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FOREWORD

Let me extend my heartiest welcome to the first issue of the Journal of Research Management and Governance (JRMG). JRMG is beginning its journey in December 2018 with the University of Malaya – the premier research university in Malaysia – as its host.

In the past couple of decades, research efforts in Malaysia have intensified to a great extent. Research outputs in term of both quality and quality has been improving significantly. The number of research publications and patents has been on the rise. Other countries in the ASEAN region are also putting great efforts to improve their research performance.

Building and sustaining the momentum of research require an effective research ecosystem. Well trained professionals in research management and governance are a key element of such an ecosystem. The scope of research management and governance is wide. At the micro-level, it may involve managing individual research projects. At a bigger scale, research management is carried out at the institutional level, in a university or a research organization. At the macro-level, research management encompasses at national and international level efforts. Effective research management and governance or administration at different levels is vital to ensure the effective use of research funding and other resources, so as to achieve the intended outcome and impact.

In advanced countries, research management has, to a great extent, taken the shape of a profession on its own. It is recognized that professionals working in the area of research management are required to have unique blend of skills and experience in areas which can be grouped into: research-related, management- and communication-skills; and transferable skills. They may get involved in wide ranging activities such a science funding, project management, science communication, technology transfer, partnership and networking, outreach, lobbying, science policy, lab management, research support services, etc.

A few universities in advanced countries offer postgraduate degree and certificate programs in research management, administration or governance. Professional societies in different countries and regions are putting great efforts for research management professionals to excel. Some of these active societies include Association of Research Managers and Administrators, UK (ARMA); Australasian Research Management Society (ARMS); European Association of Research Managers and Administrators (EARMA); National Council of University Research Administrators (NCURA), USA; Research Manager and Administrator Network Japan (RMAN-J); Southern African Research & Innovation Management Association (SARIMA) and West African

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Research and Innovation Management Association (WARIMA).

Research management, in this part of the world, is yet to emerge as a profession. In order to help research management profession to flourish in Malaysia and in this region, we need to start building a community of practice. The Journal of Research Management and Governance, the first of its kind in Malaysia and perhaps in the South East Asian region, intends to provide a platform for research management practitioners and administrators, and researchers to exchange knowledge, share their experience and views to order to achieve excellence in their professional pursuits. The journal publishes both scholarly research work and articles to share best practice and viewpoints. I take this opportunity to invite you and your colleagues to submit your contributions to JRMG in the following categories: 1. Full-length article, 2. Short communications, 3. Case Studies, 4. Opinions, 5. Book Review/Conference Report.

It is my hope that this journal will act as an effective scholarly platform for research management professionals in this region and beyond in the years to come.

Stefanie Shamila Pillai
Editor-in-Chief
Universiti Malaya

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PREFACE

It is my pleasure to welcome the publication of the 5th volume of the Journal of Research Management and Governance (JRMG). University of Malaya as the premier university in Malaysia realizes the importance of research management and governance in supporting the whole research ecosystem. Research, as an integral part of academia has been progressing at an unprecedented rate in this part of the world with many institutions from emerging economies making their marks in global rankings. In the course of evolving into research-based institutions and coping with the flux of resources, information and research output, the need for professional management of research processes has become inevitable. The birth of JRMG is aimed as a platform for exchanging ideas and sharing strategies in the management and governance of research by those who are involved in research management, for the advancement of research in their respective organizations. Good practices of research management and governance significantly influence the various aspects of research including financial management, employment of appropriate talents, output management, and translation of research to the society. I would like to extend my gratitude to Prof. M.A. Haseeb and his team for their efforts in publishing JRMG. It is my greatest hope that JRMG will be recognised as a channel to connect research communities globally to communicate on matters pertaining to research processes be they issues or solutions.

Professor Dr. Shaliza Ibrahim
Lead Advisor
Universiti Malaya

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DESCRIPTION

The Journal of Research Management & Governance (JRMG) (eISSN: 2637-1103) is an official journal of the University of Malaya. It is an international, peer-reviewed, open access journal with readership throughout the field of sciences and non-sciences. The JRMG was established to provide a platform for scholars, experts, researchers, practitioners, and students from various fields to come together under a common interest in the field covering all aspects related to management and administration of research in universities, research organizations and funding agencies including strategies and policies in research management and administration, development of research management professionals, management and storage of research output, impact and implication of research and the changing research environment at both national and international levels to publish original research, review papers, and other scholarly works that are freely accessible to the whole scientific community, locally and internationally.

AIMS AND SCOPES

The main objectives of this journal are to publish quality articles in research management and governance, and to discover and advance best practices in this area.

Articles published in JRMG cover all aspects related to management and governance of research in universities, research organizations, funding agencies and governments. This includes (but not limited to) research ecosystem, study and practice of research management profession, strategies and policies, research policy and ethics, changing research environment, quality and innovation in research administration and management, human resource management and development, full economic costing and research funding, knowledge transfer from research to application, data science and data curation as applied to research management, impact of research, developments within higher education environment and implications of major external influences on research management.

The Editors will consider papers for manuscripts based on novelty and contribution to the advancement of research management. JRMG publishes full-length articles, short communications, case studies, opinions and book review/conference report.

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RESEARCH ARTICLE

Impact of Social Distancing on Research Activities: An online cross-sectional survey

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ABSTRACT

During the Coronavirus Disease 2019 (COVID-19) pandemic, many institutions enforced social distancing measures to limit or restrict access to offices, laboratories, and workplaces, disrupting the standard workflow of research. This survey investigates the impact of social distancing measures in universities and research institutes on research and research training. An online survey was designed for distribution to researchers and students worldwide to researchers in medical physics, engineering, science, clinical, arts and social studies. In addition to demographic questions, we surveyed the impact of social distancing in terms of research output, training activities, and mental health of the researchers and students. One hundred and thirty participants completed the survey, of which 72% of the respondents were from Malaysia, and 58% of the respondents were female. Prior to the pandemic, 59% worked in hospitals and universities. There was a variation in how strict social distancing was practised/enforced in different institutions, with 85% reporting limited or completely no access to laboratories or research facilities. A significant difference was found between genders, with female respondents reporting to be less affected by the social distancing measures. No correlation was found between age and the reported effect of social distancing research activities. The most affected research activities were research progress, presentation of results at conferences, and data collection. The pandemic also affected the respondents' mental health, reporting demotivation, feeling isolated, and losing focus on their work. Measures to alleviate the negative impact of COVID-19 suggested enhancing research and training, including improved communications, making research training more accessible, and adjusting administration, work and research goals.

Keywords: social distancing, COVID-19, pandemic, research impact, mental health

1. Introduction

During the Coronavirus Disease 2019 (COVID-19) pandemic, many countries were put on partial or complete lockdowns. Everyone was asked to practice social distancing as one of the measures to break the chain of infection (Dadras et al., 2021). The measures taken in different countries to break the transmission of COVID-19 differed by the method and extent of the implementation; from enforcing the use of masks and physical distancing to complete lockdown with stay-at-home orders and travel restrictions across borders. Workplaces implemented remote working schedules and online learning for schools. For universities and research institutes, many institutions enforced measures to limit or restrict access to offices, laboratories, and workplaces to achieve this. As we transition into the post-pandemic world, social distancing measures have been lifted in many countries.

However, it is crucial to understand the mechanism and impact of social distancing in research, so as to help the community prepare for future events of a pandemic or other unforeseen challenges. Implementing social distancing in universities and research institutes disrupts students' and staff's research and research training. Depending on the strictness level of social distancing practised by each institution or region, the impact may differ for the researchers and students. While social distancing was unavoidable during the pandemic, the impact of social distancing should be understood to enable measures to promote and sustain the growth of research during future difficult times.

Regarding social distancing, studies have highlighted the impact of social distancing on mental wellbeing (Abdelrahman et al., 2022; Cao et al., 2020; Marroquín et al., 2020; Odriozola-González et al., 2020; Peterson et al., 2021). However, data on the impact on research sustainability are still scarce (Bratan et al., 2021; Dong et al., 2022). Bratan et al. (2021) surveyed research investigators from selected funding programmes in Germany on the impact of the COVID-19 pandemic on ongoing health research projects. Their studies reflected the widespread impact of the pandemic, not specifically on social distancing. Dong et al. (2022) surveyed the perspective of postgraduate students involved in medical research in China. However, both studies were focused on medical research and limited to the social distancing practices of their countries. The impact of social distancing on a broader range of research and research training is still not yet well understood. The present study investigates how social distancing affects research in various fields, including medical physics, clinical, and engineering research. The impact on the research training, mentoring, and mental health was also evaluated.

2. Material & Methods

A cross-sectional online survey was designed for distribution to researchers and students worldwide from February to June 2021. The data for the study were collected and managed using the REDCap electronic data capture tool hosted at the Universiti Malaya (https://redcap.link/wvihx9eh). The survey was disseminated via email invitation, phone messages, and organisation email lists. Only those who consented were included in the study. In addition to demographic questions, we surveyed the impact of social distancing in terms of research output, training activities, and mental health of the researchers and students.

The survey tool used a mixed-method design, which comprised 19 multiple-choice and free answer questions. No personal data was collected, although demographic data such as country of residence,

age, study level, occupation, and research fields were collected. The survey questions are shown in Appendix Table A1. All researchers, academics, or students at institutions of higher learning were eligible to participate in the survey. The following terms and definition were adopted in this survey:

i) 'social distancing': Maintaining a set physical distance (e.g., 1-2 m) with the people around us, practising distancing measures, e.g., no handshake or hugs when greeting. This also included official measures to enforce social distancing, such as partial lockdowns, reduced staffing, and limited access to research/university facilities.
ii) 'research activities': Literature search, discussion with supervisors/supervisees, data collection, data analysis, presentation of results at conferences, securing research grants, research output, research progress, writing, etc.
iii) 'research training': Research methodology training, hands-on/laboratory training, mentoring activities (discussion with supervisors/supervisees), progress management etc.

The results were analysed using SPSS version 22. Numerical data were evaluated for normality using the Shapiro-Wilks test. Data that were not normally distributed were evaluated using non-parametric tests such as the Mann-Whitney *U*-test, Friedman test and Spearman's Rank correlation. Demographic data were reported in mean, median, standard deviation, and inter-quartile range (IQR). Statistical significance was declared at $p < 0.05$. Free text answers were analysed using the framework analysis approach (Creswell & Creswell, 2018). A thematic analysis approach was also used to obtain further insights into how different genders were affected by social distancing measures.

3. Results

A total of 130 participants from 15 countries completed the survey, of which 72% of the respondents were from Malaysia. For the international respondents, the main contributors were from China (8%) and Australia (5%). The rest of the respondents were from Brazil, The Philippines, the United Kingdom, Thailand, India, Maldives, Cambodia, Singapore, Jordan, Finland, Indonesia, and Japan. Table 1 presents the demographics of the survey respondents. Fifty-eight percent (58%) of the respondents were female. The survey participants' age ranged from 22 to 70 years old, with a median age of 35 years (IQR = 30 to 42 years). The respondents were primarily academics and researchers (51%), while students comprised 34% of the respondents. Amongst the 55 students, 58% of them were doing their master's studies at the time of the survey. The second-largest student cohort was the doctoral students. Thirty-seven percent (37%) of the respondents worked in medical physics, 25% in clinical, and 15% in science domains. Prior to the pandemic, 36% worked in hospitals, 23% worked in universities, 19% in laboratories, and 14% in offices.

Prior to the pandemic, respondents' time allocated to research activities varied from <20% to more than 80% of their working/study hours. A total of 23% of the respondents reported spending more than 60% of their time on research activities. The student's study level was moderately correlated with the amount of research time (Spearman's Rank correlation, $r = .42$, $p = 0.001$).

Different workplaces practiced different measures to ensure adherence to social distancing, which also translated to the level of social distancing strictness in the research environment. The majority of the

respondents (61%) reported limited access to laboratory/research facilities/campuses. Almost a quarter of the respondents (24%) reported that they could not access laboratory/research facilities/campuses.

Table 1: Demographics of the survey respondents.

Description	N (%)
Respondents	130 (100)
Female	76 (58)
Male	54 (42)
Countries (N)	15
Malaysia	94 (72)
Others	36 (28)
Age (years)*	35 (IQR = 30 to 42)
Occupation**	
Academics	49 (30)
Researcher	34 (21)
Student	55 (34)
Others	25 (15)
Current study level (for students)	
Undergraduate	4 (7)
Masters	32 (58)
Doctoral	19 (35)
Field of research	
Medical physics	48(37)
Engineering	7 (6)
Science	20 (15)
Clinical	33 (25)
Arts & social studies	9 (7)
Others	13 (10)
Prior to the pandemic, how often were you involved/participated in research activities (as a percentage of your working/study hours)?	
<20%	29 (22)
20 to <40%	33 (26)
40 to <60%	38 (29)
60 to <80%	14 (11)
80% or more	16 (12)
Prior to the pandemic, where did you mainly conduct your research activities? **	30 (14)
Office	41 (19)
Laboratory	77 (36)
Hospital	8 (4)
Industry/Field site	51 (23)
University	9 (4)
Others	
In the last 6 months, how strict is the level of social distancing practised/ enforced at your institution?	
Only required to maintain 1 m distance between people	17 (13)
Limited access to laboratory/ research facilities/campus	79 (61)
Completely no access to laboratory/ research facilities/campus	31(24)
Other	3 (2)

Note: NA – not available, *Median, ** Total is >130 because some respondents held multiple roles.

The respondents rated the impact of social distancing on a scale of 100, from 0 (*not at all*) to 50 (*somewhat*) to 100 (*totally*). Female respondents reported a significantly lower level of being affected by social distancing measures (median rate = 65) than male respondents (median rate = 72) (Mann-Whitney *U*, z = -1.965, p = 0.049) (Figure 1). No significant correlations were found between respondents' age (Spearman's Rank correlation, r = -0.962, p = 0.288) or the study levels (Spearman's Rank correlation, r = -0.027, p = 0.843) of the students with the perceived impact of social distancing on their research. Some respondents held many different roles simultaneously. However, the higher number of roles did not correlate with their perception of the impact of social distancing.

