Tobacco control is fast becoming a key aspect of the global health agenda aimed at eliminating tobacco-related health hazards. These laws are designed to control and regulate tobacco and tobacco-related products starting from production, display, purchase and finally consumption. Interestingly, the last two decades have witnessed the evolution of tobacco control laws both at international level and national levels. Sri Lanka also as a State Party to the World Health Organization Framework Convention on Tobacco Control (WHO FCTC) has implemented different types of tobacco control laws including graphic health warnings. Graphic health warnings are considered one of the best tobacco control measures to warn people of the risk of tobacco related health hazards. Perhaps more importantly, graphic health warnings have a devastating impact on tobacco packaging as these regulations mandate to display gruesome pictures and messages on the risk of tobacco on tobacco packaging. In that sense, graphic health warnings help to stop the 'silent salesman' task of tobacco packaging. However, the tobacco industry instigates litigations against graphic health warning regulations based on their intellectual property rights viz., trademark rights. The main objective of this research is to analyse the implementation of graphic health warning regulations on tobacco products in Sri Lanka in order to explore the contribution of these regulations in reducing tobacco prevalence. Furthermore, the following subsequent objectives are in line with the main research objective. First, it explores the impact of tobacco on public health in Sri Lanka. Second, it examines the timeline of tobacco control laws in Sri Lanka with particular reference to the implementation of graphic health warnings. Third, it aims to evaluate the response of the tobacco industry on graphic health warning and important judicial decisions to the tobacco industry's challenges. Finally, it makes suggestions to ensure robustness of graphic health warning regulations in Sri Lanka.

Keywords: Tobacco control, Graphic health warnings WHO FCTC, Sri Lanka

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"YOUR MAJESTY, YOUR SON IS UNABLE TO LEARN?"[1]: A STUDY OF THE NOTIONS OF '*LEARNING*' AND '*TEACHING*' INSCRIBED IN A SAMPLE OF SOUTHERN FOLK TALES FROM ANCIENT LANKA[2]

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Folkloric speech acts, such as folktales, folksongs, folk drama and etc., tend to carry traces of socio-cultural-economic conditions of the period when such an acts were created/told/heard. Using the hypothesis that social conditions of the material sphere could be inscribed in folktales, this research undertakes a re-reading of a large sample of Sinhala folktales from southern Lanka for what they say about the ides of 'teaching' and 'learning.' The sample under consideration is Henry Parker's *Village Folk Tales of Ceylon*, 266 folktales collected by this colonial (British) irrigation officer during his official tours of southern Lanka. Parker's folktales are Lanka's first and possibly the oldest folktales and their conspicuous absence of Buddhist influence makes them ideal samples to understand how secular 'teaching' and 'learning' was conceived in the imagination of the common rural folk of ancient Lanka. This research will undertake a careful reading of the tales to understand and interpret how the notions of 'learning' and 'teaching' are constructed by the story creators/tellers which could represent how such ideas were understood in the material sphere.

Keywords: Folklore, Folktale, Learning, Education, Motif

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[1] Uttered by the Royal Preceptor upon interrogation by the king as to why the royal prince is unable to read in Henry Parker's *The Story of the Cobra's Bite*

[2] Since it is difficult to determine the actual dates of creation/recital of Parker's folktales I have referred to the nation state as 'Lanka'

WHAT DOES THE INDUSTRY REALLY NEED? A CLOSER EXAMINATION OF INDUSTRY PERSONNEL'S PERCEPTIONS OF ENGLISH LANGUAGE SKILLS OF VOCATIONAL GRADUATES

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The current study was carried out as an attempt to find out the perceptions of the industrial personnel about developing an English module that complements the requirements of the industry. At present the University of Vocational Technology (Univotec) offers a module titled "Communication Skills" which is a composition of English for General Purposes (EGP). However, the students' examination results and the performance at the industry reveal that EGP does not seem to offer the skills the students need to succeed academically and professionally. This paper presents a segment of a much larger needs analysis conducted with all stakeholders involved in vocational English. In this paper I will present the perceptions of the industry personnel and how their perceptions can be utilized to develop a more suitable and up-to-date English language programme for vocational undergraduates.

The current research was carried out with 15 industrial personnel from the field of Mechatronics who employ the undergraduates of Univotec who follow Bachelor of Technology in Mechatronics for industrial training as well as in relation to job placements. At the heart of the study is a Needs Analysis (NA). The centrality of the NA lies in the crucial role it plays in developing a curriculum. The study incorporates the NA process of Brown (2009) due to its feasibility. As inspired by Richards (2005) who highlights that 'qualitative and quantitative data do not inhabit different worlds but are different ways of recording observations of the same world' (p.36), a mixed methods research design had been adopted in the study. Thus primary data collection methods such as quantitative (questionnaires) and qualitative (focused group discussions) methods were used. Both types of data collection were used for data triangulation as it helps to strengthen the collected data to increase credibility and validity. The sampling technique that is used in the study is purposive sampling and the sample consisted of both male and female participants and they were Sinhala and Tamil first language (L1) speakers. While a thematic analysis was carried out in terms of qualitative data, quantitative data was used descriptively

The results revealed that a majority of the industrial personnel laid a strong emphasis on language skills that would be more essential to perform a task at the industry level. The type of English that the industry highlights aligns with a more ESP content while some expressions supported a more EGP content. The perceptions of the industrial personnel recommend an inclusion of more authentic activities such as reading of manuals, e-mails, letters and procurement related

documents in the English curriculum. The industry suggests a need for Technical vocabulary to be possessed by the vocational undergraduates.

Keywords: English for Specific Purposes (ESP), English for General Purposes (EGP), Needs Analysis (NA), language skills, Industry Needs

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THE ROLE OF MEDIA IN NATURAL DISASTER MANAGEMENT IN SRI LANKA

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Sri Lanka, being a small island in the Indian Ocean, is prone to natural disasters such as floods, landslides, droughts, storms, cyclones, lighting strikes, coastal erosion, tsunami and effects of environmental pollution that kill a number of people and destroy property each year. Communication media can be used for natural disaster management in Sri Lanka like other countries in the world. It is noted that the old and traditional media such as television, radio, print media, telephone, community radio, sirens, notices, leaflets, etc., are used for natural disaster management. Mobile communication including SMS, social media like Facebook are also used in terms of natural disaster management in Sri Lanka. Therefore, some media behave in a responsible manner during disaster situations. But some argue that media do not play a major role in natural disaster management. Because it is argued that media are not responsible, ethical, timely and accurate in natural disaster reporting in Sri Lanka. In this context, the problem explored in this study is 'what is the role of Sri Lankan media in natural disaster management'. Therefore, this study examines the role of media in natural disaster management in Sri Lanka. The specific objective is to identify the issues of media in natural disaster management with a view to recommend the solutions to overcome these issues. Mixed methods will be used to collect data for this study. A survey questionnaire will be used to collect quantitative data and in-depth interviews will be conducted to collect qualitative data. In order to collect the 200 self-administrated questionnaires, the researcher will randomly distribute 220 questionnaires with the support of five research assistants. In-depth interviews will be conducted to collect data from resource persons. Broadcasters and journalists must be educated on disaster journalism to ensure accurate, timely, ethical and responsible reporting.

Keywords: Media, Natural disasters, Natural disaster management, Sri Lanka

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A TRACER STUDY OF GRADUATES OF THE BA IN ENGLISH AND ELT PROGRAMME AT OUSL

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Tracer studies are one of the key methods by which systematic assessments regarding the quality and employability of graduates of degree programmes can be made. These studies help identify the effectiveness of different components of educational programmes. These studies also provide feedback on the curriculum and the teaching learning process and they are useful in obtaining information on students' overall experience of being an undergraduate in higher education institutes. The findings of such studies can also provide valuable information that can guide future changes to the programme. The OUSL has carried out tracer studies as part of its institutional research agenda by obtaining data from students who graduate from various faculties. These studies give a composite picture of the characteristics and attributes that will help students gain employment after graduating from the diverse array of programmes offered by the OUSL. The present study focuses on one of the programmes offered by the OUSL which is the Bachelor of Arts in English and English Language Teaching. This programme is offered by the Department of Language Studies of the Faculty of Humanities and Social Sciences. It was introduced over 15 years ago and is unique in that it was one of the first degree programmes in Sri Lanka that concentrated exclusively on the related disciplines of literary studies, applied linguistics and language and literature teacher education. The study wished to ascertain the extent to which the BA in English and ELT has helped graduates in gaining employment, career advancement, and further education. It also explored the extent to which the curriculum is relevant to employability in the field of English Language teaching and other related fields. The study also investigated the perceptions of graduates regarding the skills acquired through the programme and the learning experience at OUSL. The study used a mixed-method research design and collected data using questionnaires and semi-structured interviews. Quantitative data were collected from the closed ended questions in the questionnaire while qualitative data were collected from the open ended questions as well as the interviews. Questionnaires were sent to fifty graduates who comprised the sample for this study. In-depth interviews were carried out with 10 participants. The quantitative and qualitative data collected revealed broad trends that indicate to what extent the BA in English and ELT has had an impact on the career prospects of its graduates. The results reveal that the majority of the participants were employed in a range of contexts related to ELT at the point of entry to the programme when they enrolled for the degree. The impact of the qualification could therefore be seen in the manner it had enhanced their career prospects and mobility. The results also indicated to what extent the curriculum of the programme had contributed to the employability of the

graduates in terms of the academic and professional competencies it had helped to develop. Particular mention was made by the participants of the importance and relevance of the course in teaching methodology and teaching practicum that was seen as being important to professional development of teachers. One of the most significant findings of the study was that a majority of the students had progressed on to higher levels of postgraduate study which indicates the programme has laid a firm foundation which has enabled students to avail themselves of opportunities for continuous professional development. While some participants opined that the curriculum of the programme could be further enhanced and developed by introducing additional subject areas, there were others who commented on issues related to administration and certification. The study shows that even small-scale studies can reveal important insights into the career aspirations and other expectations of its graduates and to what extent these have been met by individual programmes and the institution as a whole.

