UNIVERSITI TEKNOLOGI MARA

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ASiD COLLOQUIUM SERIES 2024

EXTENDED ABSTRACT BOOK

CENTRE OF FOUNDATION STUDIES
UNIVERSITI TEKNOLOGI MARA
CAWANGAN SELANGOR KAMPUS DENGKIL

ASiD COLLOQUIUM SERIES 2024

EXTENDED ABSTRACT BOOK

Editors
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Preface

Assalamu'alaikum warahmatullahi wabarakatuh and greetings.

It is with great pleasure that I welcome you to the ASiD Colloquium 2024, where we celebrate the research contributions of our esteemed lecturers. The papers presented reflect the dedication, curiosity, and intellectual rigor of our lecturers, showcasing the diverse and impactful work they have undertaken.

In sharing their findings, we not only strengthen our academic community but also inspire one another to continue pushing the boundaries of knowledge and discovery. As we engage with each other's work, we open doors to potential collaborations and interdisciplinary explorations that can drive our collective progress forward.

I extend my deepest gratitude to the organizing committee for their hard work in bringing this colloquium to fruition and to all the lecturers who share their work. Your contributions are invaluable, and we look forward to the stimulating discussions that will follow.

Thank you for your participation, and may this colloquium inspire new ideas and opportunities for collaboration in the future.

Warm regards,
Dr. Fadiatul Hasinah Muhammad
Chairperson
ASiD Colloquium 2024

Foreword

Assalamu'alaikum warahmatullahi wabarakatuh and greetings.

It is our great pleasure at the Centre of Foundation Studies, Universiti Teknologi MARA (UiTM) Cawangan Selangor Kampus Dengkil to present the first extended abstracts of ASiD Colloquium Series 2024. We are privileged to have received contributions from an array of experts across diverse fields. These wide-ranging perspectives embody the spirit of collaboration necessary to address the complex challenges faced by education today. The research reflects your expertise and significant steps taken in the effort of building a sustainable future in education.

In today's rapidly evolving world, the convergence of technology and education presents unprecedented opportunities for educators, researchers, and institutions to rethink teaching, learning, and their contributions to a sustainable future. As we look ahead, it is evident that innovation in education requires more than simply adopting new technologies. It demands interdisciplinary collaboration, creative problem-solving, and a deep understanding of the social, economic, and environmental challenges. This compilation stands as a testament to the tireless efforts of scholars who not only examine these challenges but also propose practical solutions for a more sustainable world.

I would like to extend my sincere gratitude to the contributors, editors, and reviewers who made this publication possible. Their dedication to advancing knowledge and shaping the future of education is truly commendable. I am confident that the insights shared within these pages will inspire readers to think critically and act decisively in shaping the future of education for generations to come.

Thank you.

Professor Ir. Dr. Ahmad Farid Abidin @ Bharun
Director
Centre of Foundation Studies
Universiti Teknologi MARA (UiTM)
Cawangan Selangor
Kampus Dengkil

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Conductivity and Optical Properties of Solid Polymer Electrolytes Based on PEMA-$LiNO_3$

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ABSTRACT

In this study, solid polymer electrolytes based on poly(ethyl methacrylate) (PEMA) doped with lithium nitrate were prepared using a solution technique. The conductivity and interaction characteristics of the polymer electrolytes were investigated using electrochemical impedance spectroscopy (EIS) and Fourier transform infrared spectroscopy (FTIR). The EIS results demonstrated that increasing the $LiNO_3$ concentration led to improved ionic conductivity, suggesting enhanced ion mobility within the polymer matrix. The PEMA with 40 wt% $LiNO_3$ exhibited the highest conductivity of 5.16×10^{-6} S cm^{-1}. FTIR spectroscopy was employed to analyse the interactions between PEMA and $LiNO_3$, confirming that $LiNO_3$ was successfully incorporated into the polymer matrix. These results will facilitate in the development of improved and reliable PEMA-based electrolytes, promoting their use in advanced energy storage systems.

Keywords: Ionic conductivity, electrical properties, solid-state battery, lithium ion, solid electrolytes

1. INTRODUCTION

Lithium-ion batteries (LIB) have grown rapidly and become dominant in various applications, such as electric vehicles and mobile devices, since Sony Corporation introduced them in 1991 (Khan et al., 2023). LIBs offer several advantages over other types of batteries, including high ionic conductivity, extended endurance, minimal self-discharge, high specific energy, and long shelf life (Feng et al., 2022; Olabi et al., 2022). On the other hand, most commercial LIBs rely on liquid electrolytes, which pose a significant safety risk due to the potential formation of lithium dendrites (Li et al., 2024). The formation of lithium dendrites within the electrolyte can result in internal short circuits, potentially causing battery rupture or explosion (Lai et al., 2021). In contrast, solid polymer electrolytes (SPEs) have emerged as a promising alternative to traditional liquid electrolytes due to their potential for enhanced safety, improved thermal stability, and reduced dendrite formation (Li et al., 2020). Consequently, numerous approaches have been employed in the preparation and characterization of solid polymer electrolytes for potential use in energy storage devices, especially lithium-ion batteries. Various types of solid polymer electrolytes, including PVDF, PAN, PEMA, PEO, and PMMA, have been explored. Among these, PEMA has demonstrated excellent properties, making it an effective host for polymer electrolytes (Singh et al., 2023). Therefore, by comprehensively characterizing the conductivity behaviour of PEMA-$LiNO_3$ electrolytes, this study aims to contribute to the development of advanced battery technologies.

2. METHODOLOGY

PEMA, LiNO3 and acetonitrile were purchased from Aldrich and used without purification. The solid polymer electrolytes based on PEMA-$LiNO_3$ were prepared using solution casting technique. The various concentration of $LiNO_3$ from 0, 10, 20, 30 and 40 wt % were mixed with PEMA in 20ml of acetonitrile solvent. The solutions were stirred until homogenous solution obtained and then were cast in petri dishes to slowly evaporate in room temperature. Once dried, the films were peeled off and kept in the desiccator after dry. The electrochemical impedance spectroscopy (EIS) was carried out at room temperature to examine the ionic conductivities of the film in the 10 Hz–1 MHz frequency range. The Fourier Transform Infrared (FTIR) spectroscopy was used to study to investigate the interaction between PEMA and $LiNO_3$ salts.

Figure 1. The solid polymer electrolytes preparation

3. RESULTS AND DISCUSSION

3.1 Room Temperature Ionic Conductivity Study

The room temperature ionic conductivity of PEMA-$LiNO_3$ films at various wt % of $LiNO_3$ is shown in Table 1. It is observed that addition of $LiNO_3$ to PEMA matrix enhances the ionic conductivity. The increase in the ionic conductivity of PEMA-$LiNO_3$ films with increasing $LiNO_3$ concentration can be attributed to the increase in the number of mobile charge carriers (Khiar & Arof, 2010). Therefore, the increased mobility of ions results in a higher conductivity. Furthermore, ion mobility is enhanced in more concentrated solution due to the closer packing of ions (Lynden-Bell & Rasaiah, 1996). The film containing 40 wt % of $LiNO_3$ exhibited the highest conductivity of 5.13×10^{-6} S cm^{-1}, suggesting that the mobile ions within the polymer matrix are at maximum.

Table 1. Ionic conductivity of PEMA- $LiNO_3$ solid polymer electrolytes at RT

PEMA- $LiNO_3$ solid polymer electrolytes (wt %)	Ionic conductivity (S cm^{-1}) at RT
0	-
10	8.04×10^{-8}
20	2.47×10^{-7}
30	1.17×10^{-6}
40	5.13×10^{-6}

3.2 FTIR study

Figure 2 illustrates the FTIR spectra of PEMA- 0 wt % $LiNO_3$, PEMA-10 wt % $LiNO_3$ and PEMA- 40 wt % $LiNO_3$ films within the 650 - 4500 cm^{-1} wavenumber. This technique is employed to investigate the interaction between PEMA and $LiNO_3$ in a polymer matrix. The interaction between PEMA and $LiNO_3$ salts has been determined by the changes in the relative intensities, as well as the disappearance and shifts of peaks in PEMA-10 wt % $LiNO_3$ and PEMA- 40 wt % $LiNO_3$ film. This confirms that $LiNO_3$ was successfully incorporated into the polymer matrix (Rodi et al., 2017).

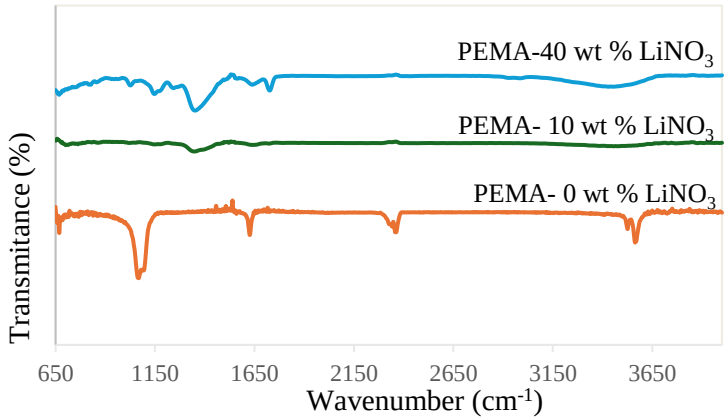

Figure 2. FTIR spectra of PEMA- 0 wt % $LiNO_3$, PEMA-10 wt % $LiNO_3$ and PEMA- 40 wt % $LiNO_3$ films

4. CONCLUSION

Solid polymer electrolytes based on PEMA-$LiNO_3$ films have been successfully prepared using solution casting technique. The conductivity was observed to increase with respect to $LiNO_3$ salts concentration. The film with 40wt.% of $LiNO_3$ exhibited the highest room temperature conductivity of 5.13×10^{-6} S cm^{-1}. FTIR studies confirmed the interaction between PEMA and $LiNO_3$. These findings will be useful in creating more reliable PEMA-based electrolytes, which will promote their use in cutting-edge energy storage systems.

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REFERENCES

Feng, Y., Zhou, L., Ma, H., Wu, Z., Zhao, Q., Li, H., Zhang, K., & Chen, J. (2022). Challenges and advances in wide-temperature rechargeable lithium batteries. Energy & Environmental Science, 15(5), 1711-1759.

Khan, F. N. U., Rasul, M. G., Sayem, A., & Mandal, N. K. (2023). Design and optimization of lithium-ion battery as an efficient energy storage device for electric vehicles: A comprehensive review. *Journal of Energy Storage*, 71, 108033.

Khiar, A. A., & Arof, A. K. (2010). Conductivity studies of starch-based polymer electrolytes. *Ionics*, 16, 123-129.

Lai, X., Jin, C., Yi, W., Han, X., Feng, X., Zheng, Y., & Ouyang, M. (2021). Mechanism, modeling, detection, and prevention of the internal short circuit in lithium-ion batteries: Recent advances and perspectives. *Energy Storage Materials*, 35, 470-499.

Li, J., Chen, X., Muhammad, S., Roy, S., Huang, H., Yu, C., Ullah, Z., Wang, Z., Zhang, Y., & Wang, K. (2024). Development of Solid Polymer Electrolytes for Solid-State Lithium Battery Applications. *Materials Today Energy*, 101574.

Li, L., Deng, Y., & Chen, G. (2020). Status and prospect of garnet/polymer solid composite electrolytes for all-solid-state lithium batteries. *Journal of Energy Chemistry*, 50, 154-177.

Lynden-Bell, R., & Rasaiah, J. C. (1996). Mobility and solvation of ions in channels. *The Journal of Chemical Physics*, 105(20), 9266-9280.

Olabi, A., Wilberforce, T., Sayed, E. T., Abo-Khalil, A. G., Maghrabie, H. M., Elsaid, K., & Abdelkareem, M. A. (2022). Battery energy storage systems and SWOT (strengths, weakness, opportunities, and threats) analysis of batteries in power transmission. *Energy*, 254, 123987.

Rodi, I., Saaid, F., & Winie, T. (2017). PEMA-LiCF3SO3 polymer electrolytes: Assessment of conductivity and transport properties. AIP Conference Proceedings.

Singh, P., Sachdeva, A., Bhargava, C., Alheety, M. A., & Sharma, J. (2023). Electrical and Structural Properties of PEMA-Based Plasticized Polymer Electrolyte. Macromolecular Symposia.

English Language Competency for STEM Education: A Mobile Learning Approach

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ABSTRACT

Proficiency in the English language is a pivotal factor in STEM (Science, Technology, Engineering, and Mathematics) education. However, there is a significant challenge for many English as a Second Language (ESL) learners to learn STEM jargon in English due to the different mediums of instruction in learning STEM subjects in schools. Therefore, this paper discusses the role of the English language in STEM education in Malaysian secondary education. This paper presents an innovative solution by incorporating mobile learning strategies to augment English language proficiency for STEM learners. Focusing on the pivotal role of English language proficiency in STEM education, this paper proposes using mobile learning to address this challenge. This paper implied that the envisioned mobile module could facilitate the acquisition of STEM-specific vocabulary and promote practical language applications tailored to the unique needs of STEM learners. By advocating for integrating mobile learning strategies, this paper proposes a transformative approach to enhance English language proficiency within STEM education, thereby fostering the development of essential 21st-century skills and leveraging global competitiveness in the STEM workforce.

Keywords: English language, mobile learning, Science, Technology, Engineering, Mathematics (STEM), secondary.

1. INTRODUCTION

English's significance as a communication medium has made it a globally acknowledged language. However, learning English as a second language (ESL) might be difficult for those studying it (Lingga et al., 2020) as ESL learners are not exposed to the language since birth, so they face difficulties using it (Krashen, 2006). It is essential to note that with the expansion of technology in the working field, the English language used for specific contexts is not similar to general English. This difference has brought into light the term English for Specific Purposes (ESP), which is the English language used by a particular community for a specific context (Hutchinson & Waters, 1987).