There was a significant correlation between the strictness level of social distancing measures and the impact of social distancing on research (Spearman's Rank correlation, r = 0.367, p < 0.001). Respondents that reported stricter social distancing measures also reported a larger impact on their research. The perceived impact of social distancing were also not correlated with the study level and time spent on research prior to the pandemic.

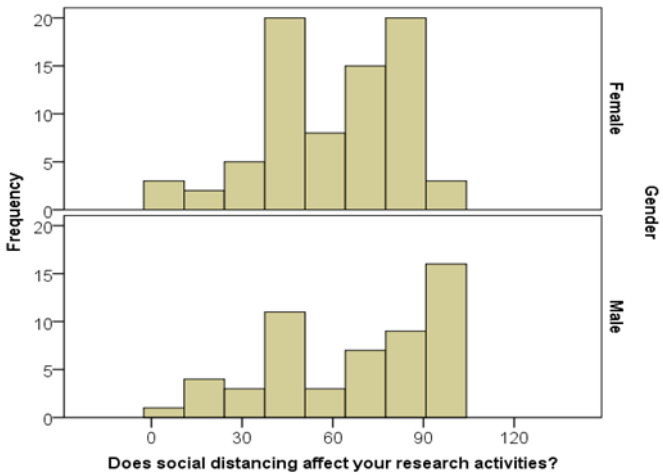

Figure 1: Histogram distribution of the perceived effects of social distancing on research activities, according to gender.
Note: Ratings are on a scale of 100; from 0 (*not at all*) to 50 (*somewhat*) to 100 (*totally*)

Figure 2 shows the response distribution on how social distancing affected research activities. Activities considered included literature search, data collection, thesis writing, scientific manuscript writing, conference presentations, general research progress, output, and securing grants. Research progress, conference presentation and data collection were negatively affected. Activities that were not affected by social distancing measures were literature search, scientific manuscript writing, and thesis writing. Interestingly, activities with the highest number of responders reporting positive enhancement were scientific manuscript and thesis writing and conference presentation. This may be due to the cheaper online registration fees for most conferences.

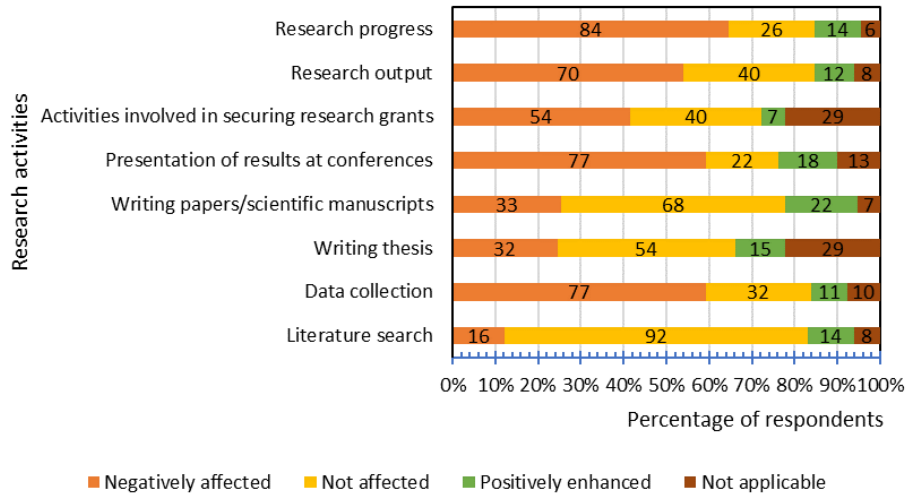

Figure 2: Distribution of the response on how by social distancing affected various research activities.

Figure 3 shows the distribution of the responses on how by social distancing affected research training activities, such as mentoring, hands-on/laboratory training, and research methodology training. Hands-on/laboratory-based training was the most negatively affected of the three activities.

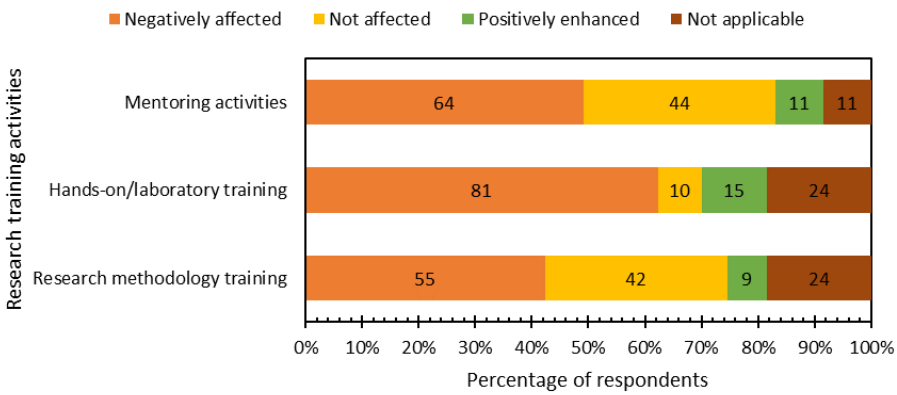

Figure 3: Distribution of the response on how by social distancing affected various research training activities.

Research training of researchers was mainly affected in terms of mentoring, hands-on/laboratory training and research methodology training. Respondents reported that face-to-face discussions were more effective when analysing data with their supervisors. While meetings could be conducted over online meeting platforms, communication was less effective. Physical meetings were also limited to small groups of three students or less. Different types of research work require a different level of

laboratory access. One respondent shared that research work and training could still be carried out in a timely manner with unconventional arrangements.

> *We reduce the number of trainees, use more facilities, performed the training after office hour/ lunchtime. The graduate student research was within the timeline and could meet the target as planned. Social distancing is not negative but also positive to the training program.*

We asked about the number of publications to measure the research productivity over three years since the pandemic (Figure 4). Interestingly, there was no statistically significant difference in the publication output in the three years since 2018 (Friedman test, $\chi^2 = 4.024$, $p = 0.134$).

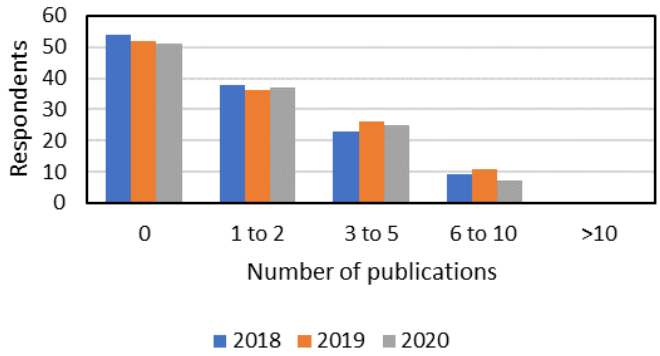

Figure 4: Number of publications for three consecutive years.

Figure 5 shows the number of conferences, seminars, workshops, webinars, or other training activities that the respondents had attended in the last three years (2018 to 2020). There was a significant difference in conference or seminar attendance (Friedman test, $\chi^2 = 7.071$, $p = 0.029$). The highest number of conference attendance was in 2019. The number of conferences, seminars, workshops, webinars, or other training activities attended by the respondents was significantly higher in 2019 compared to 2018. However, there was a slight decrease in the numbers in 2020, though it was not statistically significant. The proliferation of online webinars and courses enabled research training course material to be moved onto online platforms, enabling students to access from all over the world and at their own convenience.

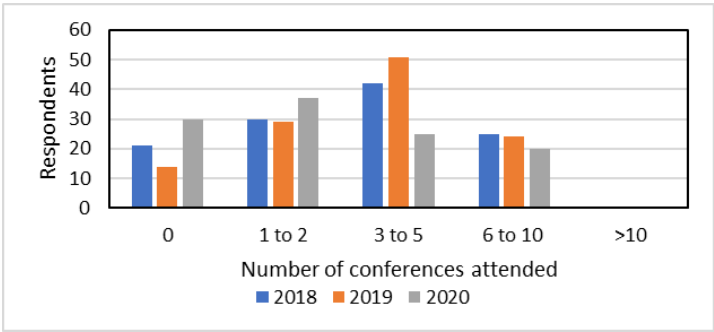

Figure 5: Number of conferences attended for three consecutive years.

During the pandemic, researchers had to modify their research methodology to adapt to the social distancing requirement (Figure 6). The most affected research activities were data collection where 72.5% of respondents reported needing to postpone or delay their data collection. About half of the respondents reported having to develop new tools or skills (52%), redesign their research methodologies (50%), and reduce the sample size (48%). Some of these tools involved tools that would enable them to collect data remotely. Only 36% of the respondents reported that they needed to change their research objectives, and 14% reported terminating their research.

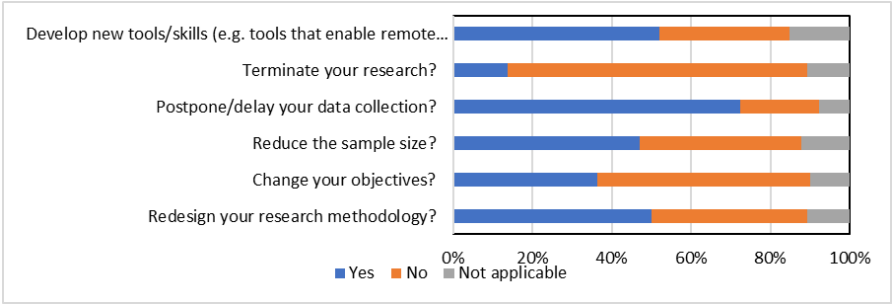

Figure 6: Measures to adapt to the requirements of social distancing.

In terms of mental health, the survey respondents reported increased mental stress. More than 50 respondents claimed that they were demotivated, felt isolated/alone and lost focus (Figure 7). Many of them reported suffering from multiple adverse effects.

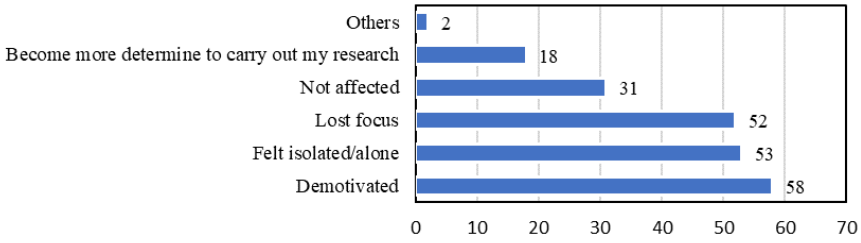

Figure 7: How social distancing affects the mental health of researchers.

A thematic analysis was carried out on the open-ended answers of 26 female and 13 male respondents that provided extended elaboration on how social distancing affected them. This was to elucidate how males and females respondents were affected by social distancing (Table 2). For female respondents, four of the most cited negative effects were that they felt isolated/alone, demotivated, distracted, and lost focus, perhaps due to the extra responsibilities and problems with data collection/writing. However, 14% of the responses indicated that they were not being affected or even had positive effects. On the other hand, for male respondents, the top three most cited negative effects were isolation, feeling that their output was lower, and changes in the daily work/research practices.

Table 2: How social distancing measures affected male and female respondents .

	Female	Male
	N (%)	N (%)
Demotivated	7 (9)	1 (2)
Felt isolated/alone	8 (11)	4 (7)
Loss of passion	1 (1)	
Problem with data collection, writing	5 (7)	1 (2)
Lost focus, extra work/family responsibilities	5 (7)	1 (2)
No support from supervisors	1 (1)	
Stressed	4 (5)	2 (4)
Output expectation/ Lack of output		4 (7)
Lack of understanding from peers/collaborators		1 (2)
Changes in work/research practices		3 (6)
Not affected	4 (5)	2 (4)
Positive effects	7 (9)	
Did not elaborate	50 (66)	41 (76)

Note: The responses have been identified from the open-ended answers, and multiple answers for a single respondent are possible.

The lack of research output and the constant awareness of the limited research/study time exacerbated the mental stress as exemplified in the following extracts:

I felt alone most of the time and demotivated to do anything.

At the same time, keeping in mind that the clock is still ticking in terms of deadlines for research papers/publication, bringing about stress in its own way!

Social distancing measures resulted in "forced" quiet times. This was reported by both male and female respondents as feeling isolated/alone and is one of the most cited negative effects of social distancing. Mental support from fellow researchers or forming a research team was also reported to help manage mental health as described by one of the respondents:

It was not easy. I was frustrated, but I had to be strong for the research group. We met online every week and motivated each other: motivation was the key! Every week we will end the meeting with something positive to keep the momentum going. Teamwork is so important.

However, it was also interesting to note that 31 of the respondents reported that their mental health was not affected by the social distancing measures. 18 respondents reported the positive effect of being more determined to carry out their research despite the restrictions, as shown in Figure 7. Some female respondents elaborated on how they had been positively affected by social distancing, as exemplified in the following extracts.

I become more determined and focused to carry out my research.

I quite enjoyed it.

> *Working from home saves me a lot of time in travelling and provides me more time to be self-alone. Then, I have more time to reschedule my timetable and re-evaluate myself as well as my research activities. Daily meditation provides a good platform and channel to have a better self-understanding.*

The respondents' feedback on the changes they would like to see to enhance research and research training were mainly in the areas of improving communication, facility/training support, extending deadlines, adjusting expectations/work/meetings, adjusting pandemic measures and increasing social support. Many also said that more efficient communication needs to be established between students and supervisors, taking advantage of the various online platforms. To keep track of the research progress and to seek solutions to difficulties in research, one-to-one meeting or coaching sessions could be organised at more frequent intervals to assist students.