Keywords: Tracer Study, B.A in English and ELT, ELT Teacher Competencies

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THE ROLE OF CONVERGENCE IN IMPROVING INNOVATION PERFORMANCE IN OPEN INNOVATION

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Open innovation practices have become popular among organizations globally. Researchers highlight multiple benefits that open innovation offers. Extant literature elaborates factors that increase innovation performance in open innovation implementation. However, open innovation does not always bring higher innovation performance and reasons for this are not sufficiently addressed in the existing literature. Many scholars have highlighted the need of further research to identify new factors that can explain varying performance. The objective of this concept paper is to suggest a new conceptual model by introducing convergence as a new variable that has the potential to bring new insights in explaining innovation performance. In this case, convergence refers to alignment and coordination between open innovation partner firms.

Keywords: Open innovation, innovation performance, convergence, alignment, coordination

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SYLLABUS REVISION: A NEEDS ANALYSIS STUDY

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Needs analysis is considered one of the key aspects in Curriculum and Material design. The central aim of need analysis is to discover the content areas that learners have to learn, the sections which learners have not learned yet, and the domains that learners want to learn that corresponds roughly to learners' needs, lacks and wants respectively. Needs assessments and English for Specific Purposes (ESP) are inextricably linked. Thus, a needs analysis was designed to identify the needs, wants and lacks of first level undergraduates of the Faculty of Social Sciences, University of Kelaniya who follow English for Social Sciences. The purpose of the needs analysis is to compare the needs of the students and the needs addressed in the existing syllabus with the primary objective of making recommendations to revise the current syllabus. A sample of students was selected and a questionnaire was used as a data collection tool. Meanwhile, written essays of students were assessed to assess their current proficiency level. The course content was analyzed to determine the current needs addressed. In addition to the addressed needs of the students, a considerable number of gaps were found in the existing syllabus and necessary recommendations were identified. It is crucial to determine the specific needs of the students while prioritizing their objectives of learning the English language. The course materials should be designed systematically without deviating from the predetermined objectives. At the same time, key consideration should be given to the duration of the course and the materials should be tailored according to the schedule.

Keywords: Needs analysis, English for Specific Purposes, Curriculum, Syllabus, Course materials

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NATURAL SCIENCES

EFFECTS OF SOIL PARAMETERS AND FERTILIZERS ON GHERKIN (*Cucumis anguria* L.) VAR. 'TREASURE' CULTIVATION IN HIRIPITIYA, SRI LANKA

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Gherkin (*Cucumis anguria* L.) or pickling cucumber is an important vegetable for fresh consumption and the canning industry. This experiment, arranged in Randomized Complete Block Design with three replicates, was conducted in the Hiripitiya area of Kurunegala to determine the best fertilizer application for the gherkin hybrid var. 'Treasure' based on the growth, reproductive and yield parameters. The changes in soil pH, organic matter content, electrical conductivity, average nitrogen (N), phosphorous (P) and potassium (K) were measured for four different fertilizer applications. The four different fertilizer applications (T1, T2, T3, T4) had varying amounts of Urea, TSP (Triple Super Phosphate) and MOP (Muriate of Potash). The experiment was done with four different fertilizer application points at 2 days before planting and 10, 20, 30 40 and 50 days after planting. In the Basal Dressing, 500 g of compost was applied per plant for all the treatments. Urea was added at 20 g, 20 g and 10 g per plant only for T1, T2 and T3. TSP was added 140 g per plant for T1, T2 and 70 g per plant in T3 and none for T4. MOP fertilizer was added 40 g per plant for T1 and T2, 20 g per plant for T3 and none for T4. Super Basal and Super Micro Mix were only added in T4 with amounts 175 g per plant and 5 g per plant, respectively. Top Dressing (TD) 1 comprised of 40 g, 50 g, 25 g per plant of both Urea and MOP in T1, T2 and T3. Kandurata TDM (Top Dressing Mixture) was added 100 g per plant only in T4. TD 2 comprised of 60 g, 50 g and 25 g per plant of Urea in T1, T2 and T3 and none for T4. MOP fertilizer was mixed with soil at 80 g, 50 g and 25 g per plant respectively in T1, T2 and T3 and none for T4. T4 comprised of 175 g per plant of Kandurata TDM only. TD 3 contained 40 g, 50 g and 25 g per plant of Urea in T1, T2 and T3 only. MOP and Kandurata TDM were applied in same fertilizer levels as TD2. Further, TD 4 contained same Urea levels as TD1 for T1, T2 and T3. Only 60 g, 50 g and 25 g per plant of MOP were mixed to T1, T2 and T3. The same amounts of Kandurata TDM were added to TD4 as TD3. TD 5 consisted of 60 g, 50 g and 25 g per plant of both Urea and MOP in T1, T2 and T3 respectively. Only 175 g per plant of Kandurata TDM was added to T4. Before and after the completion of the experiment, soils were analysed for pH, organic matter, electrical conductivity, average N, average P and average K. The results indicated that fertilizer levels had significant influence on the number of fruits per vine, fruit length, fruit diameter, yield and total yield. Among treatments, T1 showed the highest number of fruits per vine (25), fruit length (11.03 cm), fruit diameter (38.22 mm), yield per vine (2.51 kg) and total yield (45.61 tons/ha) than other fertilizer levels and it was significant.

However, with the T1 fertilizer application, the excess amount of average P (18 ppm) and K (512 ppm) were recorded after the cropping season causing a nutrient imbalance in the soil.

Keywords: *Cucumis anguria* L, Gherkin, Hybrid Variety 'Treasure'

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COORDINATION CHEMISTRY OF A (N^N^C) PALLADACYCLE

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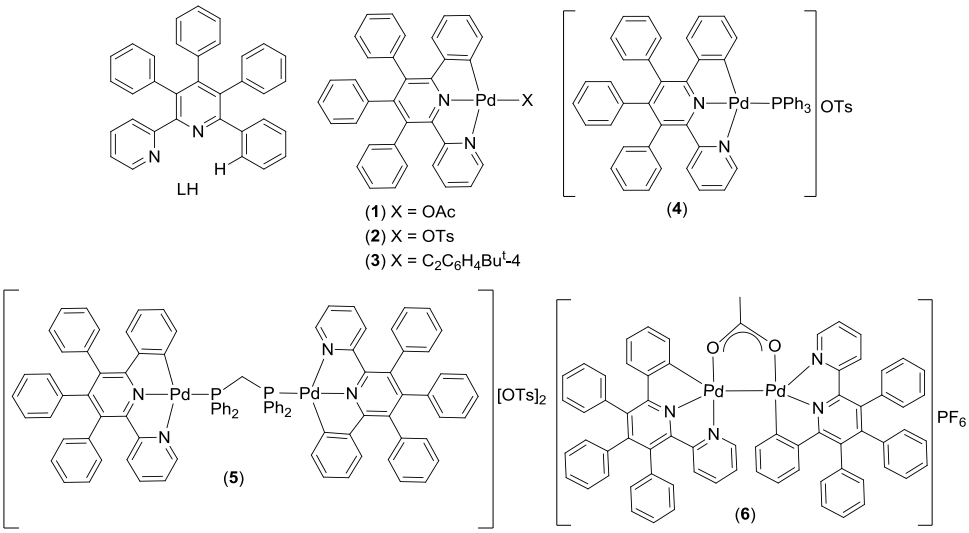
Cyclometallated Pd(II) complexes or palladacycles are used as catalysts in cross coupling reactions, and their optical and biomedical applications are being investigated by many scientists. Katlenok and Balashev reported optical properties of an acetate-bridged binuclear cyclometallated Pd(II) complex derived from 2-phenylbenzotiazole. Luminescent [(N^N^C)Pd(acetylide)] could act as a photosensitizer in light-induced aerobic oxidative C-H functionalization of amines and for light-induced hydrogen production. [(N^N^S)PdCl] complexes based on thiosemicarbazones have shown high anti-proliferative effect against A431 cells and are potential candidates for chemotherapeutic drugs. Thus, it is of interest to explore the coordination chemistry of the (N^N^C)palladacycle (**1**) and to develop synthetic routes to its tosylates, acetylides and binuclear bridging complexes.