Looking into the primary role of ESP, it is vital to leverage the English language for learners in one expanding area: the Science, Technology, Engineering, and Mathematics (STEM) field. STEM was introduced by the United States (US) National Science Foundation in 1998 as the rapid growth of machines took place. Since then, STEM has grown worldwide, and STEM- related jobs are more in demand (Ministry of Education, 2013; UNESCO, 2020). With the increasing number of STEM-related professions, the number of STEM graduates should be able to cater to the jobs for the country’s economy. However, in Malaysia, the

language barrier has become an issue in the working environment, whereby many graduates inadequate English language competency for their job scopes (Rafiq et al., 2021). This has brought up the importance of learning ESP. Therefore, this paper discusses the roles of English language and STEM education.

2. SCIENCE, TECHNOLOGY, ENGINEERING, MATHEMATICS (STEM)

Research trends concerning STEM in Malaysia have been increasing throughout the years, and its full implementation in Malaysia began in 2017. The Ministry of Education has emphasised the importance of STEM in Malaysia as a paradigm to shift the education system, empowering the Industrial Revolution 4.0 (Ministry of Education, 2013). Due to that, STEM education has been integrated into the school curriculum, be it primary, secondary, or tertiary education. Referring to the Malaysian Education Blueprint, STEM is emphasised as the world is rapidly changing towards a digital era, where the workforce in the future will be more STEM-related. However, the decline of interest among secondary school leavers to pursue STEM in tertiary education has become a worrying sight internationally and in Malaysia. In 2020, the Malaysian Ministry of Education introduced a new curriculum whereby the transition from lower secondary to upper secondary would not be based on the learners' Form 3 final assessment results; instead, the learners are given the freedom to choose their stream of studies, which are divided into the STEM and Arts Stream (Ministry of Education, 2020). Learners who decide on the STEM stream should at least:

a) Take all pure science subjects – Physics, Chemistry, Biology, and Additional Mathematics; or
b) Take any of the two pure science subjects and Additional Mathematics plus at least one elective STEM subject in applied science and technology or a non-elective STEM subject or
c) Take at least two STEM electives in Applied Science and Technology or take any one Vocational subject.

A recent policy in Malaysia that discussed the language aspect in the STEM field was known as ‘English for the Teaching of Science and Mathematics’ or is well-known in Malaysia as PPSMI. This policy showed failure as science and mathematics are taught entirely in English in schools (Ashairi et al., 2019). Due to that, a newer policy was introduced in 2016, known as the Dual-Language Programme (DLP). The programme refers to teaching and learning STEM subjects in English or Bahasa Melayu. However, only selected schools in Malaysia implement DLP with permission from the Ministry of Education. Thus, there is an undeniable gap between the English language and STEM education, regardless of the importance of these two fields for the future workforce.

3. MOBILE LEARNING AS A SUPPLEMENTARY TOOL

Mobile learning could be a panacea to fill the gap between English and STEM. A supplementary English competency course for STEM education could be carried out via mobile learning, a branch of Mobile-Assisted Language Learning (MALL). Focusing primarily on the ESL context, Artyushina et al. (2017) studied ESL learning, specifically listening skills via Podcasting. The results were positive, as learners were interested in ESL learning. Also, as mentioned, learning with mobile is learning outside of the classroom, which is possible and accepted by learners. Another view on m-learning was reported by Kilar-Magdziarz (2017), who researched encouraging the ‘Bring Your Own Device (BYOD)’ policy to improve the ESL classroom. The BYOD term also shows a positive impact,

although the teachers and students changed the teaching and learning process. Both studies proposed different views on how m- learning should be carried out, whereby the former mentioned that mobile devices act as extra lessons while the latter encouraged BYOD in the classroom. Regardless of the context, m- learning is feasible as a teaching and learning tool. Thus, a mobile app could be the first step in introducing English vocabulary in STEM contexts to encourage real-life language application.

4. CONCLUSION

This paper discusses the role of the English language in STEM education. Since m-learning has been positively accepted in this era, it could provide a supplementary English language lesson for upper secondary school learners in Malaysia, specifically in the STEM field. Since there are differences in the medium of instruction among STEM learners in Malaysia, this m-learning is an added value for learners to learn and master vocabulary in English to help them in the future. This paper implied that policymakers could introduce English as a subject for STEM to encourage STEM learners to learn and use English vocabulary in STEM contexts.

REFERENCES

Artyushina, G. G., Sheypak, O. A., & Golov, R. S. (2017). Mobility and Edutainment in ESL Learning via Podcasting. In Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics): Vol. 10345 LNCS. https://doi.org/10.1007/978-3-319-65849-0_31

Ashairi, S., Mohamed Yusoff, M. N., & Melor, M. Y. (2019). Global Journal of Business and Social Science Review Sustaining the Implementation of Dual-Language Programmes (DLP) in Malaysian Secondary Schools.

Hutchinson, T., & Waters, A. (1987). English for Specific Purposes: A Learning-Centred Approach. In Handbook of Research in Second Language Teaching and Learning. Cambridge University Press. https://doi.org/10.4324/9781315716893

Kilar-Magdziarz, E. (2017). Enhancing a syllabus for intermediate ESL students with BYOD interventions. Proceedings of the International Conference on E-Learning, EL 2017 - Part of the Multi Conference on Computer Science and Information Systems 2017, 47–54.

Krashen, S. (2006). Second Language Acquisition Theory, Applications, and Some Conjectures. In TESOL Asia. TESOL Asia.

Lingga, L. M., Simanjuntak, R. M., & Sembiring, Y. (2020). Students' Strategies in Learning Speaking Skills at SMP Nasrani 3 Medan. *Journal of Languages and Language Teaching*, 8(1), 91. https://doi.org/10.33394/jollt.v8i1.2238

Ministry of Education. (2013). Malaysia Education Blueprint 2013-2025 (Preschool to Post-Secondary Education). www.moe.gov.my

Ministry of Education. (2020). Pelaksanaan Kurikulum Standard Sekolah Menengah (Menengah Atas) dan Pelaksanaan Pakej Mata Pelajaran Mulai Tahun 2020.

Rafiq, K. R. M., Hashim, H., & Yunus, M. M. (2021). Sustaining education with mobile learning for English for specific purposes (Esp): A systematic review (2012–2021). In

Sustainability (Switzerland) (Vol. 13, Issue 17). MDPI. https://doi.org/10.3390/su13179768
UNESCO. (2020). World Teachers' Day 2020 Fact Sheet.

Semakan Landskap Kawalan Perundangan Fasal Pengecualian di Malaysia

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ABSTRAK

Pasaran globalisasi menyaksikan fenomena pengecualian liabiliti yang merupakan sebahagian daripada evolusi perdagangan tidak adil abad ke-21. Alat paling utama yang digunakan bagi melepaskan diri peniaga daripada liabiliti adalah melalui fasal pengecualian dalam kontrak pengguna. Senario yang berpunca daripada kegagalan pasaran yang membiarkan fasal pengecualian semakin berleluasa menagih penyelesaian segera. Ketiadaan peruntukan perundangan yang spesifik mencetuskan keperluan perundangan yang signifikan dalam menangani krisis ledakan fasal pengecualian. **Objektif** penyelidikan ini bertujuan untuk mengupas beberapa perundangan sedia ada di Malaysia iaitu, Akta Kontrak 1950, Akta Jualan Barangan 1957, dan Akta Pelindungan Pengguna 1999. Ketiga-tiga akta ini dibimbangi tidak berupaya menangani ketidakadilan fasal pengecualian dalam kontrak pengguna kerana fasal ini bersifat manipulatif dan digunakan sebagai senjata penindasan memandangkan terma-terma fasal ini tidak tertakluk pada rundingan antara pihak-pihak yang berkontrak.. Penyelidikan ini merupakan **metod** penyelidikan doktrinal yang mengguna pakai metode analisis kandungan, berpaksikan tiga pendekatan utama iaitu sejarah, jurisprudens, serta analitis dan kritis. Kertas kerja ini mengupas beberapa peruntukan yang terdapat dalam tiga akta sedia ada, bagi mengenalpasti sejauh mana kawalan perundangan fasal pengecualian dalam kontrak pengguna diperlukan. **Dapatan kajian** menunjukkan terdapatnya kelompangan kawalan perundangan yang minimum dan terhad walaupun ada peruntukan terma tidak adil dalam Bahagian IIIA Akta Pelindungan Pengguna 1999. **Hasil dapatan** penyelidikan ini jelas menunjukkan bahawa penambahbaikan peruntukan kawalan perundangan yang spesifik dengan menghasilkan satu kerangka perundangan yang khusus berupaya mengatasi ketidakadilan fasal pengecualian dalam kontrak pengguna di Malaysia. Kajian akan datang wajar mengambil kira intervensi kehakiman dalam menginterpretasikan konsep kesamarataan kuasa berundingan serta tidak semata-mata bergantung kepada konsep kebebasan berkontrak.

Katakunci: Fasal pengecualian, terma tidak adil, Akta Kontrak 1950, Akta Jualan Barangan 1957, Akta Pelindungan Pengguna 1999

1. PENDAHULUAN

Polemik fasal pengecualian yang berat sebelah dan anti-pengguna dilihat sebagai satu halangan dan kekangan kepada perlindungan pengguna dalam era globalisasi. Ketiadaan peruntukan perundangan spesifik menangani fasal pengecualian di Malaysia menyebabkan mahkamah mengaplikasi *common law* yang merupakan sebahagian dari sistem perundangan English (Baksh & Arjunan, 2005). Keunikan fasal pengecualian ini adalah kerana fasal ini tiada peruntukan kawalan perundangan secara khusus dan hanya mahkamah yang

menentukan kesahan fasal ini (Vaqari, 1998).

2. METODOLOGI

Penyelidikan ini menggunakan tiga pendekatan penyelidikan undang-undang, iaitu, pendekatan sejarah, pendekatan falsafah, dan pendekatan analitis serta kritis (Walker, 1997). Mengguna pakai pendekatan analisis kandungan *(content analysis)*, penyelidikan ini menggunakan dua jenis data, iaitu data primer yang terdiri daripada perundangan (statut) serta undang-undang kes dan data sekunder yang meliputi dokumen perundangan seperti jurnal atau rencana dalam laporan undang-undang, kertas kerja seminar, buku rujukan undang-undang dan sebarang dokumen undang-undang berkaitan (Hutchinson, 2006).

Dalam konteks penyelidikan ini, pendekatan sejarah digunakan untuk mengkaji perkembangan undang-undang kontrak dan perlindungan pengguna. Pendekatan falsafah digunakan untuk mengkaji dasar konsep undang-undang kontrak dan perlindungan pengguna dalam kawalan terma tidak adil dan fasal pengecualian. Metodologi perbincangan adalah bergantung pada pendekatan analitis dan kritis. 'Analitis' bermaksud menilai sesuatu kes, konsep, peraturan atau institusi undang-undang dan 'kritis' pula bermaksud mengadili sesuatu perkara itu secara berhati-hati, melahirkan pendapat berhubung sesuatu isu dan mengiyakan atau menolak sesuatu itu berdasarkan autoriti dan asas yang rasional (Yaqin, 2007). Justeru, pada hakikatnya, analitis dan kritis ini boleh disatukan sebagai satu pendekatan undang-undang yang saling berkaitan dalam menghasilkan satu penyelidikan yang mantap dan praktikal. Pendekatan ini merupakan pendekatan yang penting dalam setiap penyelidikan undang-undang (Yaqin, 2007).

3. DAPATAN DAN PERBINCANGAN

Pengguna yang mempunyai kuasa rundingan yang rendah, sukar memperoleh kebebasan dalam memilih terma kontrak yang menjadikan kontrak dimasuki berat sebelah atau lebih memihak kepada peniaga (Zulhafiz & Abdul Rahman, 2020). Pengguna tidak mempunyai kebebasan yang sama seperti peniaga, yang mana pengguna sukar untuk membantah atau mempersoalkan fasal pengecualian dalam kontrak peniaga-pengguna. Justeru itu, peniaga mendominasi terma kontrak termasuk fasal pengecualian (Abdul Razak & Abd Ghadas, 2020).

Justeru, daripada peruntukan AK 1950 yang tidak menyentuh kandungan kontrak, terma dan ketidakadilan substantif, AK 1950 bukan benteng pelindung kepada pengguna semasa berdepan dengan amalan fasal pengecualian yang menafikan hak dan remedi pengguna terhadap peniaga (Abdullah, 2019). AK 1950 ini juga tidak memperuntukkan sebarang proviso berkenaan fasal pengecualian. Ini disebabkan AK 1950 tidak memperuntukkan sebarang proviso berkenaan isu- isu spesifik terutama pertikaian melibatkan keadilan substantif seperti isi kandungan kontrak yang tidak adil atau pengawalan fasal pengecualian.

AK 1950 mengkoordinasi pembentukan kontrak dan prinsip asas dalam undang-undang kontrak. Justeru, ia tidak mempunyai peruntukan yang khusus menangani isi kandungan kontrak atau terma kontrak itu sendiri. Oleh itu, tidak timbul klausa mana yang menghadkan atau mengelakkan liabiliti, klausa-klausa yang mengintegrasikan terma-terma dalam dokumen ke dalam kontrak. Kekangan ini telah menjustifikasikan intervensi kehakiman Malaysia yang telah mengangkat kesahan klausa-klausa yang dianggap tidak adil kepada pengguna telah dilihat sebagai satu pendekatan yang wajar. Walaupun AK 1950 dianggap sebagai sumber primer yang mengawal kontrak, namun AK 1950 mempunyai kelompangan

menangani terma tidak adil terutama fasal pengecualian dan kontrak bentuk seragam. Hakikatnya, Malaysia tiada peruntukan khusus menangani fasal pengecualian, maka prinsip *common law* Inggeris masih terpakai (Abdullah, 2019).