The respondents' suggestions on improving facility and training support included setting clear and explicit instructions on the function of the research facilities and standard operating procedures. Field research that could be carried out with the implementation of distancing measures should be allowed to continue. In other words, a rational assessment of the real risk of COVID-19 infection (or future pandemics) in every research facility needs to be implemented, thus, making appropriate adjustments of pandemic management measures to ease unnecessary restrictions on research. This would enable more flexibility for researchers and students to continue to carry out certain types of research work, despite the social distancing measures. It was also suggested that research training be moved online, enabling blended learning or self-directed online learning modules. Increased online research support was also suggested, and small-scale workshops/seminars could also be conducted.

In addition, the respondents proposed adjusting the administration/work/research goals. Examples included extending research deadlines and making expected research output less demanding. It was suggested that the supervisor's goals and the research student's goals should be distinguished, as explained by one of the respondents:

> *The objectives of 'research training' should be revised. Training goals should not be set to publish papers and should instead focus on teaching the process of research. There is an obvious difference in the objectives held by both the chief researcher and the research students: the chief researcher aims to publish while the student is completing the research as part of the course. If the curriculum is unable to do without the publication of a research subject, perhaps research publication should be allowed to be extended beyond the clinical training period - at least until an acceptable degree of normalcy has been reclaimed from the effect of the pandemic.*

4. Discussion

In this study, we surveyed a diverse group of researchers and students, the majority residing in Malaysia, a developing country in south-east Asia. The research areas included niche research areas such as medical physics and more general areas such as clinical and engineering. The cohort of students surveyed also ranged from undergraduate to doctoral degrees. This may be the reason for the wide variation of perceived impact due to the implementation of social distancing measures in their respective universities or institutes. The study cohort was somewhat different from those surveyed by

Dong et al. (2022) and Bratan et al. (2021). The postgraduate medical students in Dong et al. reported an overall moderate impact on their research. Their study was also focused on a single centre, whereby the social distancing measures were quite similar.

In our survey, female respondents reported a significantly lower impact level than male respondents, even though 85% of respondents reported limited or completely no access to their research workplaces. Female respondents predominantly felt isolated and distracted, perhaps due to the work from home arrangement leading to needing to balance work and family responsibilities at the same time. The lack of access of research facilities affected data collection and writing work of the female researchers. On the other hand, the response from the male respondents elucidated that they had a high expectation on research output which was negatively impacted because of the social distancing measures. The changes in the daily work routine such as reduced staffing at the hospitals were also mentioned in their responses. Responses from the female respondents showed that some of them were more proactive in their response to the social distancing measures, leading to more positive experiences. Dong et al. (2022) reported that female postgraduate students reported lesser damage or data loss due to sudden laboratory closure.

The respondents reported that research progress was delayed mainly because data collection could not be carried out and citing delivery of consumables from an external vendor and international sources were delayed. These findings were similar to the study by Bratan et al. (2021) whereby 67% to 80% of the researchers reported that data collection and intervention could not be carried out as initially planned. For research involving recruiting patients or volunteers at hospitals, respondents reported that strict standard operating procedures (SOPs) and social distancing measures resulted in postponed appointments to reduce hospital crowds. The general fear of contracting COVID-19 during hospital visits may also lower patient recruitment (Ellehuus et al., 2021). Administrative matters were also often delayed when fewer administrative staff worked in the office. The unavailability of staff has been reported to be associated with perceived incivility of faculty by students (Alt et al., 2022).

In terms of research output, there was no significant reduction in the publication output in 2020 compared to the pre-pandemic times. This contrasts with Bratan et al. (2021), as more than half of their investigators reported that publications were delayed or not feasible at a similar time point (May 2020). Dong et al. (2022) reported that students' paper publications were negatively affected by social distancing. However, both surveys were based on perceived impact that may not be validated quantitatively. A quick literature search in PubMed using the keyword "Covid-19" and "pandemic" revealed more than 147,774 publications. This shows that while much existing research was affected, opportunistic research and surveys on pandemic related aspects such as the pandemic impact on education, mental health, medical treatments of non-COVID-19 diseases, lifestyle changes and social distancing had surged tremendously (Abdelrahman et al., 2022; Alessi et al., 2021; Azlan et al., 2020; Brog et al., 2022; Chasset et al., 2022; Eberle & Stichling, 2021; Ellehuus et al., 2021; Losso et al., 2021; Mathew et al., 2022; Peterson et al., 2021). Nevertheless, we believe that the impact of social distancing on the number of scientific publications may only be more accurately determined after one to two years post-pandemic, as publications often trail the actual research work.

Social distancing measures led to innovation in research methods, tools and training methods and have been demonstrated in several studies (Bratan et al., 2021; Brito-Brito et al., 2022; Brog et al., 2022; Chasset et al., 2022; Garg et al., 2022; Greenough et al., 2022). Social distancing has acted as a catalyst for innovation and changes in research. The use of digital platforms for research training and mentoring, modelled on online teaching methods, are also valuable for ensuring sustainability in research and research training (Azlan et al., 2020; Bratan et al., 2021).

The impact of social distancing on mental stress in researchers and students was not surprising, as many other surveys had reported similar conditions in different populations (Alessi et al., 2021; Alt et al., 2022; Cao et al., 2020; Dong et al., 2022). The personal experience and observation of the authors indicated that social distancing indeed had led to the distancing of researchers and reduced social interactions between researchers. In the pre-COVID-19 times, social gatherings, discussion meet-ups, and lunches were often spontaneous events. Researchers from different backgrounds may often interact and exchange ideas in these social events, indirectly enriching the research environment's academic and social spheres. In contrast, social distancing measures discourage gathering people in a closed space for long periods. Carvalho Aguiar Melo and de Sousa Soares (2020) called for discussion on the impact of social distancing on mental wellbeing. Further, Venkatesh and Edirappuli (2020) mentioned that mitigation of the negative impact on mental health requires concerted effort. The same can be said for the other research and research training aspects.

Research work should also be recognised as a distinct social component. Students and supervisors often gather for discussions, coffee/tea breaks or lunch discussions. These social behaviours are synergistic in encouraging a healthy research output and essential to promoting the group's sense of belonging and togetherness, facilitating the exchange of ideas and social support. Social distancing inevitably reduces this spontaneous social behaviour, indirectly affecting research students and reducing collaborative opportunities in research. More conscious effort is necessary to set up small groups to get together in a suitable environment and with sufficient physical distancing measures. Setting up formal mentoring systems to guide younger researchers or students would also be helpful.

We acknowledge that there were several limitations in this study. The study sample size may be small and may not be able to be generalised to every research institute. The study sample comprised mainly respondents from Malaysia and the social distancing measures enforced in this country. Thus, this limitation implies that the findings may mainly reflect the impact of social distancing in Malaysia. Another limitation is that, while social distancing in this survey extends to lockdowns in the definition, the impact on conference travel may be related to a further extension of the social distancing measures that affected more extensive global travel restrictions and not social distancing per se. The third limitation of this study was that the validity and reliability of the survey tool were not retested in our study and so our results should be interpreted within the context of these limitations.

5. Conclusion

During the COVID-19 pandemic, social distancing was one of the crucial measures in breaking the chain of virus spread. Due to the nature of the academic workplace, institutional management implementation of limited facility access affected research progress and output of researchers. This study provided

insights into the impact of social distancing on the research output and the mental health of researchers and students from various research areas, education levels and research activities. It is notable that female researchers reported a lower impact by social distancing measures than their male counterparts. Higher social distancing measures were associated with a higher impact on research. The majority of the researchers reported delays in research progress and delays or inability to collect data. Research productivity in scientific publications was not significantly lower in 2020 than in pre-pandemic time. Conference attendance was also lower, likely due to social distancing measures and global travel restrictions. Although less preferred by researchers, research supervision and training via online platforms ensured the continuity of research progress where implementation of social distancing measures was stricter. The pandemic also affected the respondents' mental health; reporting demotivation, feeling isolated, and losing focus on their work. Suggested measures to alleviate the negative impact of COVID-19 included enhancing research and training, improved communications, making more research training accessible, and adjusting administration/work/research goals.

In the post-pandemic era, social distancing measures have been lifted in most places and countries. Physical presence in research institutions, hospitals, and conferences has mostly resumed. Social distancing may no longer be relevant in many contexts. However, understanding the mechanisms and repercussions of social distancing within the realm of research is instrumental in preparing for future unforeseen challenges. Paradigm changes in research and training, such as remote and online learning, have continued to prevail in many facets of our professional and social lives. A clear understanding of the negative impact on the mental health of researchers and students will be crucial for university and research management to provide better support for staff and students.

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References:

Abdelrahman, M., Al-Adwan, D., & Hasan, Y. (2022). Impact of social distancing on the mental health of parents and children in Qatar. *International Journal of Mental Health and Addiction*, *20*(5), 2894–2905. https://doi.org/10.1007/s11469-021-00555-6

Alessi, J., de Oliveira, G. B., Erthal, I. N., Teixeira, J. B., Morello, M. S., Ribeiro, R. J. E., de Carvalho, T. R., Jaeger, E. H., Schaan, B. D., & Telo, G. H. (2021). "Not having a minute of self-distancing during the social distancing is exhausting": A qualitative study on the perspective of caregivers of youth with type 1 diabetes during the COVID-19 pandemic. *Acta Diabetol*, *58*(11), 1533-1540. https://doi.org/10.1007/s00592-021-01753-3

Alt, D., Itzkovich, Y., & Naamati-Schneider, L. (2022). Students' emotional well-being, and perceived faculty incivility and just behavior before and during COVID-19. *Frontiers in Psychology*, 13, 849489. https://doi.org/10.3389/fpsyg.2022.849489

Azlan, C. A., Wong, J. H. D., Tan, L. K., A D Huri, M. S. N., Ung, N. M., Pallath, V., Tan, C. P. L., Yeong, C. H., & Ng, K. H. (2020). Teaching and learning of postgraduate medical physics using Internet-based e-learning during the COVID-19 pandemic - A case study from Malaysia. *Physica Medica*, *80*, 10-16. https://doi.org/10.1016/j.ejmp.2020.10.002

Bratan, T., Aichinger, H., Brkic, N., Rueter, J., Apfelbacher, C., Boyer, L., & Loss, J. (2021). Impact of the COVID-19 pandemic on ongoing health research: an ad hoc survey among investigators in Germany. *BMJ Open*, *11*(12), e049086. https://doi.org/10.1136/bmjopen-2021-049086

Brito-Brito, P. R., Fernández-Gutiérrez, D., Martínez-Alberto, C. E., Sáez-Rodríguez, M. J., Núñez-Marrero, J., & García-Hernández, A. M. (2022). Use of the Nursing Outcomes Classification (NOC) to measure perceived knowledge about the control of SARS-CoV-2 infection: The impact of a training program in primary healthcare professionals. *Internatonal Journal of Nursing Knowledge, 33(4),* 259-269. https://doi.org/10.1111/2047-3095.12356

Brog, N. A., Hegy, J. K., Berger, T., & Znoj, H. (2022). Effects of an internet-based self-help intervention for psychological distress due to COVID-19: Results of a randomized controlled trial. *Internet Interventions*, *27*, 100492. https://doi.org/10.1016/j.invent.2021.100492

Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., & Zheng, J. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Research*, *287*, 112934-112934. https://doi.org/10.1016/j.psychres.2020.112934

Carvalho Aguiar Melo, M., & de Sousa Soares, D. (2020). Impact of social distancing on mental health during the COVID-19 pandemic: An urgent discussion. *International Journal of Social Psychiatry*, *66*(6), 625-626. https://doi.org/10.1177/0020764020927047

Chasset, F., Barral, M., Steichen, O., & Legrand, A. (2022). Immediate consequences and solutions used to maintain medical education during the COVID-19 pandemic for residents and medical students: a restricted review. *Postgraduate Medical Journal, 98*(1159), 380-388. https://doi.org/10.1136/postgradmedj-2021-139755

Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, *quantitative, and mixed methods approach* (5th ed.). SAGE Publications Inc.

Dadras, O., Alinaghi, S. A. S., Karimi, A., MohsseniPour, M., Barzegary, A., Vahedi, F., Pashaei, Z., Mirzapour, P., Fakhfouri, A., Zargari, G., Saeidi, S., Mojdeganlou, H., Badri, H., Qaderi, K., Behnezhad, F., & Mehraeen, E. (2021). Effects of COVID-19 prevention procedures on other common infections: a systematic review. *European Journal of Medical Research*, *26*(1), 67. https://doi.org/10.1186/s40001-021-00539-1

Dong, C., Yu, Z., Liu, W., Zhang, Y., Zhang, Z., Zhang, L., Cui, Z., Fan, X., Zhu, Y., Peng, H., Gao, B., & Ma, X. (2022). Impact of COVID-19 social distancing on medical research from the perspective of postgraduate students: a cross-sectional online survey. *PeerJ*, *10*, e13384. https://doi.org/10.7717/peerj.13384

Eberle, C., & Stichling, S. (2021). Impact of COVID-19 lockdown on glycemic control in patients with type 1 and type 2 diabetes mellitus: a systematic review. *Diabetology & Metabolic Syndrome*, *13*(1), 95. https://doi.org/10.1186/s13098-021-00705-9

Ellehuus, C., Jeppesen, S. S., Eckhoff, L., Vestergaard, H., Therkildsen, D. N., Frederiksen, H., & Eshoj, H. R. (2021). Health-related quality of life of patients with haematologic cancer during COVID-19 and their opinions on telehealth consultations - a Danish single site cross-sectional survey. *Acta Oncologica*, *60*(7), 872-880. https://doi.org/10.1080/0284186x.2021.1902565

Garg, I., Katz, R., Lu, Y., & Miller, J. B. (2022). Remote imaging capture with widefield swept-source OCT angiography during the COVID-19 Pandemic. *Clinical Ophthalmology*, *16*, 477-486. https://doi.org/10.2147/opth.S352503

Greenough, M. C., Sajjadi, N. B., Rucker, B., Vassar, M., & Hartwell, M. (2022). The use of telecommunication and virtualization among ongoing and discontinued COVID-19 clinical trials: A cross-sectional analysis. *Contemporary Clinical Trials*, 114, 106681. https://doi.org/10.1016/j.cct.2022.106681