Treatment of 3,4,5,6-tetraphenyl-2,2′-bipyridine (LH) with $[Pd(OAc)_2]$ in CH_2Cl_2 yielded the (N^N^C)palladacycle [(L)PdOAc] (**1**). Complex (**1**) when treated with an excess of *p*-toluenesulfonic acid (TsOH) gave the Pd(II) tosylate [(L)PdOTs] (**2**) as a yellow solid in 88% yield. The methyl proton resonance of the OTs group appeared as a singlet at 2.37 ppm. Treatment of (**2**) with 4-*tert*-butylphenyl acetylene afforded the yellow Pd(II) acetylide $[(L)PdC{\equiv}CC_6H_4Bu^t\text{-}4]$ (**3**) in 93% yield. The proton resonances of the alkynyl group appeared as an AB pattern at 7.57 (d) and 7.33 (d) ppm with $^3J(HH) = 8.3$ Hz for aryl protons and a singlet at 1.34 ppm for the nine *tert*-butyl protons. Addition of one equivalent of PPh_3 to a solution of complex (**2**) in CH_2Cl_2 yielded the monocationic salt

[(L)Pd(PPh_3)]OTs (**4**), in which OTs ion is a non-coordinating ligand. The phosphorus resonance of (**4**) showed a singlet at 27.6 ppm. Replacement of two OTs groups from two palladacycles (**2**) by one bis(diphenylphosphino) methane (dppm) ligand gave the dppm-bridged binuclear dicationic salt[(L)Pd(μ-dppm)Pd(L)]$(OTs)_2$ (**5**), with a phosphorus resonance of 24.3 ppm. Addition of NH_4PF_6 to a solution of (**2**) in CH_2Cl_2 forced two palladacycles to form an acetate-bridged binuclear salt [(L)Pd(μ-OAc)Pd(L)]PF_6 (**6**) as yellow needles in 98% yield. The complex (**6**) was characterised by X-ray crystallography and its Pd-Pd bond distance is 311.88 pm.

Author wishes to thank the Trinity College Dublin for a Research Fellowship and Professor S. M. Draper for laboratory facilities and other support.

Keywords: coordination chemistry, palladacycles, cyclometallation, Palladium complexes

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ADVERSE EFFECTS OF GLOBAL WARMING ON PRODUCTIVITY OF FIELD CROPS AND FARMER LEVEL ADAPTATION MEASURES - A CASE STUDY IN HAMBANTHOTA DISTRICT

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Agricultural crop production is highly sensitive to both short and long-term changes of climate. The tropical vegetable production environment is a mixture of conditions that varies with season and region. Climatic changes will influence the severity of environmental stress imposed on vegetable crops. Moreover, increasing temperatures, reduced irrigation water availability, flooding, and salinity will be major limiting factors in sustaining and increasing vegetable productivity. Therefore, this paper aims to examine the past data on rainfall and temperature, field observation along with farmers experience on the adverse effect of high temperature and less rainfall on various fruit and vegetable crops due to global warming and how farmers adapt to such situations and the constraints for such adaptations. Hundred and fifty farming households were randomly selected for the interviews in Weeraketiya, Weerawila and Pannagamuwa villages in the Hambantota District as they face drought frequently. Semi-structured questionnaires were used to investigate farmers' perceived changes in temperature and rainfall, causes and effects of climate change, and adaptation practices used by farmers. Four focus group discussions were conducted to survey the data. The temperature and rainfall data needed for this study were collected from the Meteorological Department, Hambantota. Further, agricultural productivity was measured as the ratio of outputs to the inputs. The vegetable output is the marketable harvested product or yield. Therefore, it was measured by the percentages of pods cracked (which cannot be marketed) out of the harvested product. In addition, the quality of the product was judged by the physical appearance. Majority of the farmers have experienced high temperature and water stress in the past few years due to global warming. They also confirmed the reduction in rainfall, which agrees with the past meteorological data on rainfall and temperature. This study showed that 48% of the farmers are using mixed crops to face the impacts of climate change such as high temperature and less rainfall as they are not certain which crop will cope with the situation. Out of the harvested product, nearly 75% of the water melon (*Citrullus lanatus*) was cracked due to temperature and /or water stress. Nearly 60% of the snake gourd (*Trichosanthes cucumerina*) harvest was out of shape and nearly 80% of the Okra *(Abelmoschus esculentus)* pods were matured within a short period after flowering. Out of the harvested pods of Cucumber (*Cucumis sativus)* 67% was dark yellow in colour and small in size due to temperature and water stress which affect the marketability. Further, farmers expressed that the lack of information is the major problem for adaptation measures to cope with climatic changes. With properly tailored policies, smallholder farmers can adjust

to climate change and improve their crop production. Finally, it is recommended to assess the feasibility of location specific farm-level adaptation practices to climate change.

Keywords: Global warming, vegetables, temperature stress

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THE ADSORPTION OF Cr(III) ONTO A KAOLIN: ALGINATE COMPOSITE ADSORBENT

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Chromium (Cr) is a toxic heavy metal used in the leather, alloy and electroplating industries. The direct discharge of chromium retentive effluents from these industries can contaminate the environment and cause chronic diseases, as well as mutations. In this study, a polymer layer silicate composite was developed, using a layered silicate (kaolin) and a biopolymer from seaweeds (alginate), to remove Cr(III) from the aqueous environment.
Sodium alginate (A) was dissolved in 100 mL of distilled water at 80 °C for 3 h. Thereafter, cleaned kaolin (K) was added to the solution (A:K=1:20) and stirred for 5 h. The mixture was then added, drop-wise, to 1% $CaCl_2$ solution. The beads that formed were washed with distilled water and dried at 70 ºC for 2 days. The dried composite was ground and sieved (250-350 µm). All the experiments were conducted using 0.20 g of the composite and 100 mL of 5.0 mg L^{-1} Cr(III), except for the isotherm study where the concentration varied from 0.5-30 mg L^{-1}. Suspensions were shaken on an orbital shaker at a constant speed of 100 rpm.
The dried composite material adsorbed 97% (2.02 mg g^{-1}) of Cr(III) from the aqueous solution within 120 minutes. The pH of the metal solution influenced the adsorption process, where the maximum adsorption of 97% was observed within the pH range 4-6. Adsorption followed a pseudo second-order kinetic model with a rate constant of 0.033 g mg^{-1} min^{-1}. The isotherm data fit the Langmuir isotherm model with a monolayer capacity of 6.14 mg g^{-1}. The adsorption is a homogeneous adsorption process in which a monolayer of Cr(III) is formed on the adsorbent surface. This study indicates that the kaolin: alginate composite could be used as an environmentally friendly green adsorbent to remove Cr(III) from contaminated aqueous environments.

Keywords: Adsorption, Alginate, Cr(III), kaolin

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SELECTION OF A POTENTIAL BIOSORBENT FOR Ni(II)/Cr(VI) BINARY SYSTEM AND INVESTIGATION INTO THE COMPETITIVE ION EFFECT ON BIOSORPTION

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Water is a natural resource that is vital to all living organisms. With the rapid progression of various industries, water pollution has become a worldwide environmental problem. Untreated waste effluent containing various organic, inorganic, and metallic compounds are released to aquatic eco-systems by many industries. Among the pollutants from industrial wastewater, heavy metals occupy a significant place in aquatic pollution because of their toxicity and non-degradability by biological or chemical agents.

Biosorption is a promising and an effective process for the removal of heavy metals from aqueous solutions. This process is greatly affected by the other ions present in the aqueous solution / wastewater. The presence of a single metal ion in wastewater is rare. Wastewater contain multiple metal ions. These co-existing metal ions are more likely to cause interactions depending on the number of metal ions and the levels of initial concentrations of metal ions present in wastewater. In order to achieve a successful biosorption process, it is very important to select a potential biosorbent which can biosorb many metals simultaneously. Furthermore, it is important to know about the affinity of the selected biosorbent for metal ions present in the wastewater and to study the interaction between metal ions present in the wastewater

In this study, adsorption batch experiments were carried out to investigate a potential biosorbent for Ni(II)/Cr(VI) binary system using used tea leaves, peanut husks, rice hull, straw, saw dust, burnt coconut shell, *Cabomba caroliana*, *Hydrilla verticillata*, *Ceratophyllum demersum*, *Salvinia molesta*, *Lemna minor* and seashells. *Lemna minor* did not show adsorption of either Ni(II) or Cr(VI). Peanut husk, rice hull and straw effectively biosorbed Ni(II) from the binary system. *Cabomba caroliniana* adsorbed only Cr(VI) from the binary system. Used tea leaves and sawdust adsorbed both Ni(II) and Cr(VI) simultaneously from the binary system.

The competitive ion effect on adsorption of both Ni(II) and Cr(VI) in the binary system was investigated by keeping the total metal ions concentration fixed to 10 mg/L using the biomass used tea leaves. The binding sites in the biomass of used tea leaves have a greater affinity for chromium (adsorption capacity, q_e= 4.3 mg/g) than nickel (q_e= 1.6 mg/g). The percentage adsorption of Cr(VI) by the biomass of used tea leaves was approximately 40% in the single system. The percentage adsorption of Cr(VI) was not affected by the increasing concentration of Ni(II) ions in the binary system. This shows that there is no interaction

between the metals studied. When Cr(VI) concentration was increased in the binary system, the percentage adsorption of Ni(II) was influenced by the presence of Cr(VI) ions.