Kaitan antara kesan fasal pengecualian dengan peruntukan seksyen 62 AJB 1957 membenarkan peniaga untuk berkontrak keluar daripada peruntukan-peruntukan di bawah AJB dengan membenarkan penggunaan fasal-fasal pengecualian. Justeru, AJB 1957, telah membuka ruang seluas-luasnya kepada pembekal dan peniaga untuk melepaskan diri daripada liabiliti dalam fasal pengecualian yang memihak kepada mereka.

Berhubung penggunaan fasal pengecualian dalam skop AJB 1957 adalah, walaupun tujuan utama penguatkuasaan perundangan adalah untuk merungkaikan dan menyelesaikan persoalan berhubung jualan barang-barang, AJB 1957 bukanlah suatu perundangan yang berorientasikan perlindungan pengguna. Peruntukan seksyen 62 AJB 1957 jelas memperlihatkan satu bukti jelas anti kepenggunaan dan menyebelahi kepentingan peniaga sekaligus bersifatkan penindasan pengguna (Abdul Aziz & Yusoff, 2010). AJB 1957 di bawah seksyen 62 membenarkan penjual di bawah terma nyata kontrak untuk mengelakkan semua syarat tersirat yang distatutorikan. Perlindungan pengguna mengkehendaki seksyen 62 ini dimansuhkanIni menunjukkan bahawa pelaksanaan fasal pengecualian masih memerlukan kepada satu layanan perundangannya yang tersendiri bagi mengenalpasti terma-terma fasal pengecualian yang yang melampau, sekaligus melarang penggunaan fasal-fasal pengecualian yang kerapkali disalahgunakan oleh peniaga (Yee & Abdul Razak, 2019).

Dalam APP 1999, walaupun bahagian 6 APP 1999 melarang pengecualian liabiliti peniaga, ianya gagal untuk merangkumi spektrum yang luas dari klausa pembebasan yang ada dalam kontrak pengguna. Kekangan statututori ini memperlihatkan kelemahan yang ketara. Kerana tertakluk kepada seksyen 2 (4) bahawa APP 1999 adalah bersifat tambahan tanpa mengurangkan undang-undang lain berkaitan dengan hubungan kontrak (Abdullah, 2019).

Manakala seksyen 24A (c) APP 1999 mendefinisikan ‘terma tidak adil’ sebagai terma dalam kontrak peniaga-pengguna, dengan mengambil kira semua hal keadaan, menyebabkan ketidakseimbangan yang signifikan dalam hak dan tanggungjawab pihak-pihak di bawah kontrak itu sehingga merugikan pengguna (Che Hashim, 2019). Persoalannya, apakah yang dimaksudkan dengan “…dengan mengambil kira semua hal keadaan” dan sejauah mana “ketidakseimbangan yang signifikan” sampai ke tahap “…sehingga merugikan pengguna”? Definisi yang terlalu umum antara salah satu kelemahan Akta ini (Abdullah, 2019). Ini merupakan antara persoalan-persoalan yang tidak dijawab oleh Bahagian IIIA APP 1999.

Walaupun Bahagian IIIA baik kepada perlindungan pengguna tetapi terdapat pelbagai permasalahan dalam interpretasi dan pengamalannya seperti yang dinyatakan di bawah ini. Daripada segi peruntukannya, Bahagian IIIA APP 1999 ini kelihatan tidak mengawal penyalahgunaan fasal pengecualian dalam bentuk notis. Bahagian IIIA Terma Tidak Adil, APP 1999 masih belum berupaya menangani fasal pengecualian secara keseluruhan. Oleh itu, kepincangan perundangan memerlukan kepada inti pati perundangan sebagai penyelamatkepada ketempangan yang ditonjolkan dalam inti pati kontrak sejajar dengan aspirasi yang dibawa oleh ideologi kebajikan pengguna. Analisis seterusnya adalah berdasarkan seksyen- seksyen yang terkandung dalam APP 1999 yang disusun berdasarkan aspek-aspek penting Bahagian IIIA.

Sebahagian besar kontrak peniaga-pengguna merupakan kontrak tidak formal yang mana terma-terma tidak adil terkandung dalam notis dan resit. Bahagian IIIA tidak

membincangkan notis dan kontrak yang bukan bentuk seragam seperti kontrak lisan. Persoalannya, adakah Bahagian IIIA terpakai dalam situasi begini? (Abdul Razak et al., 2022).

4. KESIMPULAN

Pengubalan perundangan khusus bagi menangani permasalahan fasal pengecualian dalam kontrak pengguna dilihat sebagai satu penambahbaikan yang amat relevan dalam membanteras terma tidak adil khususnya, fasal pengecualian. Penggubalan suatu perundangan spesifik menangani permasalahan kawalan perundangan fasal pengecualian ini merupakan penyelesaian bertujuan melindungi hak kontraktual pengguna kesan daripada ketidakadilan pemakaian fasal pengecualian. Menurut Yee & Abdul Razak (2019), hakim perlu mengambil kira doktrin ketidakseimbangan kuasa berunding antara peniaga dan pengguna dalam menentukan kesahan klausa dalam kontrak dimasukkan dalam perundangan kerana konsep kebebasan berkontrak memasuki kontrak tidak lagi relevan pada marcapada ini. Sehubungan itu, kawalan fasal ini memerlukan satu undang-undang khusus untuk menangani pengecualian liabiliti (Abdullah, 2019).

RUJUKAN

Abdul Aziz, A. & Yusoff, SSA. (2010). Amalan kontrak perdagangan pengguna masa kini: fasal pengecualian sebagai pengekang keutuhan doktrin kebebasan berkontrak. *Persidangan Kebangsaan Undang-undang Perniagaan*.

Abdul Razak, F., & Abd Ghadas, Z.A. (2020). Legal Issue due to Unfair Contract Term: The Malaysia Perspective. *Journal of Critical Reviews, 7(*19), 7457-7463.
Abdul Razak, F., Abd Ghadas, Z.A., Ghapa, N., & Kasmaruddin, N.I. (2022). Extending The Interpretation of "Unfair Terms" in Consumer Protection Act 1999. *International Journal of Academic Research in Business and Social Sciences*, *12*(3), 9–16.

Abdullah, F. (2019). *Kawalan Perundangan Fasal Pengecualian dalam Kontrak Peniaga-Pengguna di Malaysia* [Tesis Doktor Falsafah Tidak diterbitkan]. Fakulti Undang-undang, Universiti Kebangsaan Malaysia).

Abdullah, F., Abdul Manap, N., & Ong, T.C. (2021). *Ketidakadilan Fasal Pengecualian dalam Kontrak Pengguna*. UKM Press.

Akta Jualan Barangan 1957 [Akta 382].

Akta Kontrak 1950 [Akta 136].

Akta Pelindungan Pengguna 1999 [Akta 599].

Baksh, A. M. N., & Arjunan, K. (2014). *Business Law in Malaysia*. Lexis Nexis.

Che Hashim, R. (2019). Mistake in an Electronic Advertisement: Legal Implication. *UUM Journal of Legal Studies*, *10* (1), 113–133.

Hutchinson, T. (2006). *Researching and Writing in Law*. Thomson Legal & Regulatory Limited.
Vaqari, A. (1998). *Contracting out and Public Policy Ground under section 24(E) of the*

Contracts Act 1950. Malayan Law Journal, *2*, ix.

Walker D.M. (1980). *The Oxford Companion to Law*. Clarendon Press.

Yaqin, A. (2007). *Legal Research and Writing*. LexisNexis.

Yee, T. S., & Abdul Razak, A. M. (2019). To What Extent Deciding the Validity of Exclusion Clause in a Contract. *Malayan Law Journal, 4*, cxl.

Yusoff, SSA., & Abdul Aziz, A. (2009). *Mengenali Undang-undang Kontrak Malaysia*. International Law Book Services.

Zulhafiz, W.M. & Abdul Rahman, N. (2020). Unfair Risk Allocation in Oil and Gas Upstream Service Contracts in Malaysia: The Necessity for Oilfield Anti-Indemnity Act. *International Journal of Business and Society*, *21*(S1), 177–191.

Game-Based Computational Thinking in STEM: CoT-Game Framework

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ABSTRACT

This paper aims the integration of computational thinking into STEM education through game- based learning. This proposes the CoT-Game framework, developed from a comprehensive analysis of existing literature, to enhance educational practices by designing mobile games that combine GBL components with CT components. The framework addresses gaps in current approaches by emphasizing practical skill development over theoretical knowledge, particularly in pattern recognition, a key element of CT. By incorporating essential GBL components, such as goals, rules, feedback, interaction, challenges, and narrative, into mobile game design, the framework aims to create engaging learning experiences that foster critical skills in students. While promising, further empirical validation is necessary to assess the framework's effectiveness in real educational contexts.

Keywords: Computational thinking, Game-based learning, Mobile game, STEM.

1. INTRODUCTION

STEM education, which includes Science, Technology, Engineering, and Mathematics, can help students thrive in a technologically advanced environment through effective approaches such as game-based learning (GBL). GBL integrates educational content with digital games, improving student engagement, comprehension, and performance (Topallı & Çağıltay, 2018). Mobile games provide a flexible, accessible way for students to explore scientific concepts, enhancing their understanding of STEM subjects through interactive elements and structured goals. Additionally, integrating computational thinking (CT), involving problem-solving and algorithmic reasoning, is essential in modern education. Tools such as Alice, Scratch, and AppInventor are used to develop CT skills. Research indicates that combining GBL with CT enhances students' learning experiences by making complex concepts more tangible. This paper reviews the literature on integrating CT into STEM education through GBL and proposes a framework to improve this integration. The framework aims to guide the design of mobile games that effectively combine GBL and CT, fostering innovative educational practices and equipping students with crucial 21st-century skills.

2. METHODOLOGY

The CoT-Game framework was developed through a comprehensive content analysis of previous studies, focusing on CT and GBL components. The framework was based on keywords such as "computational thinking," "game-based learning," "mobile game," and "STEM." The gaps in existing frameworks were identified, as most existing games have focused on theoretical knowledge of CT while neglecting CT skill development and integration within STEM education (Hooshysar et al., 2020). A mapping process was conducted to combine CT and GBL components from both tables, aligning them based on criteria and standards. Operational definitions for each CT and GBL component were defined to understand the elements better. The proposed CoT-Game Framework was developed by refining existing frameworks and integrating findings from the literature review. As a result, CT components, such as pattern recognition, were extracted, while GBL components, such as goal, rule, feedback, interaction, challenge, and narrative, were incorporated. The CoT-Game framework aims to enhance user engagement by incorporating these elements into the gameplay environment, fostering a more immersive and dynamic learning experience within the GBL setting.

3. RESULTS AND DISCUSSION

The proposed framework integrates CT into STEM education through GBL by developing mobile games. This includes elements of GBL components: challenges, feedback, goals, rules, interaction, and narrative to create an engaging learning environment. The framework addresses a research gap in existing GBL with CT integration and emphasizes using pattern recognition from CT to enhance student engagement and understanding in STEM fields.

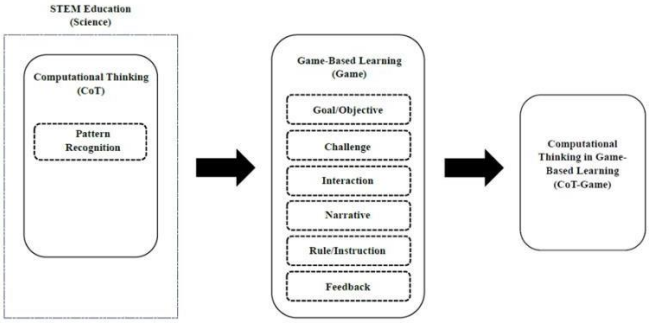

Figure 1. Proposed CoT-Game Framework

3.1 Computational Thinking (CT)

Despite extensive research into CT, there remains no fixed consensus on its definition, components, or skills. Early work by Wing identified six main elements of CT: problem formulation, problem decomposition, automation, systematic testing, abstraction, and problem reformulation. However, research over the past decade has highlighted that four fundamental components—decomposition, pattern recognition, algorithmic thinking, and abstraction—are most consistently recognized. Among these, pattern recognition is particularly significant as it involves identifying similarities and patterns to address complex problems. This study focuses on integrating pattern recognition into a proposed framework for STEM education, emphasizing its importance in science education. The study proposes to develop a puzzle-based mobile game designed to enhance pattern recognition skills, which are crucial for cognitive development and understanding complex concepts in STEM fields.

3.2 Game-Based Learning (GBL)

According to Yunus and Zaibon (2021), GBL comprises six essential elements: goal, rule, feedback, interaction, challenge, and narrative. The main components include goals, rules, and feedback, fundamental to defining and structuring a game. The goal sets the objective or purpose, distinguishing the game from simple toys and guiding players toward specific outcomes. Rules provide the instructions that control gameplay, ensuring players understand what actions are permissible and preventing cheating. Feedback is the continuous and immediate information given to players about their progress, which helps them adjust their strategies and enhances both motivation and learning. In addition to these core elements, GBL incorporates optional components such as interaction, challenge, and narrative, which further enrich the gaming experience. Interaction refers to the reciprocal responses between the player and the game system, fostering engagement through dynamic activities. Challenges present obstacles that players must overcome to advance, adding excitement and a sense of accomplishment. The narrative provides the story and emotional context, which is crucial for player immersion and effective learning. The proposed framework in this study integrates these six components to develop engaging and educational mobile games. By incorporating clear goals, structured rules, continuous feedback, interactive elements, meaningful challenges, and a compelling narrative, the framework aims to enhance the effectiveness of GBL in educational settings.

4. CONCLUSION

This study proposes a framework for integrating CT into STEM education through GBL. The framework is divided into two main components: GBL and CT elements. It highlights the importance of incorporating CT to enhance student engagement in STEM through GBL. To improve this engagement, the framework suggests optimizing software and hardware to align with STEM needs. While the proposed framework aims to advance the design of GBL tools integrating CT, it is based on existing research and recognizes that empirical validation with actual students is needed to assess its effectiveness and address potential limitations.