Losso, J. N., Losso, M. N., Toc, M., Inungu, J. N., & Finley, J. W. (2021). The young age and plant-based diet hypothesis for low SARS-CoV-2 infection and COVID-19 pandemic in Sub-Saharan Africa. *Plant Foods for Human Nutrition*, *76*(3), 270-280. https://doi.org/10.1007/s11130-021-00907-6

Marroquín, B., Vine, V., & Morgan, R. (2020). Mental health during the COVID-19 pandemic: Effects of stay-at-home policies, social distancing behavior, and social resources. *Psychiatry Research*, *293*, 113419-113419. https://doi.org/10.1016/j.psychres.2020.113419

Mathew, M., van Vlymen, J., Meza-Torres, B., Hinton, W., Delanerolle, G., Yonova, I., Feher, M., Fan, X., Liyanage, H., Joy, M., Carinci, F., & de Lusignan, S. (2022). The effect of the COVID-19 pandemic on glycemic monitoring and other processes of care for type 2 diabetes: Protocol for a Retrospective Cohort Study. *JMIR Researxh Protocols*, *11*(4), e35971. https://doi.org/10.2196/35971

Odriozola-González, P., Planchuelo-Gómez, Á., Irurtia, M. J., & de Luis-García, R. (2020). Psychological effects of the COVID-19 outbreak and lockdown among students and workers of a Spanish university. *Psychiatry Research*, *290*, 113108. https://doi.org/10.1016/j.psychres.2020.113108

Peterson, J. A., Chesbro, G., Larson, R., Larson, D., & Black, C. D. (2021). Short-term analysis (8 weeks) of social distancing and isolation on mental health and physical activity behavior during COVID-19. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.652086

Venkatesh, A., & Edirappuli, S. (2020). Social distancing in covid-19: what are the mental health implications? *BMJ*, *369*, m1379. https://doi.org/10.1136/bmj.m1379

Appendix

Table A1: Survey questionnaire

No.	Survey Questions
1.	What is your age? (in years)? *[Open-ended response]*
2.	Which country are you residing in now? *[Choose from dropdown menu]*
3.	Your gender: a. Male b. Female c. Other
4.	Occupation (you can choose more than 1): a. Academician b. Researcher c. Student d. Others: Please specify [open-ended response]
5.	If you are a student, what level of study are you currently in? a. Undergraduate b. Master's candidate c. Doctoral candidate d. Not applicable
6.	Field of research: a. Medical physics b. Engineering c. Science d. Clinical e. Arts & social studies f. Others: What is your field of research? [open-ended response]
7.	Prior to the pandemic, how often were you involved/participated in research activities (as a percentage of your working/study hours)? a. <20% b. 20 to <40% c. 40 to <60% d. 60 to <80% e. 80% or more
8.	Prior to the pandemic, where did you mainly conduct your research activities? a. Office b. Laboratory c. Hospital d. Industry/Field site e. University f. Other: Please specify. [Free text response]
9.	Does social distancing affect your research activities? [Change the slider to set a response.] Slider bar ranged from: Not at all (0) – Somewhat (50) – Totally (100)
10.	In the last 6 months, how strict is the level of social distancing practised/enforced at your institution? a. Only required to maintain 1 m distance between people b. Limited access to laboratory/ research facilities / campus c. Completely no access to laboratory/ research facilities / campus d. Other: Please specify_____

11. How has social distancing affected your research activities?
[For each of the following activity, choose between Negatively affected, Not affected, Positively enhanced, Not applicable]
    a. Literature search
    b. Data collection
    c. Writing thesis
    d. Writing papers/scientific manuscripts
    e. Presentation of results at conferences
    f. Activities involved in securing research grants
    g. Research output
    h. Research progress

12. Please share any other effects of social distancing on your research, if any.
[Open-ended response]

13. How has social distancing affected your research training?
[For each of the following activity, choose between Negatively affected, Not affected, Positively enhanced, Not applicable]
    a. Research methodology training
    b. Hands-on/laboratory training
    c. Mentoring activities

14. Please share any other effects of social distancing on your research training, if any.
[Open-ended response]

15. How many scientific papers have you co-authored in the following years (on average)?
[For each of the following year, 0, 1 to 2, 3 to 5, 6 to 10, or >10]
    a. 2018
    b. 2019
    c. 2020

16. How many conferences, seminars, workshops, webinars, or other training activities have you attended in the following years? (on average)?
Please include online and physical events.
[For each of the following year, 0, 1 to 2, 3 to 5, 6 to 10, or >10]
    a. 2018
    b. 2019
    c. 2020

17. In your research, to adapt to the social distancing requirements, did you need to …
[For each of the following activity, choose between Yes, No, Not applicable]
    a. redesign your research methodology?
    b. change your objectives?
    c. reduce the sample size?
    d. postpone/delay your data collection?
    e. terminate your research?
    f. develop new tools/skills (e.g., tools that enable remote data collection)?

18. In terms of mental health, how has social distancing affected you?
[Check all that apply]
    a. Not affected
    b. I lost focus
    c. I was demotivated
    d. I felt isolated/alone in my work
    e. I became more determined to carry out my research
    f. Other: Please describe how social distancing affected your mental health ____
    g. [Free text response]

19. What kind of changes would you like to see in order to enhance research and research training, while practicing social distancing measures?
[Open-ended response]

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RESEARCH ARTICLE

Trends of Academic Publications: A Case Study of Malaysian Research Universities

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ABSTRACT

The Ministry of Higher Education Malaysia granted five universities with Research University (RU) status, which are Universiti Malaya (UM), Universiti Putra Malaysia (UPM), Universiti Kebangsaan Malaysia (UKM), Universiti Sains Malaysia (USM), and Universiti Teknologi Malaysia (UTM). These RUs are expected to focus on research and innovation and become a model of Malaysian universities for research activities aimed at knowledge advancement. Publications are one of the performance indicators for RUs. Thus, this paper confined its scope to the publications produced from 2016 to 2020 by the five RUs. The study aimed to analyse the patterns related to the number of publications, subject areas, type of publications, international joint publications, and the language of the publications. The findings show that the number of publications increased for UPM, UKM, and USM over five years, while UTM champions four subjects: Engineering, Materials Science, Computer Science, and Environmental Science. Journal articles are the most prominent scholarly output for all RUs. All RUs actively collaborate with international scholars and use English as the primary language for publications.

Keywords: Malaysian Research Universities; Publications; Academic Performance; Research Output

1. Introduction

The Ministry of Higher Education (MOHE) Malaysia has been focusing on strengthening national higher education to ensure a conducive ecosystem for knowledge excellence. This is clearly stated in the second phase of the Action Plan in the National Higher Education Strategic Plan 2007-2020, focusing on achieving predetermined projects at Higher Education Institutions (HEIs) comprising public universities, polytechnics, and community colleges (Shariffuddin et al., 2017). During the implementation phase, greater emphasis was given to have better access to higher education. To move and encourage excellence among local HEIs, four public universities in Malaysia were conferred Research University (RU) status with the support of additional funding for research and commercialization under the 9th Malaysia Plan. The initial four RUs were Universiti Malaya (UM), Universiti Kebangsaan Malaysia (UKM), Universiti Sains Malaysia (USM), and Universiti Putra Malaysia (UPM). The rest of the universities were

categorized as focused or comprehensive universities. The fifth research university that was conferred RU status was Universiti Teknologi Malaysia (UTM) during the unveiling of the 10th Malaysia Plan in 2010. These five RUs have had to focus on research and innovation and become referred institutes that drive the development of the nation (StudyMalaysia.com, 2015).

The RUs are subject to evaluation and the instrument used is the Malaysia Research Assessment (MyRA). MyRA is a comprehensive system and instrument used to evaluate the research capacity and performance of all HEIs in Malaysia (Kementerian Pendidikan Tinggi Malaysia, 2018). The assessment indicators comprise the quantity and quality of research, researchers, and postgraduate students, innovation and commercialization, networking and linkages, and support facilities. MOHE has established a minimum requirement for each indicator, which will serve as the basis for awarding rating stars to each HEI according to their annual performance. These assessment indicators will inadvertently drive the work culture at HEIs. For RUs, the benchmark for 'passing' each criterion in MyRA has been set higher and a 6-star rating is required to retain the RU status. The rating system is also vital for the Rus to obtain funding for their research activities as this will be based on the MyRA scores they obtain.

Publications are one of the criteria in the section on the quality and quality of research. Publications include journal articles, conference proceedings, books, book chapters, and other scholarly publications. The weightage is 35% of the total marks for RUs. The publication performance of RUs serves as a benchmark for other Malaysian HEIs striving to be considered as global institutions (Suryani et al., 2013). The publication pattern is correlated with the score and position of the RUs in the World QS ranking system. Additionally, publications have become a vital indicator for accumulating scores for the World QS University Ranking and other local and international ranking systems. The more excellent performance shown by all five RUs when they were ranked among the world's top 200 in the Quacquarelli Symonds (QS) 2021 World University Rankings shows that the action plan and initiatives towards the National Strategic Plan \have been right on track (Dawn, 2020).

In view of the objectives of the establishment of RUs and the importance of scholarly publications as performance indicators of the RUs, it is crucial to study the publication trends among the RUs. Previously, Razib et al. (2016) conducted a general bibliometric analysis of RUs from 2006 to 2016. As an extension of this study, the present article discusses the publication trends produced by the Malaysian RUs from 2016 to 2020 by focusing on five bibliometrics parameters.

2. Material & Methods

Elsevier introduced Scopus, a comparable transdisciplinary and selective database, in November 2004 (Baas et al., 2020). All Scopus information is available with a single subscription that cannot be modified. Scopus incorporates material from various specialist databases, including Embase, Compendex, World Textile Index, Fluidex, Geobase, Biobase, and Medline (Valderrama-Zurián et al., 2015). Most importantly, each database is connected and equally accessible.

Scopus is recognized as a reliable and popular databased to perform a bibliometric analysis on scholarly activity around the world (Mart nez Musiño, 2020; Mart n-Mart n et al., 2018). Specifically in Malaysia, publications that are Scopus-indexed are required output for research grants awarded by the main

sponsoring bodies in Malaysia, namely MOHE and the Ministry of Science, Technology, and Innovation (MOSTI). The research grants include the Fundamental Research Grant (FRGS), the Long- term Research Grant (LRGS), and the Strategic Science Fund (SRF). In addition, the evaluation systems by MyRA and the QS World University Rankings also focus on Scopus-indexed publications for scoring indicators.

Scopus is a searchable database that is constantly updated. The data is organized and user- friendly, making information extraction easy and quick. Its user interface is straightforward and easy to use (Elsevier, 2022). The Affiliation Identifier function, which automatically identifies and matches an organization with its research output, is beneficial for this study's sampling (Elsevier, 2022). This functionality allows authors' journal publications from associated universities to be obtained. The authors' names and affiliations and the year of publication provide insight into the Scopus publication landscape in Malaysia.

It has been shown that Scopus offers a greater journal range than the Web of Science, whereas Google Scholar is regarded as "inadequate, less often updated, citation information" (Falagas et al., 2008, p. 342). The Scopus database compiles a complete list of publications with a more extensive selection of journals. Besides, a recent study reported that about 99% of journals indexed in the Web of Science are listed in the Scopus database (Singh et al., 2021). In the context of the present study, Scopus is a database that provides more thorough coverage of journals with the ability to cater to a more extensive population sampling.

The affiliation search was completed in April 2021, and the data is accurate as of that date. It is essential to keep in mind that the Scopus database is flexible, so accessing it at a different time may provide different results. The query was based on the Scopus affiliation identification (ID) as listed in Table 1. The search term "Documents, whole institution" was selected, reflecting the total number of documents associated with the five research universities. It is the sum of the publications from these universities plus the publications from the affiliations contained within its hierarchy. Where an institution is not at the top level of the hierarchy, only the affiliations below it are included in its total.

Table 1: Scopus affiliation ID of RUs in Malaysia

University	Scopus affiliation ID
UM	60029157
UPM	60025577
UKM	60001821
USM	60000906
UTM	60021005

At this point, the results were refined by limiting the document collection year between 2016 to 2020. Five years of data collection is commonly used to evaluate the research performance of universities in either local or international ranking systems. Within the five years, five bibliometric indicators have been used to study the publication trend by RUs in Malaysia. They are as follows:

i) Annual number of publications

ii) Subject area of publications
iii) Type of publications
iv) International joint publications
v) Language medium of publications

Due to a high number of sub-data indicators, normalization was carried out to analyse the subject area. A normalization process is a fundamental approach to listing the area of the subject of publication for each university because each has a different field of research interest. The top six subject areas of publications for each RU are listed first as shown in Table 2. From the list, a cross-matching process was then performed. From that, eight subject areas were obtained as the selected publication areas for this study; Engineering, Medicine; Physics and Astronomy; Materials Science; Computer Science; Agricultural and Biological Sciences; Environmental Science; and Social Sciences.

Table 2: Top six subject areas of publications by Research Universities in Malaysia (Scopus database)

	UM	UPM	UKM	USM	UTM
1	Engineering	Engineering	Engineering	Engineering	Engineering
2	Medicine	Agricultural & Biological Sciences	Medicine	Medicine	Computer Science
3	Physics & Astronomy	Materials Science	Computer Science	Materials Science	Materials Science
4	Materials Science	Medicine	Physics & Astronomy	Physics & Astronomy	Physics & Astronomy
5	Computer Science	Environmental Science	Materials Science	Computer Science	Environmental Science
6	Social Sciences	Computer Science	Social Sciences	Social Sciences	Social Sciences

Data normalization was also conducted to examine international joint publications. In particular, the six most prominent joint publication countries with the RUs have been selected as shown on Table 3. Based on the list of countries, a cross-matching analysis was performed which normalized the comprehensive list into 11 countries, which are Australia, China, India, Indonesia, Iran, Iraq, Nigeria, Pakistan, Saudi Arabia, United Kingdom, and United States.