Keywords: Biosorption, used tea leaves, binary system, competitive ion effect

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PHYTOREMEDIATION OF NITRATE AND PHOSPHATE BY *Salvinia molesta* Mitchell

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Phosphate and nitrate are two essential nutrients required by plants. Due to the over use of phosphate and nitrate fertilizers, the excess is runoff to nearby freshwater bodies resulting in eutrophication. Phytoremediation is a cost-effective green technology which uses living plants to remediate large contaminated sites. The objective of this study is to investigate the potential of a free-floating aquatic fern, *Salvinia molesta* for nitrate and phosphate removal from an aqueous medium. Samples of *S. molesta* were introduced to nitrate and phosphate solutions separately and 25 mL solution was withdrawn separately at predetermined time intervals for 30 hours. The solutions were analysed for nitrate concentration using a nitrate probe and for phosphate using UV-Vis spectrophotometer. The removal of anions was further studied by varying the initial pH values (3.0 – 10.0) of the anion solution, the mass of the plant (100.0-250.0 g) and with a series of initial anion concentrations (nitrate concentration varied between 1.0 –15.0 mg L^{-1} and phosphate concentration from 10.0 –100.0 mg L^{-1}). Nitrate removal increased gradually and reached a maximum value (62.30%) in 21 h while phosphate removal increased gradually and reached equilibrium (92.87%) in 42 h. The optimum pH range for nitrate removal was from pH 3-7 and for phosphate pH 3-10. When the mass of plant is increased, the anion removal percentage increased. Both anions showed higher removal percentage at low anion concentration and their removal decreased gradually with increasing anion concentration. *S. molesta* showed more tolerance towards higher phosphate concentrations than towards nitrate concentration. Therefore, this species is more favourable for the uptake of phosphate.

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Keywords: Nitrate, Phosphate, phytoremediation, *Salvinia molesta*

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VARIETAL PERFORMANCE OF GREEN CHILLI UNDER DIFFERENT IRRIGATION SYSTEMS AND MULCHES IN THE JAFFNA DISTRICT OF SRI LANKA

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Chilli (*Capsicum annum*) is the major cash crop cultivated throughout the year by Jaffna farmers. Generally, Jaffna farmers get a lower yield (8- 10 ton / ha) from chilli cultivation mainly due to pest and disease incidences. The potential yield of the varieties cultivated are 10 - 12 tons / ha. But the national average yields are as poor as 8–10 ton / ha. Such low yields are mainly due to high incidences of pest and disease, moisture stress, the use of inferior quality seeds, poor crop management and high input costs. This study was conducted to evaluate the varietal performance of green chilli with different mulches under different irrigation methods from May to October, 2016 with the expectation of improving the yield and reducing the cost of production. Irrigation methods (sprinkler, drip and basin), varieties (Galkiriyagama, Super hybrid and Vijaya F_1hybrid and Mulches (no mulch, neem leaves, gliricidia leaves) were factorially combined in a split plot design with three replicates where irrigation methods were assigned to the main plots while all combinations of other two factors (Mulch and Variety) were applied to sub-plots. Pod weight and pod number/plant of the chilli plants were significantly different in neem mulch + sprinkler irrigation method for Super Hybrid variety. The yield of chilli was statistically significant among varieties, mulches and irrigation systems. Higher yield was recorded in neem mulch under sprinkler irrigation system due to the low incidences of pest attacks at the 2nd harvesting in Super Hybrid variety (13.77 ton /ha). Therefore, sprinkler irrigation system with neem mulch is more suitable for Super Hybrid chilli variety cultivation to obtain an optimum yield of green chilli in Jaffna.

Keywords**:** Chilli, yield, irrigation, mulch

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EXTRACTION OF ALGINATES AND CARRAGEENAN FROM SELECTED SEAWEEDS IN SRI LANKA AND THEIR APPLICATION AS STABILIZER FOR ICE CREAM

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Seaweeds are an abundant, under-utilized source in the Sri Lankan coastal line. This study was aimed to extract alginates and carrageenan, select the best stabilizer, emulsifier or stabilizer emulsifier combination extracted from seaweeds to replace gelatine in ice-cream. The extraction of alginates and carrageenan were done and their quality and yield were measured. Different kinds of stabilizer, emulsifier and their combination were tested including the above extracted seaweeds extracts. Sensory tests were conducted to select the best combination. The first sensory test was done with cremodan, gelatine-lecithin, carrageenan and lecithin-alginate and a carrageenan incorporated ice-cream sample which exhibited the best sensory qualities. The second sensory test was done with gelatine, lecithin, carrageenan and carrageenan-lecithin. In the second sensory analysis, carrageenan-lecithin incorporated ice cream had the best sensory qualities. The Friedman rank sum test was used to analyse the data with a significant level of α=0.05. Over two sensory tests were carried out using 0.5% stabilizer, emulsifier or stabilizer-emulsifier combination. The final sensory test was conducted with different levels of the selected stabilizer-emulsifier combination. The different levels incorporated were 0.25%, 0.5% and 0.75%. Physico-chemical tests were conducted for all the treatments made and their results coincided with the standard values. The microbial quality of the final product was measured using the total plate count and was compared with SLSI standards for ice cream. The results were within the limits and the best ice cream developed contained a 0.25% carrageenan-lecithin combination. As a quantitative parameter, the overrun of all the ice cream samples were measured.

Keywords: Stabilizer, Emulsifier, Carrageenan, Lecithin

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MONTE CARLO SIMULATION OF 6 MV PHOTON BEAM CHARCTERISTICS WITH DOSIMETRIC FUNCTIONS FOR MEDICAL LINEAR ACCELARATOR APPLICATIONS

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Linear Accelerator (LINAC) is one of the most common devices used to treat cancer with external beam radiation. It uses high energy radiation beams or photons ranging from 5 to 25 MV to destroy a cancer. In such treatment practices, estimating the most accurate dose and locating the exact treatment position are the common challenges. Monte Carlo calculation for external beam radiation transport can be a useful technique to estimate the properties of the LINAC. The study developed a virtual simulator in MATLAB using Monte Carlo method for dosimetric functions of 6 MV photon beam. The simulated dosimetric functions were then compared with the estimated values from 6 MV photon beams generated by a clinical LINAC machine, Varian Clinac 2100C LINAC using water phantom measurements. Dosimetric beam parameters were generated for 10×10 cm^2 field. The study mainly analyzed percentage-depth-dose (PDD) and lateral dose profile, some key features of a high-energy photon beam. The percentage depth dose (PDD) is used to specify the beam quality for megavoltage radiation beams. Both simulated and estimated curves were normalized 100% at the depth of the maximum dose (d_{max}) on the central axis. Percentage depth dose showed an agreement between simulated and measured data at build up region with a close similarity in the shape of the curves. But there was an obvious difference at the surface region of both curves. Lateral dose profile is the variation of dose observed on a line perpendicular to the central beam axis at a particular depth. The simulated depth dose is slightly deviated from the expected graph as observed from water phantom experiment.

The differences observed in simulations may be due to the smaller number of photons used to reduce high simulation time with available computer power. In order to obtain statistically efficient simulations for photon beam with higher number of photons, preserving greater precision with less simulation time, variance reduction techniques can be used in the future**.**

Keywords: Monte Carlo Simulation, Percentage Depth Dose (PDD), Dose Profiles

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IMPACT OF TEMPERATURE AND WATER STRESS ON GROWTH AND YIELD OF RICE (*Oryza sativa* variety 'Suwandel')

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As the global climate changes rapidly due to many activities, the temperature on the earth is also on the increase. As a consequence the plants could be exposed to water and temperature stress caused by elevated evapotranspiration. When the external temperature is increased above an optimum temperature, plants respond negatively showing a sharp decline in growth and development. This would result in an adverse reduction in the yield of crop plants.

Rice is the staple food of 60% of the world population. It is cultivated in tropical regions of the world where climatic conditions today are optimally suitable for this plant. 'Suwandel' is a traditional variety of rice which is very popular among consumers as it has an exquisite aroma and a milky taste.

This study was carried out to investigate the impact of temperature stress and water stress on the growth and yield parameters of rice, taking the variety 'Suwandel' as the model plant.

The research was conducted in the Open University premises of Nawala in two locations: polytunnel in which the maximum temperature was maintained at 35 ^{o}C using a thermostat and two exhaust fans, and plant house at ambient temperature conditions. The plants maintained in the polytunnel were under temperature stress. Plants in both locations were maintained under two water regimes viz.,100% soil moisture content and 50% soil moisture content (under water stress).

The rice plants obtained through seeds were thinned to make four plants per pot. There were four sets of plants with three replicate pots. All the pots were maintained under completely randomized design, and vegetative parameters (plant height and chlorophyll content) and yield parameters (number of productive tillers/plant, length of the panicle, number of grains /plant, grain yield /plant in grams, number of unfilled grains and number of filled grains / plant and test weight) were recorded.

ANOVA carried on the parameters of growth indicated that plant was affected only by temperature stress while both temperature stress and water stress have affected the chlorophyll content. Number of productive tillers/plant was affected by both temperature and water stresses. In addition, number of grains / plant and number of filled grains/ plant had a negative impact mainly from the water stress.

This indicated that either temperature stress or water stress or interaction of both has adversely affected both the vegetative parameters and yield parameters of the rice variety selected. Rice being a water loving plant has been subjected to stress which caused a substantial reduction in the vegetative and yield parameters.