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REFERENCES

Fitz-Walter, Z., Johnson, D., Wyeth, P., Tjondronegoro, D., & Scott-Parker, B. (2017). Driven to drive? Investigating the effect of gamification on learner driver behaviour, perceived motivation, and user experience. *Computers in Human Behavior*, 71, 586- 595.

Hooshyar, D., Pedaste, M., Yang, Y., Malva, L., Hwang, G., Wang, M., Lim, H., & Delev, D. (2020). From Gaming to Computational Thinking: An Adaptive Educational Computer Game- Based Learning Approach. *Journal of Educational Computing Research*, *59*(3), 383–409. https://doi.org/10.1177/0735633120965919

Yunus, E., & Zaibon, S. B. (2021). Connecting Computational Thinking (CT) Concept with the Game-Based Learning (GBL) Elements. *International Journal of Interactive Mobile Technologies*, *15*(20), 50–67. https://doi.org/10.3991/ijim.v15i20.23739.

Sakiadis MHD Boundary Layer of Jeffrey Fluid with Heat and Mass Transfer Effects

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ABSTRACT

This study investigates the steady two-dimensional Sakiadis boundary layer flow of an incompressible Jeffrey fluid over a horizontal sheet, with heat transfer incorporating the Cattaneo-Christov heat flux model and mass transfer with a chemical reaction. The mathematical formulation includes the effects of a magnetic field, thermal relaxation, and mass diffusivity. Using similarity transformations, the governing partial differential equations are reduced to ordinary differential equations, which are solved numerically by using the 'dsolve' command with the numeric option for the boundary value problem in Maple. The results reveal the influence of the Deborah number, Prandtl number, Schmidt number, and Hartmann number on the velocity, temperature, and concentration profiles. The study provides insights into the non-Newtonian fluid flow behaviour and its impact on heat and mass transfer characteristics.

Keywords: Cattaneo-Christov heat flux model, Jeffrey fluid, Magnetohydrodynamic (MHD), Sakiadis flow.

1. INTRODUCTION

In modern industrial processes, achieving efficient heat transfer during manufacturing is critical for ensuring product quality. The use of magnetohydrodynamic (MHD) flows, where fluid motion is controlled by a magnetic field, presents a promising solution. MHD systems are widely applied in industries such as metallurgy, nuclear reactor cooling, and power generation (Othman et al., 2023). However, a key challenge lies in understanding how heat and mass transfer can be optimised in complex non-Newtonian fluids like the Jeffrey fluid, which exhibits both viscoelasticity and retardation effects (Brenn and Plohl, 2015). Addressing this challenge is essential for improving thermal management in advanced manufacturing applications.

The Jeffrey fluid model has been extensively studied due to its unique ability to capture the complex behaviour of viscoelastic fluids under various flow conditions. In recent years, researchers have explored the influence of magnetic fields on the flow characteristics of Jeffrey fluids, particularly in the context of MHD systems (Mohd et al., 2019, Hayat et al., 2020). Despite these advancements, there remains a gap in the literature concerning the application of the Cattaneo-Christov heat flux model, which accounts for thermal relaxation

time, in the analysis of MHD Jeffrey fluid flows under Sakiadis boundary layer conditions. This gap limits the understanding of heat and mass transfer in such systems, which is crucial for optimising performance in industrial processes involving non-Newtonian fluids.

To address this gap, the present study focusses on the MHD boundary layer flow of a Jeffrey fluid incorporating the Cattaneo-Christov heat flux model. The governing equations are transformed into a system of ordinary differential equations using a similarity transformation, and these equations are numerically solved using Maple software. The numerical methods employed in this study enable a detailed analysis of how magnetic fields and thermal relaxation affect fluid velocity, temperature profiles, and boundary layer thickness.

2. METHODOLOGY

The methodology employed in this study consists of three primary steps: mathematical modelling, mathematical analysis, and numerical computations. Each step is integral to evaluating the boundary layer flow of a MHD Jeffrey fluid with the Cattaneo-Christov heat and mass transfer effects under the Sakiadis boundary layer flow conditions.

The first step involves formulating the governing equations that describe the flow dynamics of the Jeffrey fluid. The fundamental equations, including the continuity, momentum, energy, and concentration equations, are modified to incorporate the Jeffrey fluid model. The effects of the magnetic field (M) are included via the Lorentz force, and the Cattaneo-Christov heat and mass transfer models are introduced to account for finite thermal and mass diffusivities. The boundary conditions corresponding to the Sakiadis flow setup are applied, ensuring that the behaviour of the fluid near the boundary is captured accurately.

After formulating the governing equations, the next step is to apply a similarity transformation to reduce the partial differential equations (PDEs) into a set of ordinary differential equations (ODEs). This transformation simplifies the complex system of equations and makes them solvable numerically. The non-dimensional parameters, such as the magnetic parameter (M), Deborah number (β), relaxation time (λ_1), thermal relaxation time (γ), Prandtl number (Pr), and Schmidt number (Sc), are introduced in this step, defining the relationships between the fluid properties and external influences like magnetic fields and heat transfer.

The final step involves solving the transformed ODEs using numerical methods. The Maple software is employed, particularly the ‘dsolve/numeric/BVP’ solver, to compute the solutions for the velocity, temperature, and concentration profiles. The accuracy of the method is validated by comparing the numerical results with existing studies and analytical solutions. The system is analysed under different values of the key non-dimensional parameters to understand their impact on the flow characteristics, such as the skin friction coefficient, Nusselt number (heat transfer rate), and Sherwood number (mass transfer rate). Through this methodology, the study comprehensively evaluates the effects of various parameters on the boundary layer flow of the Jeffrey fluid, providing insights into the complex interactions between fluid dynamics, magnetic fields, and heat/mass transfer processes.

3. RESULTS AND DISCUSSION

The solution is achieved using Maple software's dsolve/numeric/BVP function, and the results are validated against previous studies, showing favorable agreement. Key numerical results are compared with previous works by Andersson et al. (1992), Chen (2008), and Babu and Narayana (2016), demonstrating consistency and accuracy.

Table 1 demonstrates the effect of changing some of the non-dimensional parameters in the model on the skin-friction factor coefficient, $f''(0)$, the local Nusselt number, $\theta'(0)$ and the local Sherwood number, $\phi'(0)$. The results show that $f''(0)$ increases while $-\theta'(0)$ and
$-\phi'(0)$ decrease when both parameters λ_1 and M are increased. However, the results show the opposite trend when β is increased. The values of $-\phi'(0)$ are unchanged for different values of Pr and γ since these two parameters are absent from the concentration equation; thus, varying these parameters does not affect the fluid's concentration profile. The values of $f''(0)$ and $-\theta'(0)$ remain fixed for different values of Sc because the parameter only exists in the concentration equation, it does not affect the values of skin friction or the Nusselt number.

Table 1. The variations of $f''(0)$, $-\theta'(0)$ and $-\phi'(0)$ for various values of non-dimensional governing parameters.

β	λ_1	M	Pr	γ	Sc	$f''(0)$	$-\theta'(0)$	$-\phi'(0)$
0.2	0.5	0.5	1.5	0.6	1.5	−1.38902	−0.79241	−0.79869
0.4						−1.29083	−0.80091	−0.80621
0.6						−1.21266	−0.80842	−0.81224
0.3	0.5	0.5	1.5	0.6	1.5	−1.33671	−0.79649	−0.80261
	1					−1.53168	−0.77687	−0.78568
	1.5					−1.70633	−0.76138	−0.77155
0.3	0.5	0.5	1.5	0.6	1.5	−1.33671	−0.79649	−0.80261
		1				−1.52896	−0.77774	−0.78648
		1.5				−1.70314	−0.76242	−0.77255
0.3	0.5	0.5	1.5	0.6	1.5	−1.33671	−0.79649	−0.80261
			1.7			−1.33671	−0.84698	−0.80261
			2			−1.33671	−0.92648	−0.80260
0.3	0.5	0.5	1.5	0.2	1.5	−1.33671	−0.79897	−0.80261
				0.4		−1.33671	−0.79673	−0.80261
				0.6		−1.33671	−0.79649	−0.80261
0.3	0.5	0.5	1.5	0.6	0.5	−1.33670	−0.79649	−0.59685
					1	−1.33671	−0.79649	−0.69839
					1.5	−1.33671	−0.79649	−0.80261

4. CONCLUSION

The present study describes the boundary layer flow of a magnetohydrodynamic Jeffrey fluid with the Cattaneo-Christov heat and mass transfer effects, subject to the Sakiadis boundary flow. The analysis focusses on how the fluid's elasticity, magnetic fields, and non-Fourier heat conduction impact the flow and transfer characteristics. The results indicate that an increase in the Deborah number leads to a reduction in both the thermal and concentration boundary layer thickness, highlighting the role of viscoelasticity in limiting the diffusion of heat and mass. Furthermore, a higher Prandtl number reduces the temperature and causes a thinner thermal boundary layer, suggesting that fluids with greater resistance to thermal

diffusion experience slower heat transfer. Additionally, increasing the non-dimensional thermal relaxation time results in a lower temperature within the boundary layer, showing the significance of heat flux relaxation in moderating the thermal field. The study also reveals that as the Schmidt number increases, the concentration boundary layer thickness decreases, implying that higher Schmidt numbers, representing lower mass diffusivity, lead to sharper concentration gradients. These findings contribute to a deeper understanding of the complex interplay between fluid elasticity, magnetic fields, and heat and mass transfer in non-Newtonian fluids, with potential implications for engineering applications requiring precise control of heat and mass diffusion.

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REFERENCES

Othman, Z. S., Aziz, M. H. N., & Naganthran, K. (2023). Cattaneo-Christov Heat Flux Effect On Sakiadis Magnetohydrodynamic Boundary-Layer Transport Phenomena In The Jeffrey Fluid. *Thermal Science*, *27*(6B), 4861-4875.

Brenn, G., & Plohl, G. (2015). The oscillating drop method for measuring the deformation retardation time of viscoelastic liquids. *Journal of Non-Newtonian Fluid Mechanics, 223*, 88- 97.

Mohd, Z. S., Arifin, N. S., Mohd, K. A. R., Mohammad, N. F., & Salleh, M. Z. (2019). On dissipative MHD mixed convection boundary-layer flow of Jeffrey fluid over an inclined stretching sheet with nanoparticles: Buongiorno model. *Thermal Science*, *23*(6 Part B), 3817-3832.

Hayat, T., Kanwal, M., Qayyum, S., & Alsaedi, A. (2020). Entropy generation optimization of MHD Jeffrey nanofluid past a stretchable sheet with activation energy and non-linear thermal radiation. *Physica A: Statistical Mechanics and its Applications, 544*, 123437.

Andersson, H. I., Bech, K. H., & Dandapat, B. S. (1992). Magnetohydrodynamic flow of a power-law fluid over a stretching sheet. *International Journal of Non-Linear Mechanics, 27*(6), 929-936.

Chen, C. H. (2008). Effects of magnetic field and suction/injection on convection heat transfer of non-Newtonian power-law fluids past a power-law stretched sheet with surface heat flux. *International Journal of Thermal Sciences, 47*(7), 954-961.

Babu, D. H., & Narayana, P. S. (2016). Joule heating effects on MHD mixed convection of a Jeffrey fluid over a stretching sheet with power law heat flux: A numerical study. *Journal of Magnetism and Magnetic Materials*, *412*, 185-193.

Exploring Malaysia's Legal Protection on Online Harrassment

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ABSTRACT

Social media and internet platforms play central role towards social communication, sharing information and interaction globally. Use of social media and internet platform, amplify online harassment such as online threats, sexual remarks, cyber stalking, trolling, flaming, doxing and hate speech which causing negative consequences in a person's life, including death. This paper explores legal protection in addressing online harassment in Malaysia primarily on Communications and Multimedia Act (CMA) 1998, Penal Code, and related legislation. Through an examination of statutory provisions and law cases, this paper identifies shortcomings in Malaysia's existing legal protection and offers recommendations for comprehensive reform, including strengthening enforcement mechanisms, and improving international cooperation so online harassment can be combatting effectively and brings safer digital environments for all its citizens.

Keywords: Online harrassment; Anti-stalking Law, Communication and Multimedia Act

1. INTRODUCTION

The digital landscape of using social media and online platform enables various form of online harassment such as cyber bullying, online threats, sexual remarks, cyber stalking, trolling, flaming, doxing and hate speech. Perpetrators use the technology from social media, messaging platform or telephone application to threaten, harass, bullying embarrass and target another person. Online harassment or cyber harassment involves aggressive online behaviour aimed at intimidating, shaming or silencing victims. For example, statistic below showed that 4,128 complaints related to cyber bullying have been reported to Malaysian Multimedia Malaysia commission (MCMC) in 2022, following by 3, 737 complaints in 2023 and as of July 2024, it has reach 1,618 complaints.

Cyber-bullying statistic (2022-2024)

Year	2022	2023	2024 (as of July)	Total
Cyber-bully Case Recorded	4,128	3,737	1,618	**9,483**

Statistic above refers to the number of complaints received by MCMC regarding cyber-bullying. The matters falls under the jurisdiction of the Royal Malaysia Police.