Table 3: The top six countries that RUs in Malaysia have international joint publications with (Scopus database)

UM	UPM	UKM	USM	UTM
United Kingdom	Nigeria	Indonesia	Saudi Arabia	Indonesia
United State	Iran	United Kingdom	United Kingdom	Iran
China	Iraq	Iraq	Pakistan	Pakistan
Australia	Saudi Arabia	Australia	Australia	Saudi Arabia
India	United Kingdom	Saudi Arabia	Indonesia	Nigeria
Pakistan	India	United State	Nigeria	United Kingdom

3. Results

The number of publications by RUs in the Scopus-indexed database from 2016 to 2020 is shown in Figure 1. Increment trends are observed for most RUs except for UTM, which had a slight drop from 2019 to 2020. In terms of the total number of publications for the five years, UM had the highest with 21,932 publications, while UKM had the lowest number with 17,684 publications. The average annual number of publications for UM was the highest with 4384 documents, while UKM recorded the lowest at 3536. It is essential to highlight that although the number of publications by USM in 2016 was the lowest among the RUs with only 2,972 documents, it garnered the highest publications in 2020 with 4,601 documents, which is over 1.5 times or a154.81% improvement from 2016.

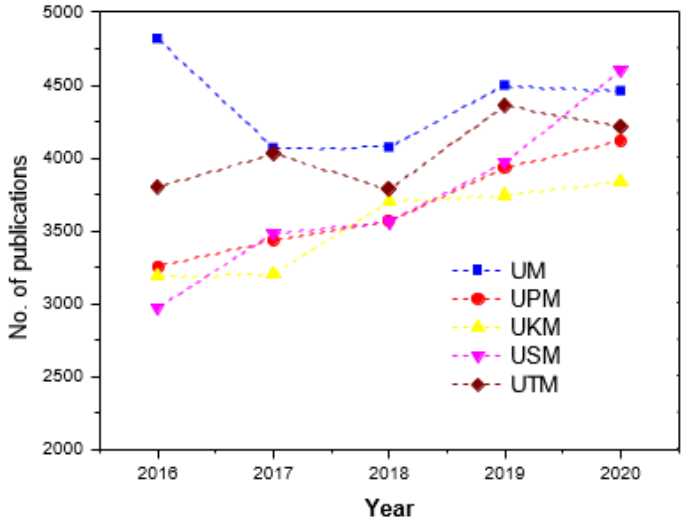

Figure 1: Number of publications by Malaysian Research Universities from 2016 to 2020

The publication pattern by subjects among the RUs is shown in Figure 2. The highest number of publications were in the subject area of Engineering. Analysis by subject shows that UTM dominated in terms of the number of publications in four different subject areas: Engineering, Materials Science, Computer Science, and Environmental Science, with these being 46.91%, 18.87%, 26.75%, and 13.40% of its total publications between 2016 to 2020. On the other hand, UM took the lead in Medicine, Physics and Astrophysics, and Social Sciences, which comprised 19.99%, 18.15%, and 10.68% of its publications respectively. In contrast, UPM had the most papers published in the area of Agriculture and Biological Sciences amounting to 20.96% of its total publications over the five years.

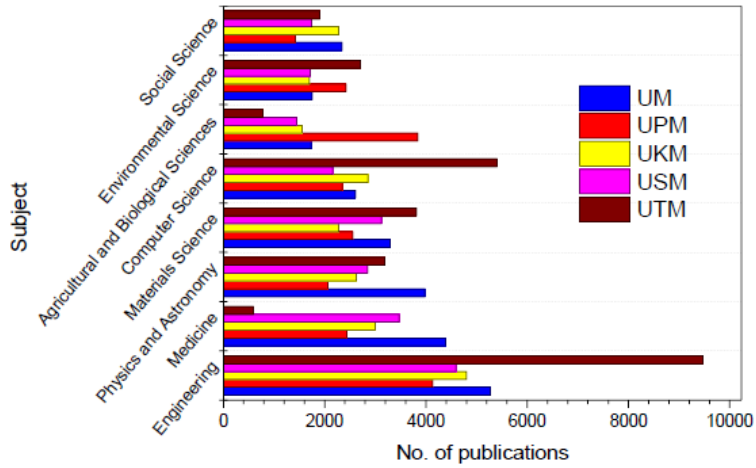

Figure 2: The main subject areas in which Malaysian Research Universities publish

For all the RUs, research articles were the main type of publication as shown in Figure 3. All universities published at least 12,500 journal articles which amounted to 64.64% of their total average publications within the period. UM had the highest number of article publications (n = 17,072) followed by UPM, UKM, UTM, and USM with 14,230, 13,423, 13,090, and 12,971 articles respectively. Conference papers were the second type of publication after research articles, with an average of 16.36% of the total publications. The publication pattern for conference papers showed a reverse trend compared to the trend for research articles. For conference papers, UPM led in terms of the number of such publications followed by USM, UKM, UPM, and UM. The third type of publication was the review paper with an average of 1157 documents or 5.98% of all publications. Similar to the pattern for research articles, UM dominated in terms of the number of this type of publication. This was followed jointly by UPM and UKM, and subsequently by USM and UTM respectively. Other publications by the RUs included book chapters, editorials, data papers, letters, book notes, and short surveys but these comprise less than 2.5% of the overall types of publications.

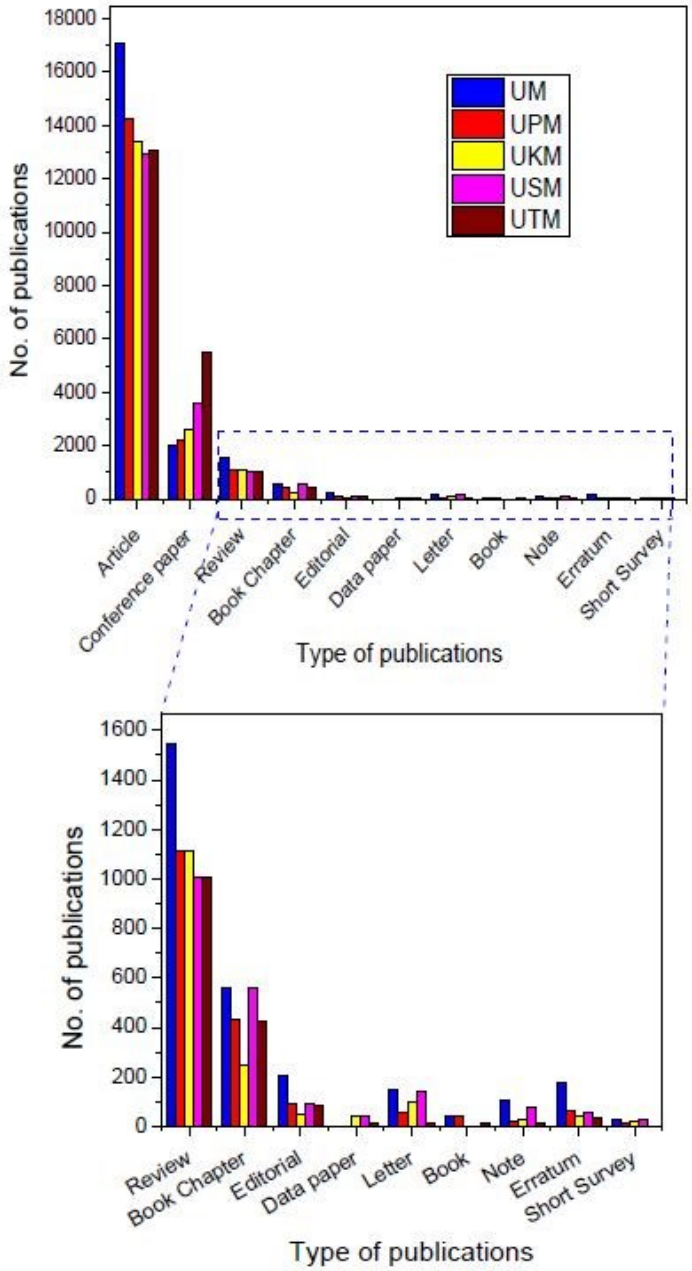

Figure 3: Type of publications by Malaysian Research Universities

Figure 4 shows international joint publications by the RUs from 2016 to 2020. UM exhibited the highest number of joint publications compared to the other RUs in Malaysia with 17,686 documents, or 80.67% of their overall publications having co-authors from other countries. The most significant publication partner for UM was the United Kingdom (12.00%), followed by the United States (10.92%), China (10.39%), Australia (8.90%), and India (8.48%). For UPM, their highest number of papers were with Nigeria, whereas USM had the most publications with authors from Saudi Arabia (5.44% and 4.38% of

their total publications respectively). UTM had the highest number of publications with Indonesian authors with 1,355 documents or 6.71% of its total publications.

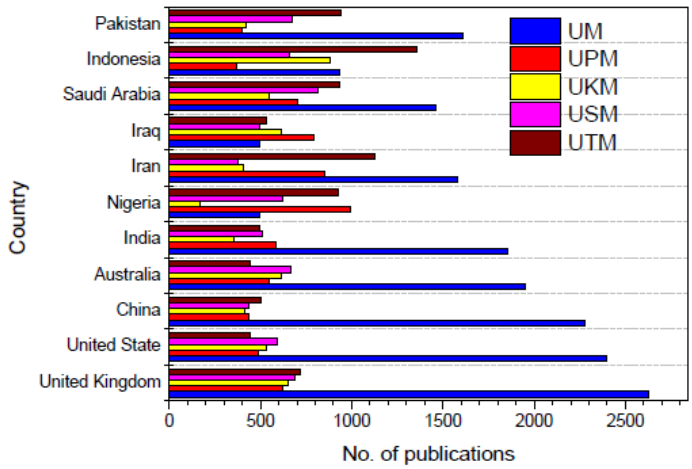

Figure 4: International joint publications by Malaysian Research Universities

As expected, English was the primary language for publications among the RUs as shown in Figure 5. A total of 95,951 or 99.23% of the documents published by the RUs were written in English. The other language used in publications by the RUs was Malay, but this only consisted of 633 or 0.65% of the total publications. UKM had the highest number of publications written in Malay with over 70% of the total documents written in Malay by the RUs. Some of the researchers in the RUs also published in other languages, such as Chinese, Arabic, Portuguese, and Indonesian, but these only comprised a very small percentage.

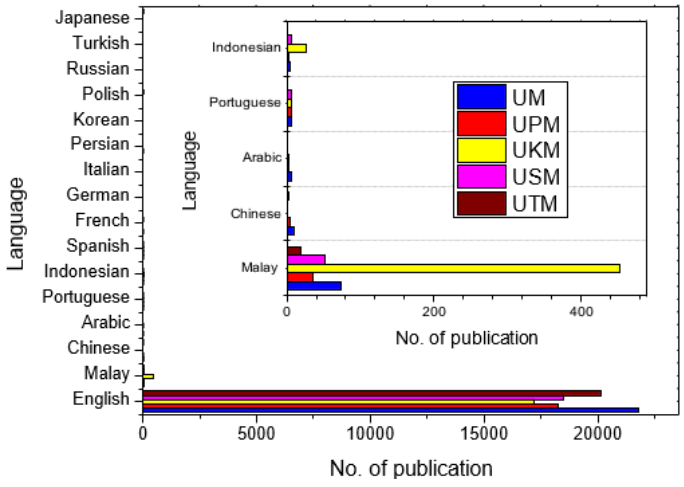

Figure 5: Language of publications by Malaysia Research Universities

4. Discussion

The annual average Scopus-indexed publications by RUs is 3,867 per university, which is slightly higher than the average for a public university in Malaysia up to August 2011 (Suryani et al., 2013). The main subject areas of the publications reflect the core research strength of each university. For example, UTM mainly focuses on technology related to Engineering and Computer Science (UTM, 2017), while UPM primarily focuses on Agriculture and Biological Sciences (Khairul Anuar, 2022). UM, UPM, UKM, and USM all have established teaching hospitals (Samadi, 2017), and are, therefore, strong in the area of medicine and this is reflected in the higher number of publications in this subject area for these universities compared to UTM.

RUs have definitely made efforts to push academics to publish their articles in journals that increase their chances of being cited around the world. For Malaysia, in particular, publishing in high-impact factor journals is seen as an essential factor for RUs (Mohamad Nazri, 2007). In fact, publication marketing tools such as ResearchID and ResearchGate can also improve the number of citations for research publications (Ale Ebrahim et al., 2014). It has also been found that in the area of Computer Science, citations per conference paper are almost similar to citations for journal articles (Rahm, 2008). This could be the reason why UTM produced the highest number of conference papers and at the same time published the most in the area of Computer Science field, as shown in Figures 3 and 2 respectively.

International collaboration has a significant impact on the quality of co-authored articles which could eventually enhance the impact of publications in high-impact journals (Low et al., 2014; Low & Ng, 2011). This trend was shown by Narin and Whitlow (1990) where publications with international authorship are likely to be cited twice compared to single–country publications. The number of publications with international co-authors have been on the increase. Factors contributing to this could be the government's support in terms ofresearch funding as wellas incentives given by universities to encourage researchers to produce international publications in higher impact publications. As MyRA is used to evaluate the performance of Malaysian RUs, networking, and linkages are some of the critical indicators monitored by MOHE. In the MyRA assessment, the quantity of publications, publications with other institutions (universities, research institutes, and agencies), and publications with international partners are measured (MOHE, 2018). This is indicative of the government's emphasis on and encouragement to the universities to publish with external collaborators.

The almost exclusive use of English in the publications is not surprising as it has been pointed out that "it is possible that authors or research groups with a higher impact on the scientific community, and thus more frequently cited, have a higher tendency to publish their work in English" (di Bitetti & Ferreras, 2017, p. 124). The publications in Malay by UKM can be attributed to its role as the leading HEI set up to uphold the national language, Malay, in both science and non-science-based research (Yamat et al., 2014). Moreover, UKM also promotes Malay-based scientific publications via their own journal, such as *Sains Malaysiana*, a Scopus-indexed journal (UKM, 2017).