Therefore, it can be inferred that *Oryza sativa* variety 'Suwandel' would not be able to withstand the temperature stress and the water stress that would occur due to climate change.
Hence, it is recommended to breed more, high yielding rice varieties which are able to withstand stress, as the population of the world is increasing at a fast rate. In addition, it would be very beneficial to the consumers if the variety 'Suwandel' could be improved to tolerate stress while maintaining its desirable characteristics.

Keywords: Climate change, temperature stress, water stress, *Oryza sativa*, vegetative parameters, yield parameters

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THE ISOLATION AND MOLECULAR CHARACTERISATION OF DIFFERENT *Pseudomonas* spp. FROM WASTE ENVIRONMENTS IN SRI LANKA

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Phenol demonstrates widespread occurrence in the environment and hence microorganisms have evolved with the capacity to utilise phenol as a carbon source. Such biodegrading microorganisms can be used as bioremediation agents to treat phenol contaminants in wastewater. The focus of this study was to isolate *Pseudomonas* species as this genus is the most utilised and popular bacterial agent that is used in the bioremediation of phenol. Bacteria were isolated from wastewater collected from petroleum-contaminated environments in the Kurunegala, Kandy, Colombo and Gampaha districts in Sri Lanka. Bacterial isolation and culturing were done in Mineral Salt Media, supplemented with 200 mg/L phenol as the sole carbon source. Bacterial identification was done using 16 S rRNA gene analysis up to the species level. The Phenol degradation efficiency of the identified *Pseudomonas* spp. was measured using 4 - aminoantipyrine spectrophotometric assay. The identified bacterial isolates were screened for the presence of catabolic gene, *LmPH* that codes the large subunit of phenol hydroxylase enzyme responsible for the initial ring activation of phenol by using a primer set designed based on the gene sequence of *P. putida*. The species *P. aeruginosa* (MH031762), *P. monteilii* (MH636875.1) *and Pseudomonas* sp. (MH027519) were isolated in this study. The phenol degradation assay showed that *P. aeruginosa* degrades 1800 mg/L phenol within 120 h, *P. monteilii* degrades 1700 mg/L phenol completely within 144 h and *Pseudomonas* sp. showed complete degradation of 1700 mg/L phenol in 144 h. Furthermore, the gDNA amplification of *P. aeruginosa*, *P. monteilii* resulted in expected amplicons of 684 bp for *LmPH* gene specific primers in PCR, confirming the presence of the *LmPH* gene. Nucleotide sequences of amplicons showed ≥ 99% homology to *LmPH* gene in the BLAST analysis. Laboratory assay on phenol degradation, followed by the characterising catabolic gene of phenol, confirmed the potential of the phenol degradation of isolated *Pseudomonas* spp.

Keywords: Phenol, *Pseudomonas* spp., waste environments

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CHARACTERIZATION OF CALCIUM OXIDE/ 4A ZEOLITE COMPOSITE PREPARED THROUGH THERMAL METHOD FOR VEHICLE EXHAUST ADSORPTION

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Vehicles emissions cause serious damage to the environment. Adsorption of the emissions is the usual technique used for remediation. The present work focuses on developing a composite using 4AZeolite and Calcium oxide (CaO) for absorbing vehicle emissions effectively. The properties of the composite under different temperatures and compositions were investigated. Two different composites were prepared from top layer and precipitate of the mixture of 4A Zeolite / CaO in appropriate composition. Both the top layer and the precipitate of the composite mixture were dried and annealed at different temperatures such as 120 ˚C, 450 ˚C, 550 ˚C, 650 ˚C and their properties investigated using X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy and scanning electron microscope (SEM) techniques.

XRD analysis reveals a phase change in both top and precipitate of the composite. When increasing the temperature, new peak at 37.4° was observed in the precipitate and some XRD peaks disappeared in both composites at elevated temperatures. FTIR spectra of the composite shows peaks relevant to both zeolite and CaO at wavelength range from 715 cm^{-1} to 1450 cm^{-1}. When temperature was increased, the intensity of peak at 1415 cm^{-1} was gradually decreased and broad peaks were observed in the range from 875 cm^{-1} to 900 cm^{-1} in both top and precipitate layers. SEM images show the morphology changes of composites prepared using both top and precipitate with increasing temperature. Phase change, morphology and the surface area change observed in the present study would considerably affect the effective adsorption of vehicle emissions.

Keywords: 4A Zeolite, Calcium oxide, temperature series

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SYNTHESIS OF IRON(III)-NAPHTHYLACETOHYDROXYMATE COMPLEX AS CHELATION-ENHANCED FLUORESCENCE SENSOR FOR DETERMINATION OF FLUORIDE IONS

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Fluoride is a toxic ion and levels above 2 ppm in drinking water cause chronic fluoride poisoning. It has been reported that the drinking water available in the dry zone has fluoride levels higher than 4 – 6 ppm, which is higher than the WHO recommended level of 1.5 ppm. Therefore, there is a great need to introduce a cost effective or portable device to detect the fluoride concentration in a critical analyte system. The present study discusses a Chelation Enhanced Fluorescence Sensor developed for the determination of trace level fluoride ions.

Naphthylacetohydroxamic acid and iron(III)-naphthylacetohydroxymate complex were synthesized using standard procedures. It was found that with the complexation of iron(III) the fluorescence of naphthylacetohydroxamic acid has been quenched. The characteristic UV absorbance of naphthylacetohydroxamic acid was found to be 267 nm while its emission wave length was found to be at 340 nm. With the increase of the metal ion the emission intensity reduced because the amount of the unbound form of the probe (Naphthylacetohydroxamic acid) had decreased.

When fluoride is added to iron(III)-naphthylacetohydroxamate complex it dissociates to release unbound naphthylacetohydroxamic acid in the solution and results in the formation of the most stable FeF_3 complex. The unbound naphthylacetohydroxamic acid enhances the fluorescence.

The versatility of the application of this novel probe was assessed by different synthetic and real sample matrices and compared with ion selective electrode measurements under the same optimum conditions. No significant interference was observed with co-existing common ions competing with the fluorescence intensity. The traditional methods of ion selective electrode were not able to detect fluoride ions at concentrations below 0.05 ppm. It was found that the iron(III)-naphthylacetohydroxamate probe could be successfully applied to a much less fluoride concentration (0.005 ppm).

In this study it was found that the iron(III)-naphthylacetohydroxamate probe with a concentration of 7.6×10^{-7} mol dm^{-3} was able to detect fluoride ion concentration of 9.4×10^{-9} mol dm^{-3} at pH = 4. The tolerance limit for interferences of other co-existing common ions on emission intensity was found to be 2.43×10^{-7} mol dm^{-3}.

Keywords: Chelation Enhanced Fluorescence Sensor, Fluoride, Hydroxamic acid

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LITERATURE REVIEW FOR IDENTIFYING THE RESEARCH GAPS ON TAXONOMY, MOLECULAR SYSTEMATICS AND CONSERVATION STATUS OF ENDEMIC SKINK GENUS *Lankascincus* (SQUAMATA: SCINCIDAE)

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Sri Lanka harbours a rich endemism for skinks. As a key link in the food-chain, skinks support to balance the ecosystem and help retaining eco-cycles, in the ecosystem. The genus *Lankascincus*, an endemic skink genus in Sri Lanka, has 10 identified species. The current rate of disappearing biodiversity and the high deforestation rates have threatened the survival of *Lankascincus*. Published literature on species of this endemic genus is scarce and yet to be carried out. Therefore, the aim of this study was to identify the research gaps on morphological, molecular and ecological aspects of research on all *Lankascincus* species. Published literature including research articles, short communications, abstracts and books were obtained through web based (Google scholar) and printed documents. The published literature demonstrates the incomplete existing knowledge on taxonomy and phylogeny of *Lankascincus*. Further, there are recognised contradictions in distinguishing the *Lankascincus* species morphologically. Majority of the studies focusing on morphology but seldom on the molecular-level or ecology, which was a major research gap in *Lankascincus* research. The lack of data has provoked conflicts in *Lankascincus* phylogeny and the requirement of great demand for species-specific conservation strategies. According to the literature, molecular and ecological studies are the most validated methods of reptile research in identifying species and to develop conservation plans, where we can recommend carrying out such research extensively for species endemic to Sri Lanka as a preservative method for rich biodiversity in the country. Thus, this literature evaluation proves the essentiality of comparative morphological analysis for all ten species in the genus along with a molecular level identification to distinguish species, to determine phylogeny and taxonomy and for species specific conservation plans.