Figure 1. Statistic of Cyber-bullying Complaints to MCMC

Online harassment can be in many forms such as i) Cyber bullying (using electronic communication or digital devices in bullying victims on mobile phone, social media, messaging platform and gaming platforms), ii) Trolling (Posting inflammatory or hateful messages to provoke or upset others is considered trolling), iii) Doxing(Publishing private information or information that identifies an individual without their consent and often with malicious purposes),iv) Flaming(Hostile posting and insulting messages in online forums or on social

media, which may result in heated and aggressive exchanges), v)Exclusion (Deliberately excluding someone from an online group or conversation) and vi) Defamatory statement (Misrepresentation of facts that causes someone to be hated , ridiculed or harm their business or reputation).Advert of technology makes ease for communication and information sharing through internet gateway. However, some people using internet to do harm to other people such as in cyber bullying that involves sexual and non-sexual online harassment. In this context, perpetrator will threaten a person either by personally messaging them or by publicising their personal details, causing them embarrassment, fear, or frustration (Faeq bin Fuad, Insyirah binti Ishkandar,Kavitharini A/P T & Ramesh Khor Mei Hui, 2021) Elements of bullying consist of: (i) repetition; (ii) intention to harm either through words or actions; and (iii) the inability to defend himself indicates a bully is in power over the victim. (Heama Latha Nair,Ambikai S T Singam, 2022)

Consequently, real impact on the victim of online harassment shown in terms of feeling embarrassment, anxiety and distress that made the victim avoid to report the crime to authorities, preferring of report and blocking the perpetrator and limits time spending on social media (Nur Shazana Abdul Rani, Siti Nur Izyandiyana Ab. Hadi, Siti Hajar Abd Aziz, &, 2024)Besides, online chatting and Facebook browsing in establishing social relations by exposing photos and videos made women becoming the target of online harassment (Norhayati Mat Ghani & Mohd Azmeer Abu Bakar, 2023).

Malaysian recent case of TikToker Ms Rajeshwary Appahu or also known as Esha, tragically died after lodge police report over fears of being raped and killed by her cybullies raises more concern of adequacy of current law in addressing online harassment. Two offenders that linked to her death has being punished; Shalini Periasamy was sentenced under Section 14 of Minor Offences with fine of RM100 for deliberately uttering vulgarities with the intention to incite anger and disturb peace through her TikTok account while B Sathiskumar, was sentenced to twelve months imprisonment under Section 233(1)(a) of Communication of Multimedia Act 1998 for making obsene remarks on his TikTok account. The distinct charges for Esha's case motivate the need to explore the specific laws governing online harassment, as existing frameworks may not adequately address the challenges posed by digital environments. So, this paper is focusing on shortcomings of existing legal protection of online harassment and case analysis in dealing with such issues.

In examining the issues of online harassment, academic journal articles from Malayan Law Journal (MLJ) and Current Law Journal (CLJ) were utilized, while news platforms are use for additional. Futhermore, Malaysian legislations including Communication and Multimedia Act 1998 (CMA) and Penal Code (PC) along with several relevant cases, are critically examined in this context. The study begins with a discussion legal protection of online harassment, followed by an analysis of Malaysian law cases, and concludes with recommendations for addressing these issues.

2. METHODOLOGY

This study employed doctrinal legal research to examine and discuss implication of online harassment from Malaysian framework. In gathering and delivering the data and findings, both primary and secondary sources of law were examined. Both sources have been accessed from online database resources such as Lexis Legal Research for Academics, CLJLaw, as well as news platforms, websites of relevant institutions and nongovernmental organisations.

3. RESULTS AND DISCUSSION

Legal protection of online harassment

Malaysian legislation provides several laws in dealing with online harassment. The perpetrator will be punished based on their intention and commissioning act coupled with the seriousness of the offence towards victim. The relevant legislations that protects victim from online harassment are as below:

	Provision	Sanction
Multimedia and Communication Act 1998	Section 211 Prohibition of the provision of offensive content with intent to annoy, abuse, threaten or harass any person	Fine not exceeding fifty thousand ringgit or to imprisonment for a term not exceeding one year or to both and further fine of one thousand ringgit for every day or part of a day during which the offence is continued after conviction.
	Section 233 Improper use of network facilities, e.g. social media, to transmit obscene, indecent, false, menacing or offensive communications with intent to annoy, abuse, threaten or harass another person	Fine not exceeding fifty thousand ringgit or to imprisonment not exceeding one year or to both and shall also be liable to a further fine of one thousand ringgit for every day during which the offence is continued after conviction
Penal Code	Section 499 Criminal defamation by making or publishing imputation by words either spoken or in written , or by signs, or by visible representation intending to harm, such person	Section 500 imprisonment for a term which may extend to two years or with fine or with both.
	Section 503 Criminal intimidation to threaten person with injury to themselves, reputation and property	Section 506 Imprisonment for a term which may extend to two years or with fine or with both If gives impute unchastity to a woman, shall be

		punished with imprisonment for a term which may extend to seven years or with fine or with both
	Section 507A Act of harassment intending to cause distress, fear or alarm to any person of his/her safety	Imprisonment for a term which may extend to three years or with fine or with both
	Section 509 Utterance of any word intending to insult the modesty of any person	Imprisonment for a term which may extend to five years or with fine or with both.
Sexual Offences against Children Act 2017 (Act 792)	Section 11 Sexually communicating with a child	Maximum of 3 years imprisonment
	Section 12 Child Grooming	Imprisonment maximum 5 years and liable for whipping.

In regards to cases involving online harassment such as racism statement or offensive remarks brings court's attention to scrutinize online harassment carefully such as happens in the case of *PP v Sharul Nizam Ab Rahim* [2019] 1 LNS 2076 and *PP v. Rutinin* [2013] 2 CLJ 427. Another example is in the case of *Muhammad Syuhaimi bin Haji Abdul Jofli & Anor v Hamirah Izzatie bt Sabirin* [2023] 9 MLJ 833 whereas the postings made by defendant is found by the court as defamatory that enables plaintiff to get injunction to restrain defendant to further publishing the statement.

4.0 CONCLUSION

In dealing with online harassment issues, requires participation and supports from individuals, family institutions, government agencies and legislator. The crime made the victims feel discouraged or upset and lead to a range of negative consequences. Although there is no specific legislation controlling online harassment on media platforms, several legislations can be used to combat it, especially Communications and Multimedia Act 1998 and Penal Code. However, court's approach still depends on facts and application of law related to the disputed issues. Specific provisions in the legislation should be included to provide authorities with more clarity and guidance. Besides, cyber ethics literacy can be introduced to educate people to be ethical and mindful person when using internet and social media.

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REFERENCES

Mahmud, A. H. (2024, July 25). Family of Malaysian TikToker Esha who died in cyberbullying case seeking legal advice after offender fined RM100. *CNA*. https://www.channelnewsasia.com/asia/malaysia-esha-rajeswary-appahu-cyberbullying-suicide-tiktok-alphaquinnsha-4490761

Mail, M. (2024, September 26). TikTok bully sentenced to 12 months in jail after influencer Esha's tragic death linked to online harassment. *Malay Mail*. https://www.malaymail.com/news/malaysia/2024/09/25/tiktok-bully-sentenced-to-12-months-in-jail-after-influencer-eshas-tragic-death-linked-to-online-harassment/151592

Faeq bin Fuad, Insyirah binti Ishkandar,Kavitharini A/P T & Ramesh Khor Mei Hui. (2021). Legal Analysis Of Online Harassment Via Social Media In Malaysia. *Current Law Journal*, 1 LNS(A) lxxv.

Heama Latha Nair,Ambikai S T Singam. (2022). Strengthening The Legal Framework For Cyberbullying And Cybercrime In Malaysia. *Current Law Journal*, 1 LNS(A) xlvii.

Norhayati Mat Ghani & Mohd Azmeer Abu Bakar. (2023). Women's Engagement in Social Media and their Susceptibility to Cybercrime Victimisation. *Internation Journal of Academic Research in Business and Social sciences*, 480-483.

Nur Shazana Abdul Rani, Siti Nur Izyandiyana Ab. Hadi, Siti Hajar Abd Aziz, &. (2024). The Impact of Online Harassment via Social Media to Self-Esteem Among. *e-Journal of Media & Society*, 44-52.

Connecting the Dots: Closeness Centrality in Co-Authorship Network

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ABSTRACT

The current work focuses on the concept of closeness centrality, which measures how quickly a person can reach others in a network. Those with higher closeness centrality can transmit information more efficiently since they require fewer steps to connect with others. A normalized closeness centrality score ranges from 0 to 1, with a score of 1 indicating direct links to everyone in the network, making the individual well-positioned to spread information. The major goal of this study is to analyze collaboration patterns, research output, and the transmission of ideas within the co-authorship network, with a specific emphasis on the field of algebraic graph theory.

Keywords: Closeness centrality, co-authorship network, collaboration, commuting graph, graph theory.

1. INTRODUCTION

Closeness centrality can be used to identify an individual that is close to the other individuals of a social network. In other words, that individual is central to the others because he can quickly interact with them. A social network is a structure made up of vertices that are represent individuals, collaborations, or family ties. Each vertex is connected to other vertices through edges, which represent relationships, connections, or interactions between individuals. A way of calculating the closeness centrality is said to be the simplest way to consider the sum of the shortest distances from that vertex to all other vertices in the graph. The closer a vertex is to all others, the higher its closeness centrality, meaning it can efficiently reach or influence the network.

Bavelas (1950) observed that vertices with high closeness centrality can spread information more quickly and reflect efficient communication patterns. This is similar to how pivotal individuals in communication networks facilitate information flow, as closeness centrality identifies influential vertices that are highly connected and influential. Additionally, the insights of the study into communication structures align with the concept of closeness centrality, which helps assess and measure the effectiveness of these structures in enhancing information dissemination.

Further formalized on the closeness centrality was initiated by Freeman (1978) who defined it as the inverse of the sum of the shortest paths from a vertex to all other vertices. Additionally, comparison on numerous centrality measures has been made including degree, closeness, and

betweenness centrality, within social networks.

Various applications of closeness centrality in social network analysis, including its use in identifying influential individuals and optimizing network communication have been discussed by Wasserman & Faust (1994). Several limitations were addressed, such as its applicability to disconnected networks, where traditional closeness centrality may not be well-defined.

Additionally, Latora & Marchiori (2001) introduced the concept of small-world networks and also a precise quantitative analysis of both weighted and unweighted networks, emphasizing that efficiency in these networks aids in understanding the implications for normalized centrality measures. Latora and Marchiori (2001) enhanced the centrality measures originally presented by Wasserman and Faust (1994) by normalizing them. This includes normalized closeness centrality, which accounts for variations in network size and structure, enabling meaningful comparisons of centrality measures across networks with different sizes and topologies. Added to that, the metrics become undefined for vertices that cannot reach all other vertices. Thus, Newman (2003) also discussed possible approaches to address these issues, such as normalizing closeness scores or using alternative centrality measures in such cases.

The other notable contributions to network theory were made by Opsahl et al. (2010) by specifically addressing the limitations of closeness centrality in disconnected networks as proposed by Newman (2003). Concrete solutions to these limitations have been provided by making the measure more practical for complex and asymmetric networks. Several studies review both theoretical and application aspects of centrality measures, including closeness centrality, in academic collaboration networks. Notable examples include the works of Borgatti & Halgin (2011), Mahmood et al. (2022), and Hasni et al. (2023).

In practice, closeness centrality is often applied to determine key influencers or highly connected individuals in social networks, collaborative environments and communication systems. For instance, researchers with high closeness centrality can act as central figures in a co-authorship network, facilitating the rapid dissemination of knowledge and collaboration across different groups. By considering closeness centrality, researchers can gain insights into the whole structure of a network, determine important vertices, and optimize the flow of information or resources, making it an important tool in the fields like computer science, sociology, and organizational studies.

"Connecting the dots" within closeness centrality in a co-authorship network refers to identifying how closely an author can connect with all other authors in the network based on their collaborative relationships. Within this setting, the "dots" represent individual authors, and the links between two authors represent collaboration between authors, typically through joint publications. The central idea is to measure how efficiently an author can interact or reach other authors through the shortest paths in the network.

The main goal of this study is to examine collaboration patterns, research productivity, and their strategic position in the dissemination of ideas and collaboration opportunities across the co- authorship network, with a specific emphasis on algebraic graph theory. The following sections will discuss the methodology, results, discussion and conclusion drawn from this research.

2. METHODOLOGY

As this study intersects graph theory and centrality analysis, key information is presented below. The majority of the sources can be found in Latora et al. (2017). T This section covers key concepts of graph theory and centrality analysis, followed by examples that demonstrate the application of closeness centrality analysis.

2.1. Graph theory

A graph is defined by specifying a set of elements, known as vertices, and a set of edges that connect some or all pairs of these vertices. We can use a graph to represent a network of social connections. The vertices in the graph correspond to a group of friends on a social media platform, while the edges represent a mutual friendship or acquaintance between two people. A graph or network is defined in mathematical terms in the following way:

A graph $\Gamma = (V, E)$, consists of two sets, $V \neq \emptyset$, and E. The elements of V are distinct and are called the set of vertices of the graph Γ. The elements of E are distinct unordered pair of distinct elements of V, and are called edges. A network is considered simple and undirected if it does not have multiple edges between any pair of vertices, contains no loops, and has no direction on the edges.

A connected component or cluster in a graph is a subgraph in which any two vertices are connected by a path, and no vertex in the subgraph is connected to any vertex outside of it. In other words, it is a maximal set of vertices where each pair of vertices is reachable from one another, either directly or indirectly through other vertices. In an undirected graph, a connected component represents a subset of vertices that are all interconnected, but there are no edges linking these vertices to other vertices in the graph outside the component.

Another central concept in graph theory is that of the reachability of two different vertices of a graph. In fact, two vertices that are not adjacent may nevertheless be reachable from one to the other. Based on this scenario, we can explore a simple undirected graph to visit the concept of distance to be the length of the shortest paths between two vertices.

Additionally, the most straightforward method to characterize and differentiate vertices in a network is by counting the number of their connections, or in other words, by evaluating their vertex degree. There are different ways to completely describe a network $\Gamma = (V, E)$ by means of a matrix. One possibility is to use the so-called adjacency matrix. The adjacency matrix of a network is a square matrix whose entries are set equal to 1 if there exists an edge between two distinct vertices, while they are zero otherwise.