The results of this study have been examined from a quantitative perspective based on the publication trends of RUs. However, research performance should also be analysed from the number of citations and not only based on the number of publications (Aksnes et al., 2019). In fact, there is a strong

correlation between the number of publications and the number of citations (Sandström & van den Besselaar, 2016). Higher citations can be achieved by publishing in high-impact factor journals (Jain, 2011), which means that looking at the quality of journals is another aspect to examine. Furthermore, the research quality and impact of the RUs should be explored in future studies, correlated with the paper citation count.

5. Conclusion

In short, this paper provided an overview of publication trends among the Malaysian RUs based on bibliometric indicators extracted from the Scopus database for this study. Among the trends observed was that the number of publications for UPM and UKM steadily increased over the five years studied. Significant progress was shown by USM whereas UM and UTM showed a decreasing trend. The subject areas of the publications by the RUs tend to reflect their focus areas. Most of the publications were research articles and almost all are written in English. UM has produced more joint publications with international collaborators compared to the other RUs.

It is acknowledged that this study is limited to the trends based on Scopus-indexed publications among the RUs without an in-depth assessment of the role of research ecosystems such as funding and policies. Scholarly publications in Malaysia are also likely to be affected by individual factors like researcher's experience and expertise, and behavioural factors related to researcher's attitudes (Dhillon et al., 2015). In addition, the innovation management systems at universities are also essential to ensure high research performance by the universities (Kowang et al., 2015). These are all areas for future studies on the research performance of RUs as well as HEIs in general to obtain a more comprehensive picture of the research ecosystem of HEIs not just in Malaysia but elsewhere.

Acknowledgement

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References:

Aksnes, D.W., Langfeldt, L., & Wouters, P. (2019). Citations, citation indicators, and research quality: An overview of basic concepts and theories. *SAGE Open*, *9*(1), 215824401982957. https://doi.org/10.1177/2158244019829575

Ale Ebrahim, N., Salehi, H., Embi, M. A., Habibi, F., Gholizadeh, H., & Motahar, S. M. (2014). Visibility and citation impact. *International Education Studies*, *7*(4), 120–125. https://doi.org/10.5539/ies.v7n4p120

Baas, J., Schotten, M., Plume, A., Côté, G., & Karimi, R. (2020). Scopus as a curated, high-quality bibliometric data source for academic research in quantitative science studies. *Quantitative Science Studies*, *1*(1), 377–386. https://doi.org/10.1162/qss_a_00019

Dawn, C. (2020, July 28). *Malaysian research universities in top 200 of QS World University Rankings*. *New Straits Times*. Retrieved from https://www.nst.com.my/education/2020/07/612296/malaysian-research-universities-top-200-qs-world-university-rankings

Dhillon, S.K., Ibrahim, R., & Selamat, A. (2015). Factors associated with scholarly publication productivity among academic staff: Case of a Malaysian public university. *Technology in Society*, *42*, 160–166. https://doi.org/https://doi.org/10.1016/j.techsoc.2015.04.004

di Bitetti, M.S., & Ferreras, J.A. (2017). Publish (in English) or perish: The effect on citation rate of using

languages other than English in scientific publications. *Ambio*, *46*(1), 121–127. https://doi.org/10.1007/s13280-016-0820-7

Elsevier. (2022). *How Scopus works*. Elsevier. Retrieved from https://www.elsevier.com/solutions/scopus/how-scopus-works

Falagas, M.E., Pitsouni, E.I., Malietzis, G.A., & Pappas, G. (2008). Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses. *The FASEB Journal*, *22*(2), 338–342. https://doi.org/10.1096/fj.07-9492LSF

Jain, A.K. (2011). Impact factor: Measure of quality of research publication. *Indian Journal of Orthopaedics*, *45*(4), 289–290. https://doi.org/10.4103/0019-5413.82330

Kementerian Pendidikan Tinggi Malaysia. (2018). MYRA Glosari II Pindaan 2018 (Versi KPT). Retrieved from https://umresearch.um.edu.my/myra-information

Khairul Anuar, M.N. (2022). The establishment of another Agriculture University is not necessary - Sultan. *Universiti Putra Malaysia*. Retrieved from https://upm.edu.my/news/the_establishment_of_another_agriculture_university_is_not_necessa ry_sultan-24924

Kowang, T.O., Long, C.S., & Rasli, A. (2015). Innovation management and performance framework for research university in Malaysia. *International Education Studies*, *8*(6), 32–45. https://doi.org/10.5539/ies.v8n6p32

Low, W.Y., Ng, K.H., Kabir, M.A., Koh, A.P., & Sinnasamy, J. (2014). Trend and impact of international collaboration in clinical medicine papers published in Malaysia. *Scientometrics*, *98*(2), 1521–1533. https://doi.org/10.1007/s11192-013-1121-6

Low, W.-Y., & Ng, K.-H. (2011). International collaboration in journal publishing. *Asia Pacific Journal of Public Health*, *23*(5), 649–650. https://doi.org/10.1177/1010539511424481

Martínez Musiño, C. (2020). Big data informetric analysis of documents indexed in Scopus and Web of Science. *Investigacion Bibliotecologica*, *34*(82), 87–102. https://doi.org/10.22201/iibi.24488321xe.2020.82.58035

Martín-Martín, A., Orduna-Malea, E., & Delgado López-Cózar, E. (2018). Coverage of highly-cited documents in Google Scholar, Web of Science, and Scopus: A multidisciplinary comparison. *Scientometrics*, *116*(3), 2175–2188. https://doi.org/10.1007/s11192-018-2820-9

Md Razib, K., Shahir, S., Omar Yahya, B., & Noraziah, S. (2016). A bibliometric analysis of the research output of Malaysia research universities scholarly publication indexed in Scopus from 2006 – 2015. *ICOLIS 2016, Kuala Lumpur: LISU, FCSIT*, 223–234.

Mohamad Nazri, A.H. (2007). *Journal Impact Factor*. Universiti Malaysia Perlis (UniMAP).

MOHE. (2018). MYRA Glosari II Pindaan 2018 (Versi KPT). In *Kementerian Pengajian Tinggi Malaysia*. https://umresearch.um.edu.my/myra-information

Narin, F., & Whitlow, E.S. (1990). *Measurement of scientific cooperation and coauthorship in CEC-related areas of science*, *May 1990, Volume* 1. Commission of the European Communities.

Rahm, E. (2008). Comparing the scientific impact of conference and journal publications in computer science. *Information Services & Use*, *28*(2), 127–128. https://doi.org/10.3233/ISU-2008-0562

Samadi, A. (2017, July 15). Lima hospital pengajar universiti wujudkan konsortium [Five teaching hospitals form a consortium]. *Berita Harian Online*. Retrieved from https://www.bharian.com.my/berita/nasional/2017/06/293210/lima-hospital-pengajar-universiti- wujudkan-konsortium

Sandström, U., & van den Besselaar, P. (2016). Quantity and/or quality? The importance of publishing many papers. *PLOS ONE*, *11*(11), e0166149. https://doi.org/10.1371/journal.pone.0166149

Shariffuddin, S.A., Razali, J.R., Ghani, M.A., Shaaidi, W.R., & Ibrahim, I.S.A. (2017). Transformation of higher education institutions in Malaysia: a review. *Journal of Global Business and Social Entrepreneurship (GBSE)*, *1*(2), 126–136.

Singh, V.K., Singh, P., Karmakar, M., Leta, J., & Mayr, P. (2021). The journal coverage of Web of Science, Scopus and Dimensions: A comparative analysis. *Scientometrics*, *126*(6), 5113–5142. https://

doi.org/10.1007/s11192-021-03948-5

StudyMalaysia.com. (March 14, 2015). *The Malaysian higher education system - An overview*. Retrieved from https://www.studymalaysia.com/international/the-national-education-system/the- malaysian-higher-education-system-an-overview

Suryani, I., Yaacob, A., Hashima, N., Rashid, S.A., & Desa, H. (2013). Research publication output by academicians in public and private universities in Malaysia. *International Journal of Higher Education*, *2*(1). https://doi.org/10.5430/ijhe.v2n1p84

UKM. (2017). *Sains Malaysiana*. Universiti Kebangsaan Malaysia. Retrieved from https://www.ukm.my/jsm/

UTM. (2017). *Expanding the Research Horizon*. Universiti Teknologi Malaysia. Retrieved from https://experts.utm.my/files/2015/08/Expanding-Research-Horizon-2017.pdf

Valderrama-Zurián, J.-C., Aguilar-Moya, R., Melero-Fuentes, D., & Aleixandre-Benavent, R. (2015). A systematic analysis of duplicate records in Scopus. *Journal of Informetrics*, *9*(3), 570–576. https://doi.org/10.1016/j.joi.2015.05.002

Yamat, H., Umar, N.F.M., & Mahmood, M.I. (2014). Upholding the Malay language and strengthening the English language policy: An education reform. *International Education Studies*, *7*(13), 197–205. https://doi.org/10.5539/ies.v7n13p197

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RESEARCH ARTICLE

The Positive Impact of University-Community Engagement Projects: A Case Study in the Context of Universiti Malaya

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ABSTRACT

Collaborative partnership or engagement between university and community are essential and have become a widespread practice adopted by many universities worldwide. While university-community-engagement projects which are undertaken in a variety of ways of multidiscipline are growing rapidly, questions about its impact on communities remain largely ignored. Little empirical evidence is available exploring the impact of such partnerships for either the community partners or the university. This study presents a case study of the Universiti Malaya's experience of evaluating the impact of such engagements through several funded community projects. These university-community engagement funding are disbursed and managed by UM's Community Engagement Centre (UMCares). The result chain model was applied to collect data on the input, activities, output, outcomes and impact of the funded projects. Differences in nine impact areas and indicators were also identified. The results show that the funding projects are able to create an impact in different areas of community engagement. However, the development and maintenance of a dedicated database, in combination with periodic, systematic impact assessments is crucial to increase impact in community engagement.

Keywords: University-Community Engagement; Change Management; Research Impact; Public Relations; Sustainable Development

1. Introduction

Over the past fifty years, the concept of community engagement (CE) has remained crucial although there have been debates within the realm of higher education (HE) research and discussion. (Benneworth et al., 2008; Farrar & Taylor, 2009; Mtawa et al., 2016). This is due to universities having the capacity to enable communities to live in sustainable ways (Shiel et al., 2016). The community engagement concept has transformed from a one-way to a two-way approach which entails delivering knowledge to the public and developing partnerships, reciprocity as well as mutual learning (Mtawa et al., 2016).

For the past decade, academia has been discussing the importance of the non-academic impact of research activities conducted in universities. It is well-known that research has to demonstrate academic impact in their respective fields to enhance the understanding or application of a particular theory or framework. However, research and development are also increasingly being conducted to improve the well-being of the community. Hence, it is essential for research to demonstrate their contribution to society, the economy and environment. Wróblewska (2021) defines an impact as the ability of academic research to influence areas beyond the academic sphere, such as education, public health, and culture. It is also common now for researchers to align their projects to the Sustainable Development Goals (SDGs).

To date, Malaysia has five Research Universities (RU), including Universiti Malaya (UM). These universities are required to lead research and innovation, and this will entail engagement with multiple stakeholders and community groups. This highlights the importance of community engagement. Although there are various definitions and interpretations of the term 'community engagement', UM has defined community engagement as "active and meaningful engagement within and outside the university across local, national and international levels with the aim of exchanging knowledge and enabling learning for the benefit of society" (UMCares, 2013). The establishment of the community arm for the University, i.e., UM Community Engagement Centre (UMCares), signifies UM's commitment to community engagement and engagement for sustainability.

UMCares is constantly driven by its core value of raising UM to a prominent level in terms of its impact to society, inclusive engagement and action for communities and the environment. UMCares has funded numerous projects that have targeted different communities in Malaysia. The fundings for these projects are generated from the Ministry of Higher Education as well as other government ministries and agencies, and industries in Malaysia. The projects have shown significant success based on community feedback, and the continuation of support and recognition at the local and global levels. In monitoring the alignment of the funded projects with the mission and vision of UM, this paper aims to evaluate the impact of the community projects managed by UMCares from 2015 to 2020.

2. Methodology

The following sections explain the methodology used in this study.

2.1. Study design and participants

Scholars have proposed that university needs to emphasise impactful research to address on community needs within a region. Thus, a retrospective study was conducted among Universiti Malaya researchers from different faculties who were awarded the community engagement research grants funded by UMCares from 2015 to 2020 to evaluate their impact.

2.2. Data collection procedures

A Research Electronic Data Capture (REDCap™) survey was developed and faculty members who received the grants were invited to participate in the survey. The REDCap™ online survey link (https://redcap.link/communityengagementimpactevaluationsurvey) was distributed via email to 122 researchers. The survey was in English and included a description of the survey and its purpose. A reminder was sent via email to all researchers to encourage their participation in the study. The survey took approximately about 35 to40 minutes to complete. Informed consent was obtained on this web-based survey.

2.3. Variables

The questionnaire for the survey was adapted from the University Community Engagement Toolkit (Syed Kechik et al., 2019). The survey consisted of three parts; general information of participants, alignment towards Sustainable Development Goals (SDGs) and project details. The five components of community engagement impact pathway (i.e., input, activities, output, outcomes, and impact) and sustainability were assessed and included the following questions:

i) Input - financial contributions, key partners, key resources, basic infrastructures, and human capitals.
ii) Activities and Output - type of community engagement using the International Association for Public Participation spectrum for public participation (IAP2) (International Association for Public Participation, 2021), duration of the activity delivered to targeted groups and direct products delivered.
iii) Outcomes - changes that result from the community engagement activities conducted.
iv) Impact - type of impact, knowledge transfer, awards received, promotion of stakeholders and external funding.
v) Sustainability - continuity of project, continuity of impact, community empowerment and sustainability after completion of project.
vi) Type of impact and indicator were also measured (Research Excellence Framework, 2021).