Keywords**:** Skinks, *Lankascincus*, endemism, reptile conservation

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PRESERVATION OF SNAKE GOURD (*Trichosanthes cucumerina)* BY FERMENTATION

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This investigation was carried out to preserve snake gourd by two fermentation methods. Two types of snake gourds were chosen from Sri Lankan supermarkets and local fairs. The two snake gourd types were pickled using two available traditional pickling methods for preservation (i.e. Sinhala pickling and sweet pickling). The two pickles were produced using TA 2 (long snake gourd) and MI Short (short snake gourd) and a combination of both long and short snake gourds (i.e. TA 2 and MI Short). A sensory analysis was carried out to select the best product from the two preservation methods. The resulted best products were again subjected to sensory evaluation to select the best traditional fermentation technique. For the selected two best products, experimental procedures were carried out to test for the physical, chemical and microbiological parameters. After a storage period of seven months, the products were analyzed for microbial stability and for proximate composition. According to sensory results, the pickles made from MI short snake gourd were most preferred and among the two traditional fermentation methods, the sweet pickle had a higher rank sum and was selected as the best fermentation method. Overall, the acceptability data were considered for the samples to statistically analyze using Friedman Test in Minitab Statistical Package. The sweet pickled MI short snake gourd had a moisture level of 89.02% while the Sinhala pickled MI short snake gourd had 89.05% of moisture. The dried and powdered product of sweet pickled MI short snake gourd had protein, fiber, total fat and ash contents as 3.94%, 3.51%, 0.89% and 2.0%, respectively whereas the dried Sinhala pickled MI short snake gourd had protein, fiber, total fat and ash contents as 4.99%, 3.65%,0.92% and 2.36%, respectively. Sweet pickle had a pH of 3.52 while the Sinhala pickle had a pH of 3.46. The salinity of the sweet pickle was 102 g/kg and for the Sinhala pickle it was 75 g/kg. Mineral content observed by Atomic Absorption Spectrophotometer gave 283.9, 219.0, 4.9197 and 42.5 mg/L of potassium, calcium, iron and magnesium, respectively, for the sweet pickle sample, and 1758.3, 418.6, 6.4 and 142.5 mg/L of potassium, calcium, iron and magnesium, respectively, for the Sinhala pickle sample. No pathogenic microorganisms were detected in the products. Sweet pickle and Sinhala pickle had an APC count of 5.6×10^3 and 5.8×10^2, respectively. The products after 7 months of storage gave 90.70% and 90.11% of moisture levels for sweet pickle and Sinhala pickle, respectively. Sweet pickle contained 3.5% of protein and 1.70% fiber after the storage. The Sinhala pickle contained 4.94% of protein and 2.03% of fiber content after the storage. The pH levels of samples were 3.76 and 3.68 for sweet pickle and Sinhala pickle, respectively. The APC counts during the two month interval have increased in both products indicating a good environment for the fermentation bacteria. Both products after the 7 month storage had no development of yeast and mould but had become

smooth and resulted in a strong odour with a persistent colour. The results show that the pickles made from MI short snake gourd has a high level of minerals and nutrients which are good for the health and the pickling methods contribute to microbial safe products and also is a good approach to preserve snake gourd.

Keywords: fermentation, pickling, preservation, snake gourd, Sinhala pickle, sweet pickle

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OXIDATION AND REDUCTION OF Fe IONS INTRODUCED TO BANANA PITH ELECTROLYTIC MEDIA OF A BIO-BATTERY

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Innovative solutions are essential to cope with challenges to the construction of bio-batteries as they provide non-toxic and cheap energy requirements compared to other available technologies. Hence, the current study investigated the performance of a bio-battery made of mild steel electrodes with *ambun* banana pith as the electrolytic media by using electrochemical techniques such as cyclic voltammetry (CV) and impedance spectroscopy (IS). A comparison was made on the performance of the bio-battery with the inclusion of Fe^{3+} ions to the banana pith and without it. Electronic conductivity was observed in both of the cells made from the banana pith and banana pith with Fe^{3+} ions after connecting a constant voltage of 2 V in between the mild steel electrodes for two hours, which was an indication of initial polarization of the media due to diffusion of Fe ions from mild steel electrodes to the electrolyte. Nyquist plots of IS curves showed that polarization of the medium increased the charge transfer resistance and decreased the admittance of a constant phase element. Interpretation of the CV curves supported the electrochemical reversible nature of the electrolyte with or without the inclusion of Fe^{3+} ions. The iron complexed with phenolic groups in the banana pith further facilitated the transformation into a redox indicator of Fe^{3+} and Fe^{2+} ions. In fact, this study may have laid the foundation for widening the applicability of banana pith as a constituent for rechargeable bio-batteries in the future.

Keywords: bio-battery, cyclic voltammetry, impedance spectroscopy

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FORMULATION OF A COOKIE USING COMPOSITE FLOUR BASED ON COWPEA, KOLLU, RICE AND WHEAT FLOUR

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Modern consumers demand food that features two main properties: the first one deals with convenience whereas as the second is connected to traditional nutritional aspects of the food expected from its regular ingestion. This study seeks to investigate the potential of Cowpea flour, Kollu flour, rice flour and wheat flour in cookie making which could be used as a meal replacement. Cookies were prepared according to the factorial experimental design. Four flour samples (T_1, T_2, T_3, T_4) were prepared. Sensory evaluation was carried out for all four (T_1, T_2, T_3, T_4) samples. The most preferred sample (T_1) was selected from the sensory evaluation. This contained, 25 g cowpea flour, 15 g kollu flour, 20 g rice flour (Pachchaperumal), 40 g wheat flour, 35 g sugar, 40 g margarine, 10 ml egg and 10 ml milk, 1g salt and 2 g baking powder.

All the tests were carried out for the selected sample from the sensory evaluation. The proximate analysis of the sample (T_1) revealed that the selected composition has 3.18% of mixture content, 12.05% of protein, 16.81% of total fat, 62.40% of carbohydrate, 3.26% of fibre and an energy content of 449.09 kcal g^{-1}. Cookie was rich with minerals such as Mg (711.84± 0.46 ppm), Ca (46.60 ± 0.008 ppm), Na (512.564± 0.06 ppm), Fe (39.169± 0.0098 ppm). According to the fatty acid profile analysis, lauric, myristic, palmitic were present with 98% probability. Oleic, stearic, linoleic acids were identified with 99% probability. Based on the DPPH radical scavenging test for the selected cookie (T_1) methanol soluble fraction exhibited the lowest (IC50 value, i.e., 14.74 ± 0.02 mg /ml while the water soluble fraction IC50 values,(i.e., 16.93 ± 0.04). Total phenolic content of the extract was 645.30 µg GAE/mg extract. Yeast and mould count of the tested sample were too low than standard level (1.0x10 g^{-1}). Moisture content variation was very less during three months' time period and the results of peroxide value indicated that there was high quality fat contained in the food and the product was not oxidized during three months' time period. The product also showed a minimum shelf life of 12 weeks.

Keywords: Composite flour, Cookie, Antioxidants, Fatty acid, minerals

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SPECIES COMPOSITION AND CATCH PER UNIT EFFORT (CPUE) OF THE OFFSHORE FISHERY, OPERATED FROM THE GALLE FISHERY HARBOUR, SRI LANKA

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Fisheries is one of the major income sources for Sri Lankan coastal inhabitants. Of the 15 fisheries administrative districts in Sri Lanka, the Galle district which contributed nearly 55,200 Mt of production in 2015 is the second largest fisheries administrative district. The present study focused on the offshore fishery, operated from the Galle fishery harbour, and ascertained fishing methods, species composition and Catch per Unit Effort (CPUE) for each species. Data was collected from 98 randomly selected multiday boats, which landed between 31st August and 11th November 2017. The data on fishing methods, species composition and the biomass of each species was gathered as primary data at the fish landing centre. The data on cost revenues and new technological approaches were collected as secondary data through a questionnaire and interviews from fishery inspectors and fishers engaged in offshore fisheries. Ring net, gill net and long line were the major fishing methods used. There were 19 fish species, belonging to 10 families encountered during the study. There were significant differences ($p<0.05$) in fish landings among the three fishing methods. From the total offshore fish landings in the Galle fishery harbour, 68%, 23% and 5% were from the ring net, gill net and long line, respectively. The highest species composition was recorded from ring nets (16 species) followed by the gill nets (9 species) and longlines (4 species). *Decapterus russelli* (Indian Scad), *Katsuwonus pelamis* (Skipjack tuna), *Auxist hazard* (Frigate tuna), *Elagatis bipinnulata* (Rainbow runner/ "lennaw") and *C. maculatus* (Rough tiger fish/ "pothubari") were the dominant species in ring nets, of which *D. russelli* accounted for the highest biomass (CPUE, 200.57±3.10 kg per day). *Katsuwonus pelamis* was the dominant species recorded from gill net catches (CPUE, 188.02±5.27 kg per day), while *Thunnus albacares* (Yellow fin tuna) was dominant in the longline catches (CPUE, 93.77±4.52 kg per day). The study revealed that gill net and longline catches consisted of economically valuable, mature species and the quality of the harvest was increased, reducing post-harvest losses, when compared to the ring nets. *K. pelamis*, *T. albacares* and *T. obesus* (Big eye tuna) were the main species targeted by longline and gill net fishers. Ring net fishery is more profitable than the other two methods because the operational cost for gill net (130,000 LKR per boat trip) and longline (135,000 LKR per boat trip) are higher than the ring net (99,500 LKR per boat trip). From the data obtained from fishers, the secondary variability of species is an important factor to be considered when comparing

fisheries statistics and suitable management strategies should be adopted to minimize the juvenile in the harvest especially in ring net fishery.