Studying complex networks is crucial for understanding the intricate relationships and interactions within various systems, such as social networks, biological systems, and communication networks. By analyzing these networks, we can uncover patterns of connectivity, identify key influencers, and optimize processes. Insights gained from complex network studies can lead to more effective strategies in fields like disease control, social media analysis, and organizational management, ultimately enhancing our ability to navigate and influence complex systems
In general, networks permeate all aspects of our life and constitute the backbone of our modern world. A co-authorship network is a type of social network where vertices represent individual researchers or authors, and edges represent collaborative relationships between them based on their joint authorship of research articles.

2.2. Centrality analysis

Centrality analysis is a method used in network theory to determine the relative importance, influence, or prominence of vertices (individuals, entities, or objects) within a network. Centrality measures help identify which vertices are most central in terms of their position and connections to other vertices. Various types of centrality measures emphasize different dimensions of importance, including degree centrality, betweenness centrality, closeness centrality, and eigenvector centrality.

Closeness centrality is a measure of how quickly a vertex can reach all other vertices in a network. It is calculated as the inverse of the sum of the shortest path distances from a given vertex to all other vertices in the network (Latora et al., 2017). In other words, vertices with high closeness centrality have shorter paths to other vertices, allowing them to efficiently spread information or interact with others in the network. Mathematically, for a vertex u which is in a connected graph, closeness centrality is expressed as:

$$C^{C}(u) = \frac{1}{\sum d(u,v)} \tag{1}$$

The normalized quantity defines as:

$$C^{C'}(u) = \frac{n-1}{\sum d(u,v)} \tag{2}$$

takes values in the range $[0,1]$ where n is a total number of vertices, and $\sum d(u,v)$ is the total shortest distance between vertices u and v.

Closeness centrality is typically defined only for connected graphs. In fact, in disconnected graphs, there are pairs of vertices that cannot be joined by a path. For such pairs of vertices, assume that vertices u and v, the geodesic length or the shortest distance between two vertices,
$d(u,v)$ is not a finite number. In order to extend Equation 1 to Equation 2 as the normalized quantity, also to graphs with more than one connected component, whenever there is no path between vertices u and v, we must artificially assign a finite value to $d(u,v)$, for instance equal to n, a distance just greater than the maximum possible distance between two vertices.

Vertices with high closeness centrality are considered to be more central because they can quickly access and influence other parts of the network.

Several examples of four connected networks as presented in Figure 1 are used to interpret which vertex central the most among five vertices. Suppose we want to calculate the closeness centrality $C^{C'}(u)$ between vertex A and all other vertices of Network 1. The following observations make this clear:

- For vertex A, we have $d_{AB} = d_{AE} = 1$ and $d_{AC} = d_{AD} = 2$. Then, $C^{C'}(A) = 0.67$.
- For vertex B, the shortest distances are $d_{BA} = d_{BC} = 1$ and $d_{BD} = d_{BE} = 2$. Now, $C^{C'}(B) = 0.67$.
- For vertex C, we therefore have $d_{CB} = d_{CD} = 1$ and $d_{CA} = d_{CE} = 2$. Then, $C^{C'}(C) = 0.67$.

- For vertex D, the shortest paths are $d_{DC} = d_{DE} = 1$ and $d_{DA} = d_{DB} = 2$. So, $C^{C'}(D) = 0.67$.
- For vertex E, we have instead $d_{EA} = d_{ED} = 1$ and $d_{EB} = d_{EC} = 2$. Then, $C^{C'}(E) = 0.67$.

Therefore, the closeness centrality for each vertex in Network 1 is 0.67. It means that all vertices are equally central with respect to the distances to all other vertices. This situation often arises in a network where all vertices are equally well-connected or where the network is symmetric in some way. Since Network 1 is connected, it is said to be a regular graph as all vertices have the same degree, then each vertex can have the same closeness centrality. Prior to calculating closeness centrality, it is essential to first determine the adjacency matrix of the network. As an example, the adjacency matrix for Network 1 is provided below:

$$\begin{bmatrix} & A & B & C & D & E \\ A & 0 & 1 & 0 & 0 & 1 \\ B & 1 & 0 & 1 & 0 & 0 \\ C & 0 & 1 & 0 & 1 & 0 \\ D & 0 & 0 & 1 & 0 & 1 \\ E & 1 & 0 & 0 & 1 & 0 \end{bmatrix} \tag{3}$$

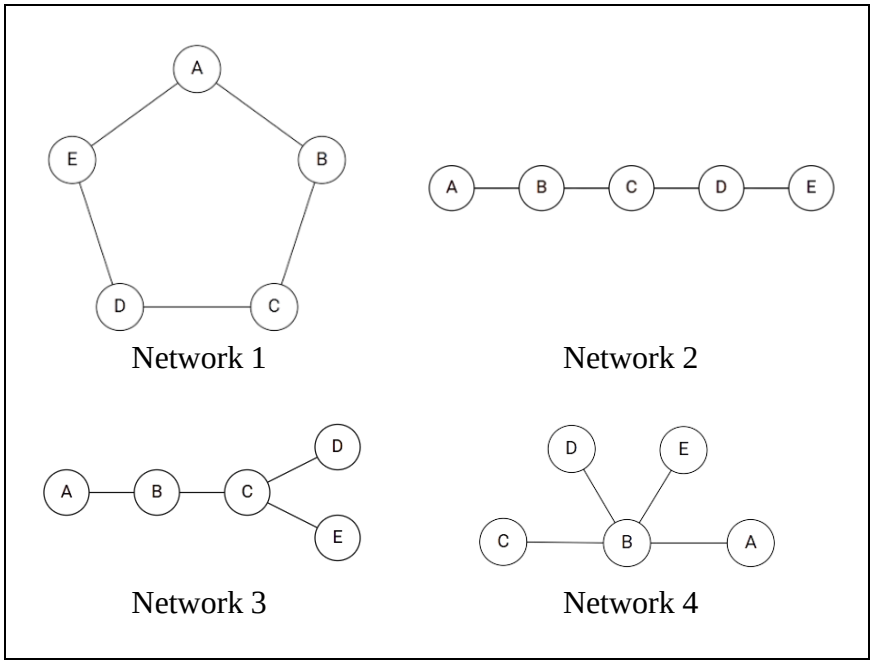

Figure 1. Several network with five vertices

In Network 2, the closeness centrality scores are as follows: 0.67 for vertex C, 0.57 for vertices B and D, and 0.4 for vertices A and E. Since vertex C has the highest closeness centrality, it indicates that this vertex is generally closer to all other vertices in terms of shortest path distances. This implies that the vertex can more quickly or efficiently reach other vertices compared to vertices with lower closeness centrality. Essentially, a higher closeness centrality indicates a more central or influential position within the network.

Turning to Network 3, the closeness centrality for each vertex is as follows: 0.44 for vertex A,

0.5 for vertices D and E, 0.67 for vertex B, and 0.8 for vertex C. Thus, vertex C is identified as the central vertex. Now, when one central vertex is connected to many vertices, it can lead to two possible scenarios that affect closeness centrality in networks of the same size: (1) If a vertex is highly connected, it will have a shorter average distance to all other vertices, hence increasing its closeness centrality. This situation can be seen in Network 4 where vertex B scores 1.00, as it has the highest closeness centrality, while the rest is 0.57. However, this can reduce the closeness centrality of other vertices because the dominant vertex might now act as a hub, and other vertices will have longer paths to vertices not directly connected to them. (2) When a vertex has many direct connections, it effectively shortens the distance between otherwise distant vertices, as illustrated in Network 3. This can cause other vertices, especially those closer to the central vertex, to have somewhat similar closeness centrality scores since they can reach the rest of the network through the central vertex.

These kinds of examples demonstrate that the central vertex acts as a shortcut in the network, making other vertices relatively closer to each other, thereby equalizing closeness centrality scores across vertices to some extent. However, the more central vertex will still hold the highest closeness centrality score due to its direct reachability to many other vertices.

3. RESULTS

In this study, the closeness centrality of a co-authorship network is analyzed to determine scientific collaboration patterns. Two co-authorship networks were obtained from the Scopus and Web of Science (WoS) databases. The focus is on the mathematical field of commuting graphs of finite groups, and research articles including conference proceedings were collected up to the year 2023. Approximately 65 researchers were identified from the Scopus database, while 93 researchers were sourced from the WoS database. Moreover, the names of the researchers were verified using Author ID from the specific database.

Figures 2 and 3 display these two co-authorship networks along with the closeness centrality scores of the authors. The network visualizations were created using VOSviewer, whereas the computation of closeness centrality as shown in Tables 1 and 3, was performed with UCINET. This computation of closeness centrality requires the adjacency matrix. Given that both networks are disconnected, the closeness centrality scores need to be normalized.

A total of 21 clusters or connected components were formed within the co-authorship network shown in Figure 2. The findings of the closeness centrality analysis from the Scopus database indicate that the author named Li. has the highest score, 0.187, in terms of collaborative connections, as summarized in Table 1, compared to the other authors. In 2021, the author co-authored two articles with five other researchers, all of whom are also ranked among the top 15 authors in the Scopus database. While 29 clusters or connected components altogether were identified within the co-authorship network, as illustrated in Figure 3. Closeness centrality analysis from the WoS database reveals that the author Rowley achieved the highest score, 0.217, in terms of collaborative connections, as summarized in Table 2, outperforming other authors. Between 2003 and 2022, Rowley co-authored nine articles with six other researchers, all of whom are ranked among the top 15 authors in the WoS database, with many of them collaborating multiple times.

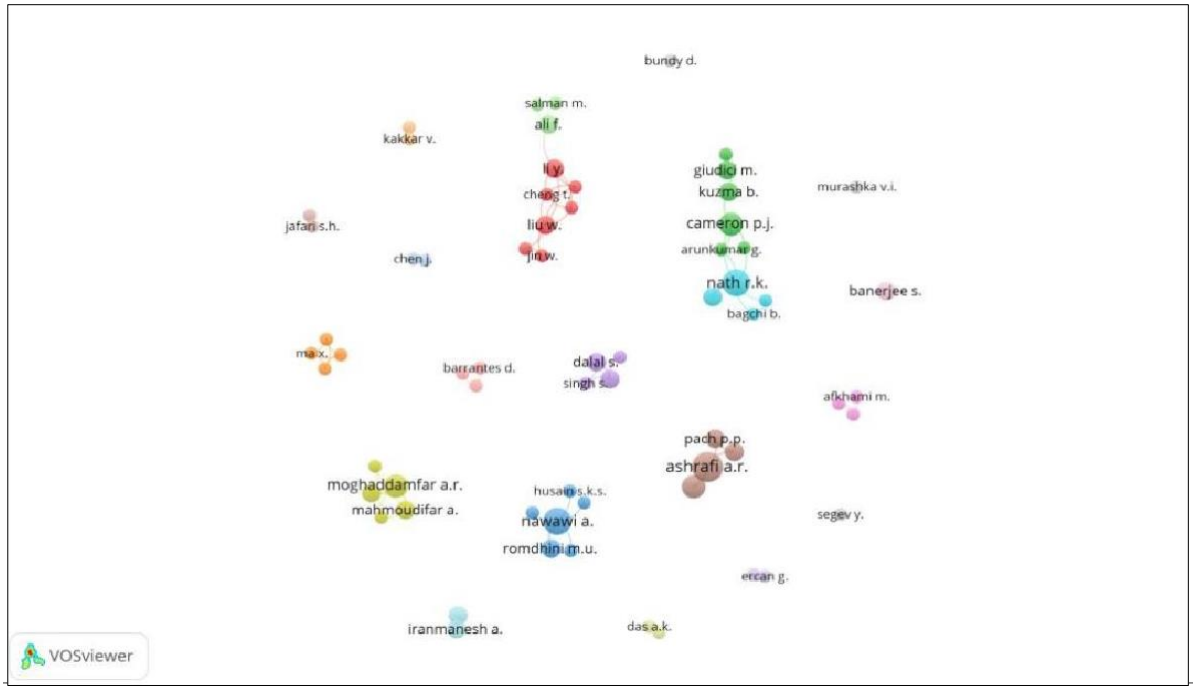

Figure 2. Co-authorship network from Scopus database

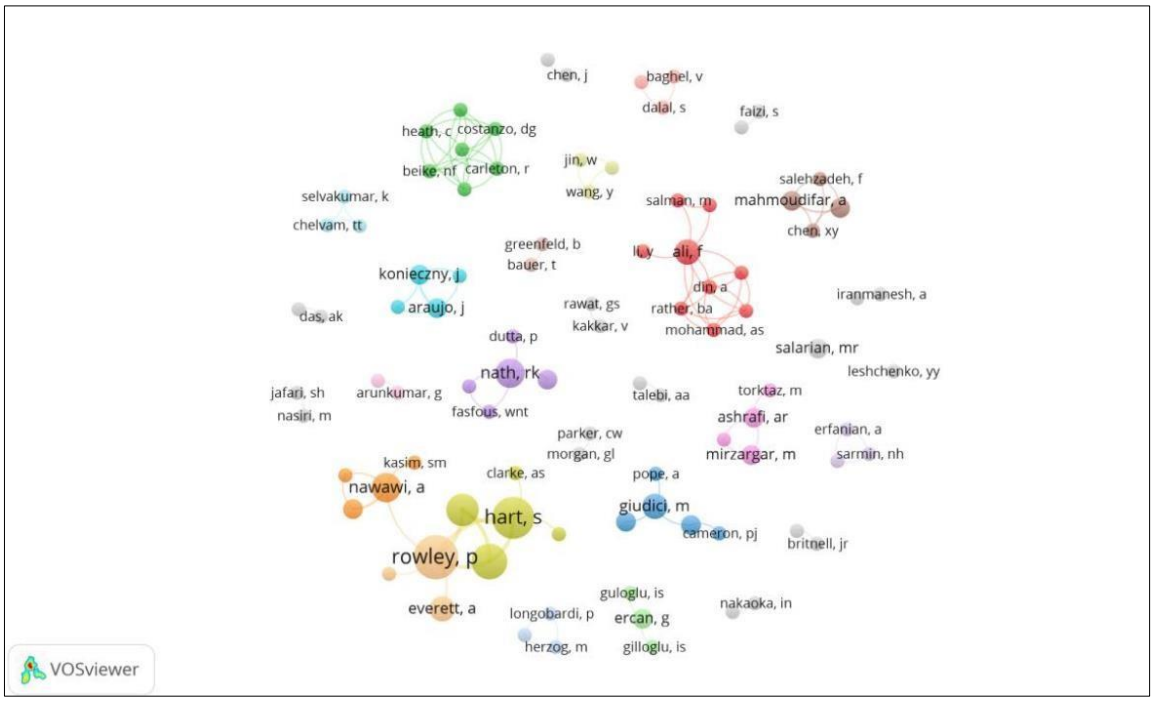

Figure 3. Co-authorship network from WoS database

Table 1. List of top 15 authors in co-authorship network from Scopus database

No.	Author	Closeness Centrality	No.	Author	Closeness Centrality
1.	Li	0.187	9.	Arunkumar	0.184
2.	Liu	0.186	10.	Selvaganesh	0.184
3.	Nath	0.186	11.	Kuzma	0.183
4.	Cameron	0.186	12.	Bagchi	0.182
5.	Cheng	0.185	13.	Dutta P	0.182
6.	Dehmer	0.185	14.	Jin	0.182
7.	Emmert-Streib	0.185	15.	Wang	0.182
8.	Ali	0.184			