2.4. Data analysis

Data were analysed using IBM SPSS version 22. Descriptive analyses (percentages) were carried out on the project's variable. Results for categorical variables were expressed as percentages. The variables with multiple-choice questionnaires, in which researchers were allowed to select multiple options that corresponded to the outcomes of their respective projects, were reported as percentages represent the proportion of respondents stating the presence of each specific sub-variable, rather than a percentage from the main variables.

3. Results

Out of 122 questionnaires distributed, 32 principal investigators (PI) participated in the survey evaluating the impact of the projects funded by UMCares. A total of 29 PIs completed the survey. Only 27 responses (22.1%) were considered as complete for inclusion in the evaluation. Hence, the analysis was done based on these 27 projects.

3.1. Input

Table 1 shows the breakdown of the various inputs from the projects involved in this study, categorised into four main variables: financial contributions by stakeholders, the number of key partners, the number of key resources (internal or external collaborators) provided in-kind, and the number of human capital. In terms of financial contributions by the stakeholders, most of the CE projects received their funding from UM (58.6%), followed by shared value (institution/government agencies/communities) (24.1%), shared value (institution/industry/community) (20.7%), institution/community funding (17.2%), shared value (institution/government agency/industry/community) (10.3%).

Twenty-four studies collaborated with either internal or external key partners with 11 studies having two or more key partners. Three studies had no key partners as for key resources (internal or external collaborators – in kind), seven studies had no key resources, 12 studies had one key resource and another eight studies had two or more key resources. Most of the studies had no basic infrastructure in their project (55.6%). For the number of human capital (e.g., research assistant and students) 10 studies reported having four human capital (37.0%), followed by seven studies with no human capital (25.9%), six studies with one human capital (22.2%) and one study with more than five human capital in their project (3.7%).

Table 1: Input from the projects

	Input	Percentage (%)
Financial contributions by the stakeholders	Institution funding	58.6
	Institution/ Community funding	17.2
	Shared value (Institution/ Government agency/ Community)	24.1
	Shared value (Institution/ Industry/ Community)	20.7
	Shared value (Institution/ Government agency/ Industry/ Community)	10.3
Number of key partners	0	11.1
	1	48.1
	2	18.5
	3	7.4
	4	11.1
	≥5	3.7
Number of key resources (internal or external collaborators) - In kind	0	25.9
	1	44.4
	2	7.4
	3	3.7
	4	18.5
	≥5	0
Number of basic infrastructure	0	55.6
	1	29.6
	2	11.1

	Input	Percentage (%)
Number of human capital	3	3.7
	4	0
	≥5	0
	0	25.9
	1	22.2
	2	11.1
	3	0
	4	0
	≥5	3.7

3.2. Output

Participants and activity

The activities conducted and participants involved in these projects are summarised in Table 2. All CE projects managed by UMCares were clustered in nine areas including education, culture, health, welfare, sports and recreational, rural development, environment, information and communication technology (ICT) and entrepreneurship. The results indicate that only five clusters were reported in the survey: education, health, environment, welfare, and information and communication technology (ICT) as shown in Table 2. The amount awarded to each project ranged from RM 6,000 – RM 58,500.

Alignment with the 17 goals of the United Nations' Sustainable Development Goals (SDG) designed by the United Nation was explored in the survey. Our findings revealed that 24 projects predominantly aligned with Goal 4 (Quality Education), while ten projects related to Goal 3 (Good Health and Well-being). Three studies were consistent with Goal 12 (Responsible Consumption and Production), and two studies each showed alignment with the following goals: Goal 1 (No Poverty), Goal 2 (Zero Hunger), Goal 11 (Sustainable Cities and Communities), Goal 16 (Peace, Justice, and Strong Institutions), and Goal 17 (Partnerships for the Goals). This data suggest a prevailing focus on education and health-related objectives among the evaluated projects.

Table 2: List of project participants, activities, clusters and SDGs

No.	Participants	Activities	Clusters	SDGs
1	Secondary school students	Seminar, career talk, group activities, survey	Education	Goal 4 (Quality education)
2	Secondary school teachers	Mentor-mentee program	Education	Goal 4 (Quality education); Goal 9 (Industry, innovation and infrastructure)
3	Local community	Psychoeducational tool, exposure to breast health literacy materials and breast cancer survivors, charity mammogram service	Health; Education	Goal 3 (Good health and well-being) ; Goal 4 (Quality education); Goal 17 (Partnerships to achieve the goal)
4	Secondary school teachers	Workshop	Education	Goal 4 (Quality education); Goal 16 (Peace and justice strong institutions)
5	Non-governmental organization	Application testing	Information and Communication Technology (ICT)	Goal 4 (Quality education)

No.	Participants	Activities	Clusters	SDGs
6	Parents and children with special educational needs and special educational needs teachers	Delivering effective techniques and activities of Ecotherapy to parents via 'hands-on' while being monitored by expert trainers.	Health; Education	Goal 3 (Good health and well-being); Goal 4 (Quality education).
7	Director and head of department of Teacher Training Institute	Researchers and assistance	Health; Education	Goal 3 (Good health and well-being); Goal 4 (Quality education).
8	School teachers, school children, sports officers	Training of trainers	Health; Education	Goal 3 (Good health and well-being); Goal 4 (Quality education); Goal 10 (Reduce inequality); Goal 17 (Partnerships to achieve the goal).
9	People with disabilities	Education and technology sharing	Education	Goal 3 (Good health and well-being); Goal 4 (Quality education)
10	Local community	Training on a proper waste management practices and garden composting process, actual hands-on training	Environment; Education	Goal 1 (No poverty); Goal 4 (Quality education); Goal 12 (Responsible consumption and production)
11	Secondary school club	Consultancy services, course and training services, project guidance services	Education	Goal 4 (Quality education); Goal 16 (Peace and justice strong institutions).
12	Post treatment cancer survivors, public, undergraduate students	Annual cancer walks, free colon screening, free cancer prevention talk, supervised walk/physical activity in the community for supportive and cancer prevention advocacy	Health	Goal 3 (Good health and well-being); Goal 4 (Quality education).
13	Underprivileged local community	Intensive classes, "Linking Charity with Sustainability" program, car boot sale	Welfare	Goal 3 (Good health and well-being); Goal 4 (Quality education).
14	Local community	Knowledge transfer	Education	Goal 2 (Zero hunger); Goal 4 (Quality education); Goal 11 (Sustainable cities and communities); Goal 12 (Responsible consumption and production)
15	Adolescent and young adults	Interactive workshop	Education	Goal 4 (Quality education).
16	Secondary school students	Building gazebo	Education	Goal 4 (Quality education); Goal 11 (Sustainable cities and communities) Goal 12 (Responsible consumption and production)
17	Primary school students	Motivational program, banner, poster, pamphlet, educational videos, art competition.	Education	Goal 4 (Quality education)
18	Local community	Poster presentation, counselling, hands-on activities	Education	Goal 4 (Quality education).

No.	Participants	Activities	Clusters	SDGs
19	People with spinal cord injury	Awareness exhibition, train the trainer workshop	Health	Goal 3 (Good health and well -being)
20	Primary school students	STEM-based activity	Education	Goal 4 (Quality education);
21	General public, breast cancer survivors	Talks, meetings, road show and show case during breast cancer awareness month	Health	Goal 3 (Good health and well -being)
22	Primary school students	Module development, teaching and learning activities	Education	Goal 4 (Quality education).
23	Wheelchair users	Module teaching, module training, competition	Health	Goal 3 (Good health and well -being); Goal 4 (Quality education).
24	Local community	Weekly lesson	Education	Goal 4 (Quality education).
25	Primary school students	One-day workshop	Education	Goal 4 (Quality education).
26	Primary school students and teachers	Training for students and teachers	Education	Goal 1 (No poverty) ; Goal 2 (Zero hunger); Goal 4 (Quality education).
27	School students	Awareness booths, poster, video competitions, climate change and energy efficiency workshops	Education	Goal 4 (Quality education).

Type of community engagement

Five types of community engagement as classified by the International Association for Public Participation (2021) were assessed: inform (Figure 1), consult (Figure 2), involve (Figure 3), collaborate (Figure 4) and empower (Figure 5). As shown in Figure 1, social media (59.3%) was the highest platform used in providing balanced and objective information to the public. In obtaining the public feedback on analysis, alternatives and/or decisions (see Figure 2), surveys (51.9%) were the most used platform used by the researchers. In addition, workshops (59.3%) were the most used platform to work directly with the public to ensure that their concerns and aspirations were consistently understood and considered (see Figure 3).

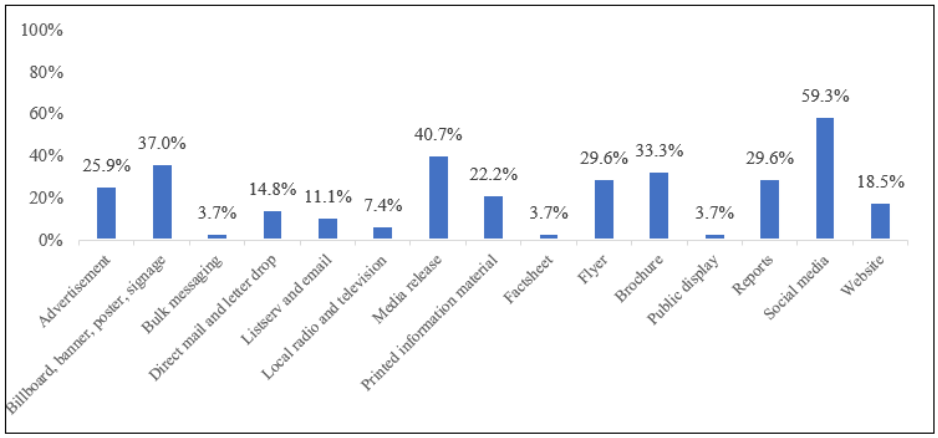

Figure 1: Type of community engagement: Inform

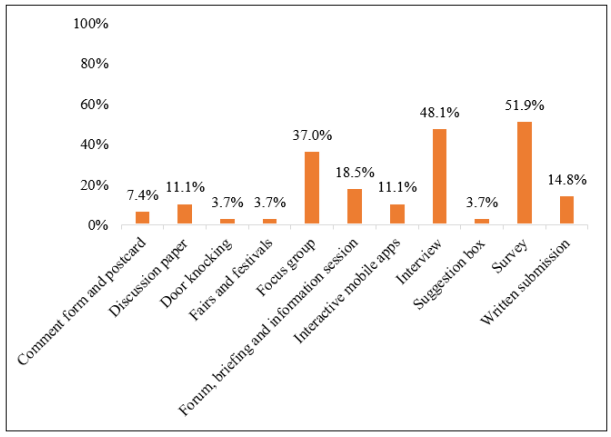

Figure 2: Type of community engagement: Consult

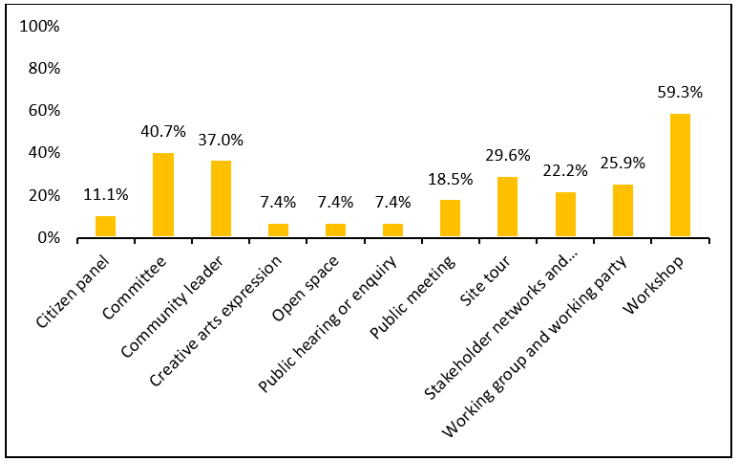

Figure 3: Type of community engagement: Involve

Collaboration with the public is another type of community engagement (see Figure 4). Researchers involved in CE projects under UMCares had mostly partnered with the public in developing alternatives and identifying the preferred solution via dialogues and roundtable discussions (50.0%). Finally, in empowering the type of community engagement, i.e., placing final decision making in the hands of the public, co-developing a program or service and final decision e.g., programme design (66.7%) was the most chosen implementation (see Figure 5).

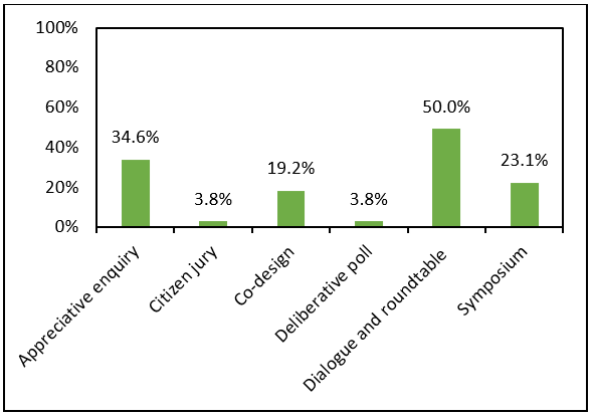

Figure 4: Type of community engagement: Collaborate

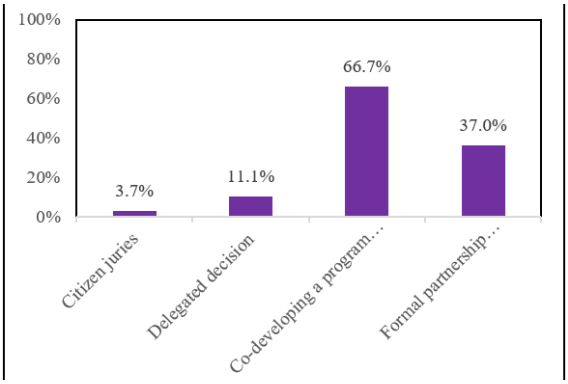

Figure 5: Type of community engagement: Empower

In addition, several activities achieved their targets in terms of knowledge transfer, technology transfer, marketing mix, marketing chain, hand-over process over the given period (duration of the activity delivered to the targeted group). For knowledge transfer, 33.3% of the projects were able to achieve this target within 12 months, 25.9% did this within 6 months, 22.2% took more than 24 months, 7.4% achieved their targets within 18 months and another 7.4% within 24 months. For technology transfer, most of the projects (40.7%) did not have this target and for the projects that did, this target was mostly (22.2%) achieved within 12 months. A total of 70.4% of the projects did not have marketing mix and marketing chain activities. In terms of the handover process, 25.9% of the projects that had this target were able to achieve it within 12 months, 18.5% more than 24 months, 14.8% within 18 months and 3.7% within 24 months.