Keywords**:** Ring net, Long line, Gill net, Multiday boats, Dominant species

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ENHANCEMENT OF THE PERFORMANCE OF DYE SENSITIZED SOLAR CELLS BASED ON NATURAL PIGMENT EXTRACTED FROM *Carissa carand* FRUIT AND SnO_2 FILMS COATED WITH A THIN LAYER OF SiO_2

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Dye sensitized solar cells, which can be categorized as the second generation of solar cells are low cost energy conversion devices because of its simple fabrication technique in contrast to silicon or other kinds of solar cells that are made using thin film technologies. The efficiency of these solar cells can be increased by improving the properties of the semiconductor material and the dye sensitizer. In this study, we prepared thin films of SnO_2 and then a thin layer of silica (SiO_2) was coated by dip coating the films in a silicic acid solution (H_2SiO_3). The silicic acid solution was prepared by dissolving 1.2 g SiO_2 in 100 ml of deionized water. Silicic acid with high purity was obtained from SiO_2 extracted from rice husk ash. The natural pigment extracted from *Carissa carandas* fruit, which is locally called as "Jamson", was used as the sensitizer in the solar cells. Films of SnO_2 coated with a layer of SiO_2 were characterized with impedance spectroscopic measurements and the fabricated cells were characterized with I-V measurements. The results show that the highest impedance of the composite films could be obtained by dipping SnO_2 films in silicic acid for 10 min and the highest recorded photo current was also obtained from the solar cells fabricated with the above photo anodes. It can be concluded that at this optimum condition, the SiO_2 layer deposited on SnO_2 has the highest capacitive impedance and it suppresses the recombination of photo generated charge carriers injected into the conduction band of SnO_2 films to enhance the photocurrent.

Keywords**:** Dye-Sensitized Solar Cells, silicic acid, composite films, sensitizer, semiconductor, natural pigment, Dip coating

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AUTOMATED ELECTROPLATING DEVICE COUPLED WITH A COLORIMETER TO MAINTAIN ELECTROPLATING VOLTAGE

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Electroplating is a chemical process of forming a protective coating of one metal upon another. In this study, a thin layer of a different metal is plated on another to get some desired properties. Normal Electroplating cell consists of four parts; Anode, Cathode, Electrolyte solution and the external direct current (dc) power supply. There are two types of electroplating; the consumable anode system and the non-consumable anode system. In the consumable anode system**,** the anode gets corroded during the electroplating process and the current density across the anode and cathode gets changed. In non-consumable anode systems, the ions in the solution are deposited on the cathode and the concentration decreases during the plating process. Therefore, the electroplating solution should be replenished frequently for the continuity of the plating process. Galvenostat and Potentiostat systems are used to maintain fixed current through an analyte solution and a fixed voltage across the electrodes in electroplating, respectively.

The constructed device consisted of an electroplating device with transparent cell, colorimeter, voltage amplifier, data processing unit and voltage driver circuit. The concentration variation of the electroplating solution could be linearly detected by the colorimeter while the other components in this device decide the electroplating voltage according to the present concentration of the electrolyte solution and the desired condition of the electroplating. This desired condition (e.g. electroplating voltage and concentration of the solution) is governed by the program written in the data processing unit and accordingly**,** the electrode voltage is automatically adjusted and driven by the voltage driver circuit**.** Therefore, the plating process is continued in a desired condition even though the concentration of the solution gets reduced. $CuSO_4$ as the electrolyte solution, carbon-rod as the anode and an aluminium-plate as the cathode were used to demonstrate the working principle of the constructed device.

The following equation can be obtained for the concentration of electrolyte solution using Beer-Lambert's Law.

$$C = k\,\{-\log[V/V_o]\}$$

Where, C is the concentration of the analyte solution, V is the output voltage of the colorimeter and V_0 is the corresponding voltage to the blank solution. *k* is the concentration - voltage proportionality constant which depends on the properties of incident radiation as well as the solution. This constant was predetermined using a series of electrolyte solution with different concentrations. According to the results**,** the colorimeter device produced a linear relationship between the concentration of the solution and the absorbance defined in Beer-Lambert's Law.

The software decides the electroplating voltage according to the concentration of the electrolyte solution. For simplicity, it is assumed that, to maintain a uniform

electroplating, the electroplating voltage (V_e) is inversely proportional to the concentration of the electrolyte solution. It is mathematically given by $V_e \alpha 1/C$, then $V_e = K_e(1/C)$ where, K_e is an experimental constant for a specific system. In this system, any complicated relationship between the concentration of the electrolyte solution and electroplating voltage can be managed by modifying the program according to the desired condition in electroplating. This system is more important for an electroplating system in which the concentration of the solution is changed rapidly. Therefore, this is a suitable solution for the replenishment problem of the non-consumable anode system.

Keywords: Electroplating, Electrode voltage, Colorimetry

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SPECTROSCOPIC AND MOLECULAR DOCKING EVIDENCE OF DICLOFENAC AND MEFENAMIC ACID BINDING TO DNA

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Non-steroidal anti-inflammatory drugs (NSAIDs) are used in treatments such as inflammatory, analgesics and anti-pyretic by interacting with cyclooxygenase and forming prostaglandins. The study of the interaction of NSAIDs with DNA is very sensitive and significant not only in understanding the mechanism of the interaction but also in new drug designing. Diclofenac and mefenamic acid are different classes of drugs called non- steroidal anti-inflammatory drugs. A set of biophysical experiments such as UV-visible spectroscopy, Fluorescence spectroscopy and viscosity measurement studies and molecular docking studies were conducted to investigate the interaction mechanism of DNA with small molecules. The software- aided molecular docking plays an important role in the drug design as well as in the mechanistic study by placing the molecule into the binding site of a target macromolecule in a non-covalent fashion.

The binding constant of diclofenac and mefenamic Acid from UV – visible experiment was found to be 2.05 x 10^4 M^{-1} and 2.73 x 10^4 M^{-1}, respectively. The corresponding value of fluorescence experiments of diclofenac and mefenamic acid was 8 x 10^{-3} µl ng^{-1} and 6 x 10^{-3} µl ng^{-1}. Both, binding constant and fluorescence experimental values showed that the diclofenac indicates a relatively higher affinity to DNA due to two chloride substitutions, which promote inter-molecular hydrogen bonding with DNA backbone. Apart from that, hyperchromism and hypochromism are the two main effects that can be observed with the increasing concentration of DNA and measuring the effect at a particular wavelength. The drugs diclofenac and mefenamic acid are resulting in the tendency of hypochromism. This is because when the drug molecule binds to the DNA, the orbital of the binding ligand could couple with an orbital of base pairs in the DNA. The coupling orbital will be partially filled by electrons, thus leading to a decrease in the transition probabilities.

The classical intercalators often result in increased viscosity of DNA solution due to the lengthening of DNA duplex as base pairs are unwound to accommodate such ligands. Yet, in the case of groove binders, if there is no noticeable increase in the viscosity of DNA solution, relatively small changes in viscosity can be considered for groove binders. The molecular docking studies exposed both drugs showing binding with DNA in minor grooves. The resulting relative binding energy of respective docked complexes (diclofenac and mefenamic acid) was found to be -6.0 kcal/ mol and -5.8 kcal /mol respectively. They resulted in

the minor groove binding mode because of the narrow pocket area. Small molecules interact with minor groove when large molecules tend to be bound at the major groove. It was confirmed that the molecular docking results are in approximate correlation with the studied experimental results.

Keywords: Molecular docking, NSAIDs, DNA

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EFFECT OF IRRIGATION INTERVAL ON THE GRAIN YIELD OF BG 250 AND BG 94-1 GROWN IN AMPARA DISTRICT SRI LANKA

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Irrigation plays a vital role in paddy production in Ampara district. Major, medium, minor and seasonal irrigation projects have been implemented for developing the paddy sector in the district. Irrigation interval has an influence on the growth and the yield of the rice crop. During *"Yala"* season, the Irrigation Department provides limited water whenever available for the irrigation of the paddy fields in Ampara district. Field trials were conducted at Rice Research Station, Sammanthurai during *"Yala"* season 2017 to evaluate the effects of irrigation intervals (7, 10 and 14 days) on growth and yield parameters of rice varieties Bg 250 (80 days-Short duration) and Bg 94.1 (105 days-Long duration) in order to cope with drought situation in the study area. The trial was performed as a factorial experiment in randomized complete blocks design with six treatments and three replicates. The results showed that the Bg 250 produced a grain yield of 2967.30 ± 90.92 kg/ha which is 27% higher yield than Bg 94-1 with the application of water at 7 days irrigation interval. The Bg 250 produced 2589.50 ± 350.83 kg/ha (18% higher yield) grain yield with the application of water at 10 days irrigation interval. Cost of irrigation for the Bg 250 was 17.6 % and 16.7% lower than the cost of Bg 94-1 when water was applied at 7 days and 10 days irrigation intervals respectively. The grain yield was significantly different ($P<0.05$) between the rice varieties Bg 250 and Bg 94-1 where the Bg 250 produced higher grain yield in all three irrigation intervals. However the yield of the 14 day irrigation interval was lower than 7 days and 10 days of irrigation interval even though the irrigation cost was the lowest. Therefore Bg 250 is suitable for "*Yala*" season in Ampara District with the application of water at irrigation intervals of 7 days and 10 days to deal with the shortage in water that is being faced by farmers in Ampara district now and in the foreseeable future.