Table 2. List of top 15 authors in co-authorship network from WoS database

No.	Author	Closeness Centrality	No.	Author	Closeness Centrality
1.	Rowley	0.217	9.	Rather	0.213
2.	Ali	0.215	10.	Sehra	0.213
3.	Nawawi	0.215	11.	Ullah	0.213
4.	Hart	0.214	12.	Huang	0.212
5.	Bates	0.214	13.	Salman	0.212
6.	Bundy	0.214	14.	Aubad	0.212
7.	Din	0.213	15.	Everett	0.212
8.	Mohammad	0.213			

4. DISCUSSION

Certain authors within both co-authorship networks can be observed that they are closely connected to others within their respective clusters or groups. Authors with higher closeness centrality scores tend to have shorter paths to all other authors in their cluster, indicating that they are more central in the network. This clustering is not only reveal collaboration patterns, but it can highlight influential researchers. Our findings highlight the following perspectives of the closeness centrality analysis in detail, including:

a) Influence of authors – Authors with higher closeness centrality scores are more central or leading within their clusters, as they have shorter paths to other authors, and facilitating quicker dissemination of knowledge and collaboration.
b) Collaboration patterns – Clusters manifest how authors work together based on research interests or institutional affiliations. The closeness centrality highlights which authors are central to these collaborations and may serve as bridges between different research groups.
c) Connectivity and fragmentation – Analyzing closeness centrality within clusters can show either the network is highly connected or fragmented. A highly interconnected cluster will have high centrality scores distributed across authors, while fragmented clusters may show lower overall centrality.
d) Research communities – The division into clusters reflects distinct research communities or subfields within a broader academic domain. Closeness centrality helps determine key authors who connect or lead these communities.
e) Interdisciplinary collaboration – In networks with interdisciplinary research, closeness centrality can focus on authors who collaborate across fields, acting as key connectors between different scientific domains.

Impact of network size and structure – Larger or denser clusters may present different dynamics compared to smaller or more sparsely connected ones. Closeness centrality reveals insights into how central authors function in both compact and expansive networks.

5. CONCLUSION

The closeness centrality analysis allows us to identify key authors who are more central within the co-authorship network. These central authors tend to have shorter paths to other authors, indicating their prominent in collaborative efforts. This analysis helps highlight patterns of collaboration, showing which researchers are more interconnected potentially play a pivotal role in the dissemination of ideas and knowledge across network. However, future research could advance this study by exploring adaptations of closeness centrality for weighted graphs, dynamic networks, and complex systems with evolving vertex interactions over time.

REFERENCES

Bavelas, A. (1950). Communication patterns in task-oriented groups. *Journal of the Acoustical Society America, 22*(6), 725-730. https://doi.org/10.1007/978-3-658-21742-6_8

Borgatti, S. P., & Halgin, D. S. (2011). On network theory. *Organization Science, 22*(5), 1168- 1181. https://dx.doi.org/10.2139/ssrn.2260993

Freeman, L. C. (1978). Centrality in social networks: Conceptual clarification. *Social Networks, 1*(3), 215-239. https://doi.org/10.1016/0378-8733(78)90021-7

Hasni, R., Yussof, N. I., Movahedi, F. S., Gobithaasan, R., & Bakar, S. A. (2023). The co-authorship network analysis of research papers in malaysian journal of mathematical sciences in 2019. *Journal of Mathematical Sciences and Informatics, 3*(5), 25-41. http://doi.org/10.46754/jmsi.2023.06.00

Latora, V., & Marchiori, M. (2001). Efficient behavior of small-world networks. *Physical Review Letters, 87*(19), 198701. https://doi.org/10.1103/PhysRevLett.87.198701

Latora, V., Nicosia, V., & Russo, G. (2017). *Complex Networks: Principles, Methods, and Applications*: Cambridge University Press.

Mahmood, B., Sultan, N. A., Thanoon, K. H., & Kadhim, D. S. (2021). Measuring scientific collaboration in co-authorship networks. *IAES International Journal of Artificial Intelligence, 10*(4), 1103-1114. https://dx.doi.org/10.11591/ijai.v10.i4.pp1103-1114

Newman, M. E. J. (2003). The structure and function of complex networks. *SIAM Review, 45*(2), 167-256. https://doi.org/10.1137/S003614450342480

Opsahl, T., Agneessens, F., & Skvoretz, J. (2010). Node centrality in weighted networks: Generalizing degree and shortest paths. *Social Networks*, 32(3), 245-251. https://doi.org/10.1016/j.socnet.2010.03.006

Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. Cambridge University Press.

Effect of 1-methyl-3 propylimidazolium iodide ionic liquid on transport properties of hexanoyl chitosan/PVC blend based polymer electrolyte system

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ABSTRACT

In this work, 1-methyl-3 propyl imidazolium iodide (MPImI) is employed as ionic liquid in polymer blend electrolyte system based on hexanoyl chitosan and poly(vinyl) chloride (PVC) in the weight ratio 90/10. The films were prepared by solution casting. Sodium iodide (NaI) was used as dopant salt and act as Na^+ provider in the system. Addition of MPImI into the optimized hexanoyl chitosan/PVC-NaI composition increased the ionic conductivity of the system. The highest room temperature ionic conductivity of 1.34×10^{-4}S cm^{-1} was exhibited by hexanoyl chitosan/PVC-NaI containing 8 wt.% MPImI which is one order higher than ionic liquid free electrolyte system. The linear variation of conductivity with temperature suggested the Arrhenius type thermally activated process. The variation of conductivity as a function of MPImI concentration and temperature were discussed on the basis of number and mobility of charged carriers determined using impedance spectroscopy method. The transference number measurement showed that the conductivity was predominantly ionic.

Keywords: Hexanoyl chitosan, PVC, Sodium iodide

1. INTRODUCTION

Generally, the conventional DSSC are based on liquid electrolyte as they provide high power conversion efficiency. Unfortunately, liquid electrolyte based DSSCs have many drawbacks like electrolyte leakage, evaporation, corrosion of the platinum electrode and instability at higher temperature (Prabakaran et al., 2015). Therefore, research effort in this area is focused on developing solid polymer electrolyte based DSSCs. Despite that many researchers have started working on solid polymer electrolytes; they are still facing problems on the low conversion efficiency and poor ionic conductivity, respectively. Thus, in order to overcome these problem, the addition of room temperature ionic liquids (RTILs) have also attracted as an alternative strategy to overcome problem associated with SPEs. Consisting of an organic cation and inorganic cation, ionic liquids have several advantages such as high chemical and thermal stability, and high ionic conductivity (Dissanayake et al., 2014). Among this ionic liquid, imidazolium iodide based ionic liquids are widely used for dye sensitized solar cells (DSSCs) application because of better performance. The incorporation of MPImI introduced additional mobile ions namely $MPIm^+$ and I^-. In this work, the polymer electrolytes prepared utilizing blend of hexanoyl chitosan and PVC as the polymer host with incorporation of sodium iodide (NaI) and MPImI ionic liquid.

2. METHODOLOGY

Hexanoyl chitosan that exhibited solubility in tetrahydrofuran (THF) was prepared by acyl modification of chitosan (Zong et al., 2000). Poly(vinyl) chloride (PVC) with molecular weight of 2.3 x 10^5 g mol^{-1} and sodium iodide (NaI) with purity 99% both from Aldrich were used in this work. Tetrahydrofuran (THF) with purity > 99 % obtained from J.T Baker was used as the solvent. NaI was dried at 100°C for 24 h prior to use. In a study conducted separately, the composition of 90:10 blend of hexanoyl chitosan/PVC gave the highest conductivity. Films of hexanoyl chitosan/PVC (90:10)-NaI-MPImI were obtained by solution casting technique. The amount of polymer and NaI were fixed. MPImI with different weight fraction ranging from 0 to 10 wt% were added to hexanoyl chitosan/polystyrene-NaI dissolved in THF. The solutions were stirred until homogenous. The homogenous solutions were then cast in different glass petri dishes and allowed to evaporate slowly at room temperature to form films. Impedance measurements of the films were carried out using HIOKI 3532-50 LCR Hi Tester in the frequency range of 50 Hz to 1 MHz, from 333 to 373 K. The prepared sample film was sandwiched between two stainless steel electrodes with diameter 1.2 cm under spring pressure.

3. RESULTS AND DISCUSSION

The conductivity is observed to increase with increasing MPImI concentration. Maximum conductivity of 1.3 x 10^{-4} S cm^{-1} is achieved at 8 wt.% MPImI. Addition of MPImI ionic liquid beyond 10 wt.% results in a decrease in conductivity. The ion transport mechanism of the polymer electrolyte was evaluated by measuring ionic conductivity over the temperature range of 303-343k as presented in Figure 1. The temperature dependent variation appears to be linear with an average regression value of 0.992 reveals that the conduction mechanism is obeying the Arrhenius law.

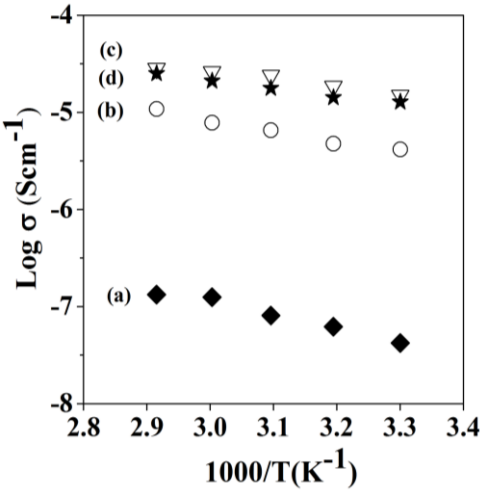

Figure 1. Temperature dependence of conductivity for hexanoyl chitosan/PVC (90:10)-NaI with various concentrations of MPImI

The ionic transference number for electrolyte containing 8 wt.% MPImI ionic liquid has been determined using DC polarization method. The current decays immediately and approaches steady state as shown in Figure 2. The value of ionic transference number, t_{ion} was calculated from the plot of polarization current versus time using the equations

$$t_{ion} = (I_i - I_f)/I_i \quad (1)$$

$$t_e = I_f / I_i \quad (2)$$

where I_i is the initial current and I_f is the final current. The calculated value of ionic transference

number is found to be 0.918 which suggest that the charge transport in the electrolytes system is predominantly due to ions.

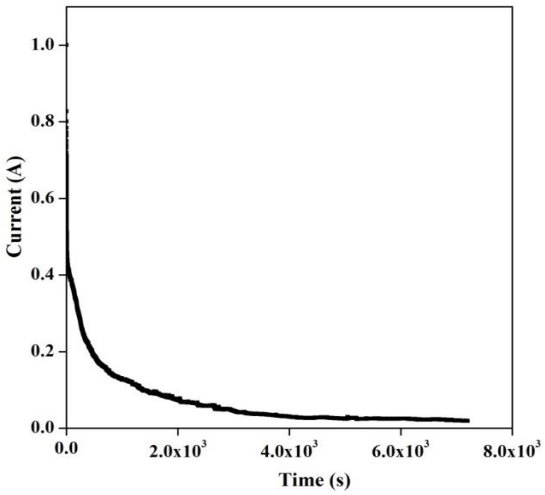

Figure 2. Plot of transference number for hexanoyl chitosan/PVC (90:10)-NaI-8 wt% MPImI

4. CONCLUSION

Studies shown the addition of ionic liquid MPImI increased the ionic conductivity due to the softens the polymer backbone and improves the polymer segmental mobility and ionic transportation by providing more conducting pathways for the charge carriers to move around freely thus enhance the ionic conductivity. All samples under investigation showed a linear variation of conductivity with temperature, suggesting the Arrhenius type thermally activated conduction.

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REFERENCES

Dissanayake MAKL, Rupasinghe WNS, Seneviratne VA, Thotawatthage CA, Senadeera GKR (2014). Optimization of iodide ion conductivity and nano filler effect for efficiency enhancement in polyethylene oxide (PEO) based dye sensitized solar cells. *Electrochim Acta*, 145, 319–326

Prabakaran K, Mohanty S, Nayak SK (2015). Solid state metal-free eosin-Y dye sensitized solar cell based on PVdF-HFP electrolytes: combined effect of surface modified TiO2 and plasticizer on electrochemical and photovoltaic properties. *J Solid State Electrochem*, 19, 2465–2479.