Keywords**:** Cost of irrigation, Drought, Irrigation interval, Rice

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EFFECTS OF COCONUT WATER ON CALLUS INDUCTION OF *Gyrinops walla* Gaetner ('WALLA PATTA')

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Agarwood oil obtained from a number of genera of the family Thymelaeaceae is an expensive product in the global market. *Gyrinops walla* is the only representative species of agarwood in Sri Lanka experiencing rapid declining due to over-exploitation and illicit felling. It has now become a threatened species which requires prompt conservation strategies and tissue culture is one of the alternative techniques for this. The effect of coconut water on callus induction was examined in the present study because coconut water is one of the most versatile natural products, commonly used as a growth enhancer in plant tissue culture/micropropagation. Modified Murashige and Skoog (MSM) and Woody Plant (WPM) media supplemented with 3% (w/v) sucrose, 0.25% (w/v) activated charcoal and gelled with 1% (w/v) agar were used with varying concentrations of coconut water (T1 – T10) to investigate the callus induction in *G. walla*. Fresh leaves were washed with Teepol and running water and cut into square-shaped pieces of 1 cm^2. Surface of the leaf pieces was sterilized with 70% alcohol for one minute and 5% NaOCl for 10 minutes under aseptic conditions. Explants were placed on culture media and incubated at 25 °C and 75%±10% relative humidity under dark condition. Weight of the callus was measured and callus induction percentage was calculated for a period of 60 days. Mean comparison (ANOVA and Tukey's Honest Test) was performed using SAS. Number of days taken to initiate callus was subjected to Z-test using SPSS. Though callus initiation was observed in all coconut water concentrations except control, the highest callus induction was noted in T6 in MSM (100 ml/l) and T10 in WPM (100 ml/l) with 41.5% and 38.3%, respectively. Comparatively, the highest concentration of coconut water in MSM (T6) showed higher rate of callus induction during 60 days of incubation of *G. walla* leaf explants.

Keywords: Agarwood, Callus, Coconut water, *Gyrinops walla* Gaetner, 'Walla Patta'

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THE EFFECTS OF DIFFERENT MULCHING MATERIALS ON GROWTH AND YIELD OF LOCAL GINGER (*Zingiber officinale* Roscoe) CULTIVATED IN THE LOW COUNTRY INTERMEDIATE ZONE OF SRI LANKA

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Mulching is one of the important and effective practices in improving growth and yield of ginger (*Zingiber officinale* Roscoe). A field experiment was conducted at the Intercropping and Betel Research Station, Narammala with the objective of investigating the effect of different mulching materials used on growth and yield of ginger. Randomized complete block design (RCBD) with three replicates was employed for the study. Six treatments namely control –without mulch (T1), straw (T2), gliricidia leaves (T3), polythene mulch (T4), coconut leaves (T5), and coir dust (T6) were used with local type of ginger for the study. Equal amount (35 L) of water (20% of field capacity) was applied to each plot (130 cm in length and 105 cm in width) and other inter cultural practices were done according to the recommendations of Department of Export Agriculture (DEA). Data related to growth and yield was collected at one month interval during six months of study period. Data were analysed using SAS statistical package. All the ginger plants with mulches showed better performances than the plants without mulch. Gliricidia mulch positively contributed to increasing yield of ginger (44% per hectare more than average yield). The results further indicates that mulching has a remarkable effect on growth and yield of ginger and this study showed that Gliricidia as a mulch is superior for Ginger and therefore farmers can be advised to use this freely available mulch in their farm lands to improve the yield of Ginger.

Keywords- Ginger, Gliricidia mulch, Growth, Yield

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THE EFFECTS OF SUPER ABSORBENT POLYMERS (SAPs) ON GROWTH OF BLACK PEPPER (*Piper nigrum* L.) IN NURSARY MANAGEMENT UNDER VARIOUS IRRIGATION REGIMES

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Black pepper is one of the most economically important export crops in Sri Lanka. Local black pepper owned high demand in the export market due to its high piperine content. But drought tolerant ability of local black pepper is lower than other exotic types. Therefore, drought stress is one of the most adverse limitations of local black pepper production in Dry and Intermediate zones of Sri Lanka. By applying Super Absorbent Polymers better results can be achieved by means of moisture conservation. A study was undertaken to examine the effect of different irrigation intervals and different weights of super absorbent polymer to find out the best treatment combination on black pepper plants under nursery management. The experiment was conducted at the Betel Research Station, Narammala. GK-49 variety of black pepper and Zeba, the super absorbent polymer, were employed in this study. An experiment was carried out in factorial layout based on Completely Randomized Design (CRD) with three replications. The factors were; irrigation interval with three levels as 4 days, 8 days, 10 days (T1 to T3) and weights of Zeba with four rates as no Zeba , 1 g of Zeba , 1.5 g of Zeba and 2 g of Zeba (L1 to L4). Before planting Zeba was added to the media and two nodal cuttings of black pepper we replanted. Plant growth parameters were measured in 2 week intervals and all the data were analysed using SAS package. Results of statistical analysis showed that the rate of application of Zeba, irrigation levels and their interaction had a significant effect ($P<0.0001$) on plant growth parameters. Plant parameters decreased with the decreasing amount of Zeba and increasing irrigation interval. In this study 1.5 g of Zeba with 4 day irrigation interval (L3T1), 2 g of Zeba with 4 day irrigation interval (L4T1), 2 g of Zeba with 8 day irrigation interval (L4T2) treatments were the better treatments. However, when considering the cost effectiveness 2 g of Zeba with 8 day irrigation interval (L4T2) treatment can be considered as the best treatment for increasing plant performances and decreasing water stress conditions for the plant.

Keywords**:** Irrigation, Pepper, Super Absorbent Polymer, Water stress, Plant parameters

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GROWTH AND YIELD RESPONSE OF ONION (*Allium cepa*) FOR DIFFERENT TYPE OF BIOCHAR AND FERTILIZER REGIME IN RED YELLOW LATASOLS IN JAFFNA PENNINSULA

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Soil fertility is an essential aspect for sustainable agricultural productivity. It is a manageable soil property and its management is vital for achieving sustainable crop production in both short-term and long-term. Biochar is produced as an amendment to soil, mainly to improve nutrient retention and carbon storage. In the Jaffna peninsula, soil has low fertility due to intensive cultivation. Therefore farmers use inorganic fertilizers at very higher rates than the departmental recommended rates even though the yield is not high. This research was conducted to find the response of *Allium cepa* (onion) for three types of biochar namely coconut char (CC), palmyrah char (PC), and paddy husk char (PHC) in combination with organic and inorganic fertilizers and to find the effect of these biochar on growth parameters of onion. The field experiment was carried out at the Regional Agriculture Research Station, Thirunelvely. Randomized Complete Block design was used with three replicates and eight treatments. The treatments were, department recommended fertilizer (DRF), farmers practice fertilizer (FPF) and each three types of biochar with either DRF or FPF. Treatment, farmer practice fertilizer and paddy husk char (T7) showed the significantly highest mean plant height (23.2 cm), mean number of cluster per plant (6.5) and mean cluster weight with leaves (15.86 g). Similarly, T7 treatment showed the significantly highest mean cluster weight without leaves (14.75 g), mean fresh weight of yield (6750 kg/ha) and average yield (6393 kg/ha). Hence the study results revealed that the yield of onion can be increased by using farmer practice fertilizer with paddy husk char than farmer practice fertilizer alone.

Keywords**:** Biochar, Onion, Growth and yield

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EFFECTS OF PARTIALLY-BURNT PADDY HUSK ON GROWTH AND YIELD OF *Curcuma longa* L. (TURMERIC) CULTIVATION IN SRI LANKA

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Farmers use higher amount of potassium fertilizer in the form of Muriate of Potash (MOP) than other fertilizer for Turmeric cultivation because Turmeric plants show positive response to it. There are so many disadvantages of the usage of inorganic fertilizer, at the same time it increases the cost of production. Excessive use of chemical fertilizers and other agro-chemicals, which are the important inputs in modern farming, creates depletion in soil fertility and pollution in surface water bodies. The combined use of organic and inorganic fertilizers in crop production has been widely recognized as a way of increasing yield and improving productivity of soil. In Sri Lanka, paddy husk is available in sufficient quantities as by products from paddy industry at relatively low cost, paddy husk is converted into partially-burnt paddy husk by controlled burning. Therefore, this experiment was conducted at the Intercropping and Betel Research Station, Narammala and designed to identify the optimum percentage of inorganic fertilizer and partially-burnt paddy husk (PBPH) for highest yield in Turmeric cultivation. One factor in RCBD with three replicates was used as the design with 7 treatments; T1 (Control with no fertilizer), T2 (100% MOP= 20 g/m^2), T3 (75% MOP= 15 g/m^2 and 25% PBPH= 230 g/m^2), T4 (50% MOP= 10 g/m^2 and 50% PBPH= 450 g/m^2), T5 (25% MOP= 5 g/m^2 and 75% PBPH= 680 g/m^2), T6 (100% PBPH= 900 g/m^2) and T7 (100% MOP= 20 g/m^2 and 50% PBPH= 450 g/m^2). All data were subjected to Analysis of Variance (ANOVA) using SAS software package. Results revealed that T7 was significantly different from other treatments having highest plant height, number of leaves, stem diameter, number of rhizome fingers, fresh weight and rhizome and dry weight of rhizome. Therefore, farmers could use the freely available paddy husk in the farm field with muriate of potash to get highest yield than using it alone. Partially-burnt paddy husk has other advantages such as potassium contribution, enhanced moisture content and assist the turmeric plants to withstand the drought conditions.

Keywords: Turmeric, partially-burnt paddy husk, potassium, yield

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