Zong Z, Kimura Y, Takahashi M, Yamane H (2000). Characterization of chemical and solid-state structures of acylated chitosans. *Polymer*, 41,899–906

A Comparative Study of Store Location Selection: Analytic Hierarchy Process and Potential Method

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ABSTRACT

Comparison of alternatives is a common way to solve the problems using Multi-Criteria Decision Making (MCDM) method. It implies consideration of many factors and generates the weighted of outcomes for every alternative. Among the most popular MCDM techniques are Analytic Hierarchy Process (AHP) and Potential Method (PM). Potential Method uses a directed graph created by pairwise comparisons to determine a value for every alternative. In this paper, PM will be applied to the store location selection problem for which results are already provided by AHP. This is aimed at illustrating how PM applies in the making of decisions. Besides, the obtained results from both methods rank options similarly. This shows that when it comes to solving real-world problems with many criteria, PM is just as effective as AHP.

Keywords: Decision making, Multi-Criteria Decision Making, Analytic Hierarchy Process, Potential Method, Store location

1. INTRODUCTION

In decision-making, it's important to find and choose options based on what the decision-maker prefers. Decisions often involve looking at different possibilities and selecting the one that best fits goals and values (Panpatte and Takale, 2019). Multi-Criteria Decision Making (MCDM) is a mathematical method that offers tools to help decision-makers tackle complex situations with multiple criteria. This study will focus on two main tools in MCDM: The Analytic Hierarchy Process (AHP) and the Potential Method (PM). The AHP helps in choosing the best options by defining key criteria. It was developed by Saaty in 1980 to solve multi-criteria decision problems. According to Canco et al. (2021), AHP is effective in handling both qualitative and quantitative data. It gives decision-makers a way to understand decision-making models, especially for complicated tasks that require subjective judgments (Guillén-Mena et al., 2023). AHP organizes information into several levels, including objectives, criteria, attributes, and alternatives, to tackle complex issues (Terzi, 2019).

2. METHODOLOGY

The Potential Method is a decision-making technique that utilizes graph called a "Preference graph". The preference graph is used to illustrate pairwise comparisons between alternatives (Čaklović and Kurdija, 2017). The definition of a preference graph is given in Definition 1 and

some instances of preference graphs are illustrated in Figure 1.

Definition 1 (Čaklović & Kurdija, 2017)

A preference graph is a triple $G=(V,A,F)$ where V is a set of $n\in\square$ vertices, $A\subseteq V\times V$ is a set of directed edges, and $F:A\to\square$ is a preference flow which maps each edge (u,v) to the corresponding intensity $F_{(u,v)}$.

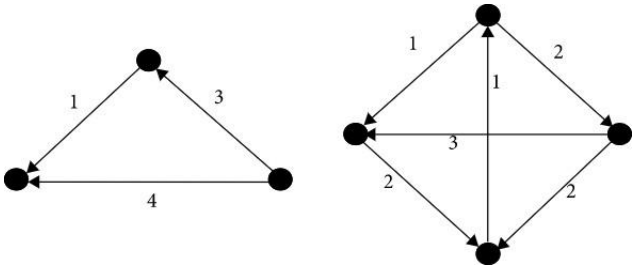

Figure 1. Preference graphs

3. RESULTS AND DISCUSSION

Akalin *et al*. (2013) have to choose the optimal store location for the scenario depicted in Figure 2. The store location is evaluated based on four criteria: Population (C1), Retail Settlement (C2), Costs (C3), and Competition (C4). A total of 13 subcriterion must be taken into account in addressing this problem. The available alternatives are designated as A1 (Umraniye), A2 (Eskisehir Merkez), and A3 (Bodrum).

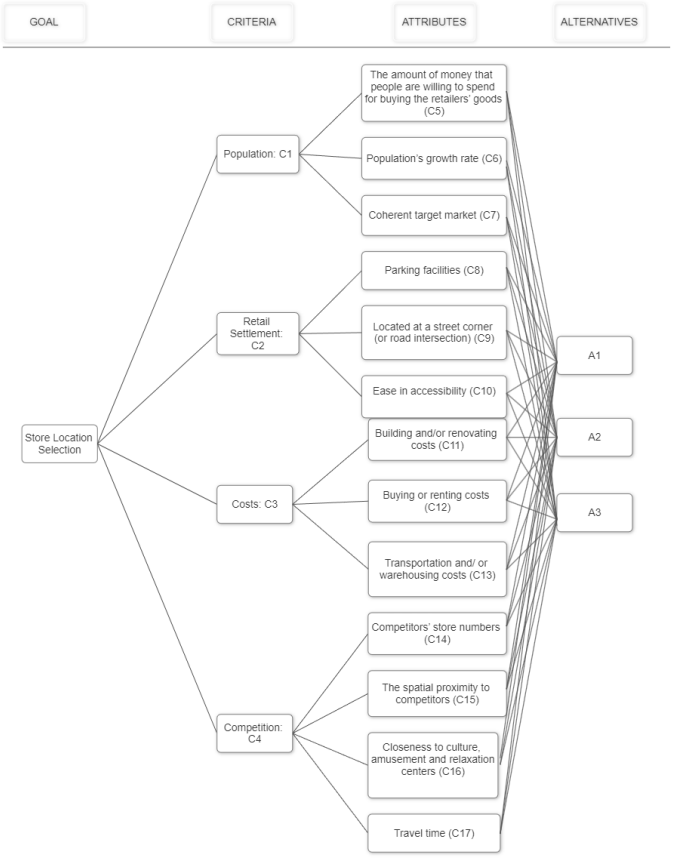

Figure 2. The hierarchical structure of store location selection (Akalin *et al*., 2013)

3.1 Weight Determination

Analyzing the criteria is a crucial step in decision-making because it helps identify the key factors that influence the choice of alternatives. The preference graph with respect to criteria is illustrated in Figure 3.

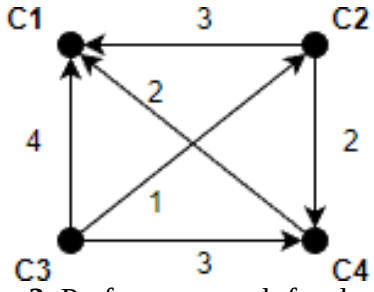

Figure 3. Preference graph for the criteria

Table 1 shows the global weightage of each alternative and it's ranking using PM.

Table 1. Global weightage of alternatives for sub-criteria

Alternatives / Sub-criteria	A1	A2	A3
C5	0.0454	0.1145	0.0090
C6	0.0454	0.0180	0.0036
C7	0.2064	0.2064	0.0129
C8	0.0024	0.0024	0.0024
C9	0.0438	0.0006	0.0003
C10	0.0014	0.0022	0.0142
C11	0.0015	0.0037	0.0003
C12	0.0042	0.0213	0.0017
C13	0.0016	0.0003	0.0001
C14	0.0488	0.0194	0.0038
C15	0.0606	0.0076	0.0038
C16	0.0092	0.0073	0.0015
C17	0.0044	0.0112	0.0564
Global weight	0.4751	0.4149	0.0917
Final Ranking	1	2	3

Table 2 compares the final results of PM and AHP. In the PM analysis, A1 has the highest weight (0.4751), followed by A2 (0.4149), and A3 (0.0917). AHP shows similar results: A1 (0.126), A2 (0.070), and A3 (0.016). Both methods rank the alternatives consistently as A1 > A2 > A3.

Table 2. Comparison of weight and ranking between PM and AHP

Alternatives	AHP	Rank	PM	Rank
A1	0.126	1	0.4751	1
A2	0.070	2	0.4149	2
A3	0.016	3	0.0917	3

5. CONCLUSION

The results from the Potential Method (PM) show a strong consistency with the outcomes obtained from the Analytic Hierarchy Process (AHP). This alignment highlights the reliability of PM in decision-making contexts. Therefore, we conclude that PM is not only effective in addressing the specific challenge of selecting store locations but also has broader applications in various decision-making scenarios that involve multiple criteria. Its structured approach allows decision-makers to evaluate alternatives systematically, making it a valuable tool for tackling complex problems across different fields.

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REFERENCES

Akalin, M., Turhan, G., & Sahin, A. (2013). The Application of AHP Approach for Evaluating Location Selection Elements for Retail Store: A Case of Clothing Store. In *International Journal of Research in Business and Social Science*, 2(4), 1-20.

Čaklović, L., & Kurdija, A. S. (2017). A universal voting system based on the Potential Method. *European Journal of Operational Research*, 259(2), 677-688.

Canco, I., Kruja, D., & Iancu, T. (2021). AHP, a reliable method for quality decision making: A case study in business. *Sustainability*, 13(24), 13932.

Guillén-Mena, V., Quesada-Molina, F., Astudillo-Cordero, S., Lema, M., & Ortiz-Fernández, J. (2023). Lessons learned from a study based on the AHP method for the assessment of sustainability in neighborhoods. *MethodsX*, 11, 102440.

Panpatte, S., & Takale, V. D. (2019). To study the decision making process in an organization for its effectiveness. *The International Journal of Business Management and Technology*, 3(1), 73-78.

Terzi, E. (2019). Analytic Hierarchy Process (AHP) to solve complex decision problems. *Southeast Europe Journal of Soft Computing*, 8(1), 5-12.

Enhancing Vocal Performance in English-Language Opera: Phonetic Challenges and Solutions through Vowel Modification and IPA Training

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ABSTRACT

The research explores some of the issues that opera singers face with English pronunciation, stressing practical exercises for better diction and vocal technique. English presents a special set of challenges as the language with an uneven phonetic structure, complex vowels and diphthongs, and consonant clusters, which may hinder smooth vocal legato and resonance. This research includes a series of pedagogical strategies ranging from vowel modification to International Phonetic Alphabet (IPA) training, as well as educational musical exercises that address these problems. Based on exploring the literature on phonetic challenges germane to vocal performance, this research suggests that these strategies will optimise vocal resonance and diction. This is principally for non-native speakers performing English lyrics. Selective vowel changes (e.g. /ae/ to /a/) dramatically improve the tenure and clarity of the vocalist's voice, while IPA coaching can help solve vocal challenges involving difficult consonant clusters. The acoustic analysis from previous studies jointly affirms the effectiveness of these strategies in dealing with the problems arising from characteristics of English phonetics. The findings have significant implications for voice coaches and educators who must adapt appropriately structured strategies for addressing the complexities of English pronunciation in opera.

Keywords: Opera, English Pronunciation, Vocal Technique, Diction, Vocal Performance

1. INTRODUCTION

English is a tough language for opera singers, especially compared to languages like Italian and French, which have specific and consistent phonetics. The numerous inconsistencies of English vowel systems, diphthongs, and consonant clusters become barriers to producing a vocal line that is both legato and resonant all the time (Massey, 2023). This research explores strategies to combat these problems, notably through vowel changing, instruction in the IPA and exercises focusing on educational music. Whilst effective, these have presented difficulties for native-born English-speaking singers in mastering regional accents and dialects for performance (Massey, 2023).

2. METHODOLOGY

Based on this review, the current research contributes to understanding phonetic difficulties for vocalists and non-native speakers performing in English. The papers were selected based on any focus on vowel modification and IPA training-related research in vocal performance, with a particular emphasis on empirical studies that measured improvements in phonemic accuracy or changes to voice resonance. A study from Massey (2023) was selected because it offers an across-the-board assessment of vowel modification approaches, and Niu, Chen, and Wu

(2023) were chosen for its ability to offer acoustic analysis that investigated the difficulties encountered by non-native speakers with English phonetic sounds.

3. RESULTS AND DISCUSSION

The findings and discussions are described in detail in this section.

Massey (2023) finds that in English-language opera performances, changing the vowel /ae/ to /a/ significantly improves both resonance and diction. As Massey remarked, the study sensed greater resonance and more consistent legato because of the held notes on vowels that transition. IPA training has been especially useful in helping singers articulate difficult consonant clusters and diphthongs that are often the cause of diction problems within English operas. Singers increased their vowel output by approximately 15% after the targeted vowel modification exercise, as shown experimentally in an acoustical study (Niu et al., 2023).

These strategies were implemented into educational musical activities and can be quite successful, as shown in the works of Vukićević & Ćirković-Miladinović (2023), where singers without an accent improve pronunciation accuracy and intonation on a large scale. Through the exercises' attention to rhythm and articulation, the singers were able to clarify how they enunciated words so that when they sang in English, listeners could more clearly understand them. The results showed that the improvements were largest in sections involving complex diphthongs and consonant clusters in those commonly found in English Language arias.

4. CONCLUSION

With English language operas becoming increasingly more prevalent in the global repertoires, it is important to find solutions for training that address some of the phonetic challenges faced by vocalists when singing in English. Vowel modification, IPA training, and instructional musical exercises are presented in a universal approach to English phonetic enhancement for opera. These same techniques are even beneficial for native and non-native speakers to improve diction, vocal resonance, and quality of the performance. The results show that the vocalists' resonance gets a bigger spank when you modify their vowels, and IPA training significantly improves their articulation/pronunciation clarity. However, future studies should examine how these strategies might stably apply to a broad landscape of vocal genres and, in turn, music education for English-speaking performance exchange as well as future perspectives.

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REFERENCES

Ichim, T. (2023). The Valuation of the Original Text in an Opera Vocal Score: Meaning and Pronunciation. *Bulletin of the Transilvania University of Braşov. Series VIII: Performing Arts*, *15(64)*(special issue (2022)), 79–86. https://doi.org/10.31926/but.pa.2022.15.64.3.9

Massey, Christie, "A Study of the English Language and Its Effects on Vocal Technique" (2023). *Masters Theses*. 1016.https://digitalcommons.liberty.edu/masters/1016

Niu, R., Chen, Y., & Wu, J. (2023). L2 learners' pronunciation of English phonetic sounds: An acoustic analysis with software Praat. *International Journal of Linguistics, Literature and Culture, 9*(5), 209–225. https://doi.org/10.21744/ijllc.v9n5.2363

Vukićević, N. M., & Ćirković-Miladinović, I. (2023). Improving English Pronunciation by Using Instructive Musical Exercises: University Teaching Context in Serbia. *Journal of Language Teaching and Research, 14*(5), 1159–1167. https://doi.org/10.17507/jltr.1405.02

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