Direct products

The average number of target communities/beneficiaries and activities/channels of delivery that researchers were able to achieve in relation to fulfilling the objectives of their programmes or projects were 150.96 (*SD* = 394.09) and 6.85 (*SD* = 6.42), respectively.

Type of output produced (academic)

The highest type of academic output produced (Figure 6) was human capital development (55.6%), followed by book/chapter in books (44.4%), IPR/copyrights (37.0%), papers indexed in Scopus/peer-reviewed journals (29.6%) and indexed in the Web of Science (25.9%) and policy papers (3.7%).

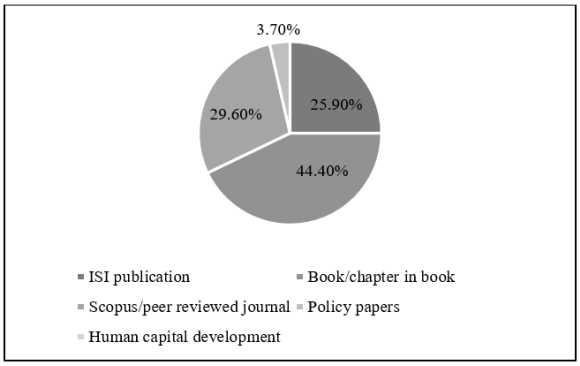

Figure 6: Type of academic output produced

Type of output produced (non-academic)

In terms of non-academic output produced (Figure 7), societal engagement was the highest (74.1%), followed by media articles (48.1%), others (29.6%), website (22.2%), commercialization of research output (18.5%) and software/applications (7.4%). Others included creating a healthy competition at the end of the workshop and Memorandum of Agreement with the international association.

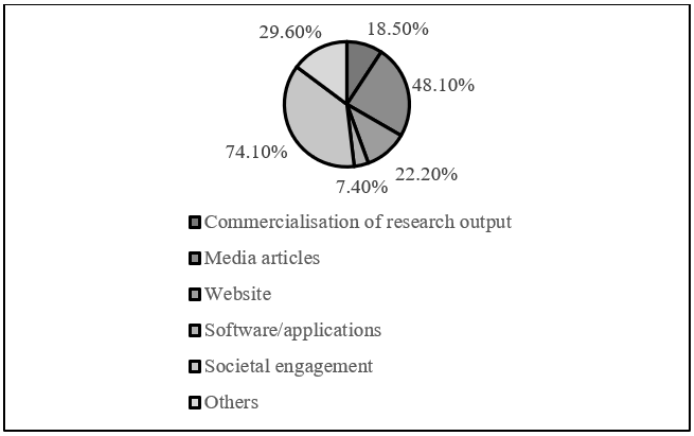

Figure 7: Type of non-academic output produced

Outcome (short-medium results)

An overwhelming majority (96.3%) reported that the communities involved in their projects showed an increase in their well-being (knowledge/attitude, behaviour/skills/status/job opportunity/earning/level of functioning) as a result of the activities conducted throughout the CE projects. For example, educational intervention led to significant literacy enhancements among students. Post-intervention data showed a doubling in both the number of students who could read and those utilizing dictionaries to comprehend English, with reading proficiency and Quranic reading each increasing by 100%. Reading comprehension also improved from 40% to 60%. These outcomes indicate a comprehensive improvement in the students' linguistic abilities and literacy. Intervention on a sports exergaming programme facilitated holistic empowerment among disadvantaged youths, enhancing their active lifestyles, mental acuity, spiritual engagement, and life quality. Concurrently, the initiative fostered soft skills development, boosting self-confidence, leadership, and independence. Additionally, participants acquired effective teamwork, self-discipline, and a sense of community equality.

Impact (long term results)

Our survey indicated that most of the projects demonstrated impact in the related areas of practice (70.4%). For instance, one noteworthy project centred on the establishment of a peer support group specifically designed to cater to individuals afflicted with spinal cord injuries. Subsequently, it was observed that this initiative has become a standard referral practice for UMMC rehabilitation facility, with newly injured patients routinely directed towards the group. This practice facilitates the provision of enhanced support to these patients in the critical period preceding their hospital discharge. Intervention programmes were the second highest (51.9%), followed by procedures (37%), social entrepreneurship (18.5%) and policies (14.8%). The majority (96.2%) demonstrated a transfer of knowledge/skills/competencies from their projects. Half of the projects had received societal/ community/institutional recognition/awards (50%). For example, the project on technological application in Quranic lessons for special needs children was awarded the Grand Prize during the Workshop, Exhibition, and Competition Related to Persons with Disabilities and the Elderly (WEC2017). In addition, 57.7% had promoted and uplifted the stakeholders and programme owner/solution provider through their projects. The peer support group, for instance, currently identified as the Malaysia Spinal Cord Injury Advocacy Association (MASAA), has achieved prominent recognition nationwide within Malaysia. It serves as an association to which other rehabilitation facilities frequently refer their patients. Further, 42.3% had also received funding and other types of contributions from industry/ the community. An as example, a project designed to reduce illiteracy rates within FELDA children secured funding from the State of Institute of Islamic Studies of Jember in Indonesia and the Beijing Institute of Technology, China. Another project, which focused on incorporating sustainability development goals within the educational curricula, received a donation of 50 solar-powered lights from industrial partner.

Impact areas and indicators

Nine impact areas and indicators (Figure 8a-i) of the projects included in this study were observed: (1) health, well-being of people and animal welfare; (2) creativity, culture, and society; (3) social welfare; (4) commerce and economy; (5) public policy, law and service; (6) production; (7) practitioners and delivery of professional service, or ethical practice; (8) environment; and (9) understanding, learning and participation.

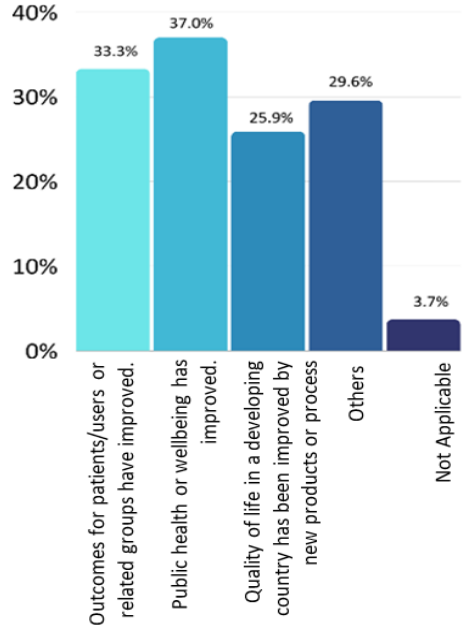

Figure 8(a): Impact on health and wellbeing

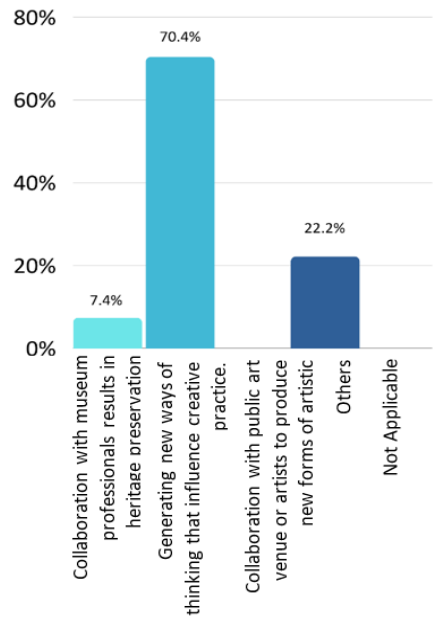

Figure 8(b): Impact on creativity, culture and of people and animal welfare Society

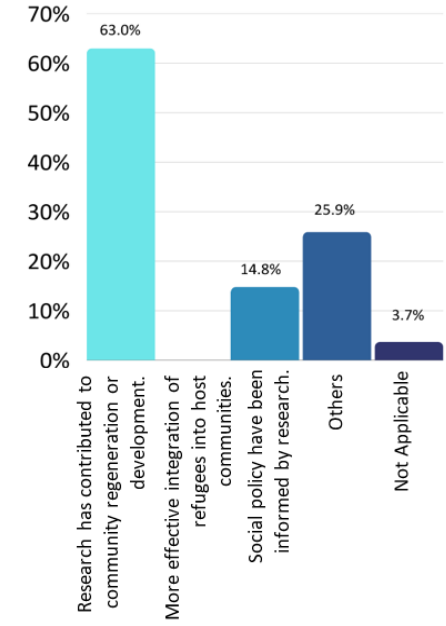

Figure 8(c): Impact on social welfare

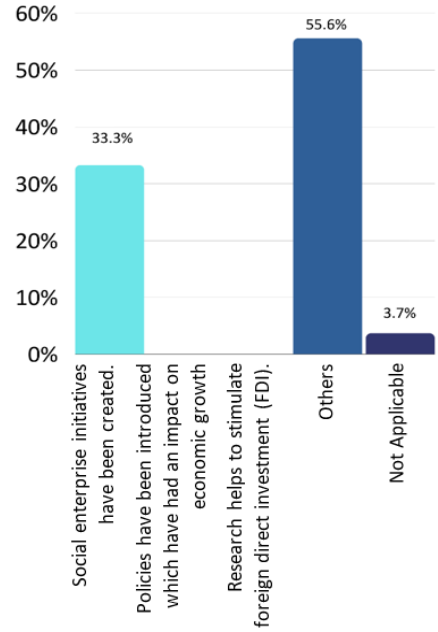

Figure 8(d): Impact on commerce and the economy

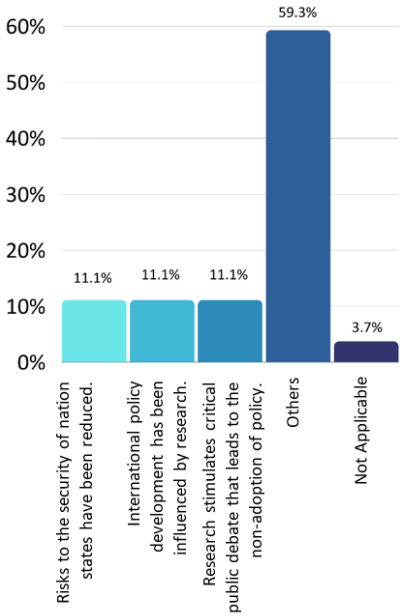

Figure 8(e): Impact on public policy, law and services

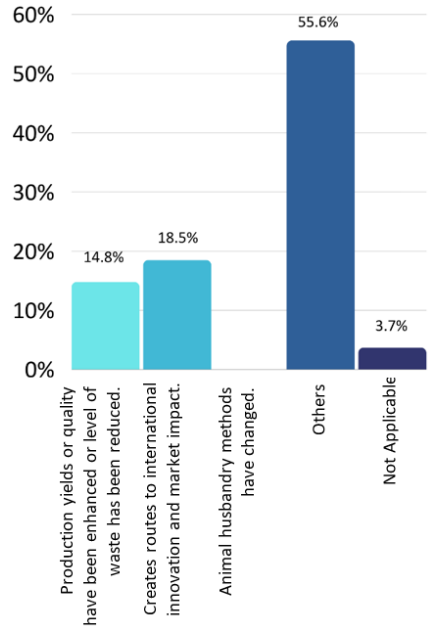

Figure 8(f): Impact on production

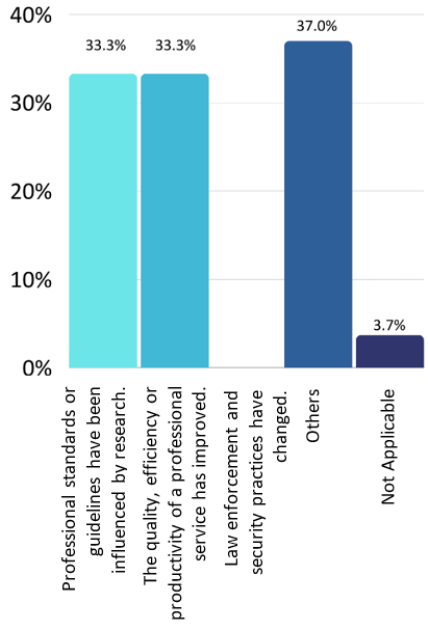

Figure 8(g): Impact on creativity, culture and society

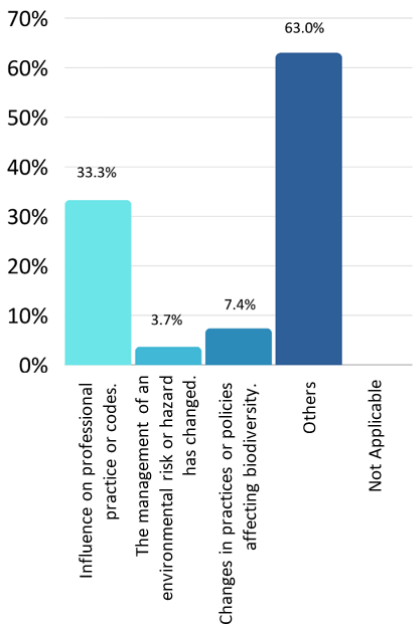

Figure 8(h): Impact on commerce and economy

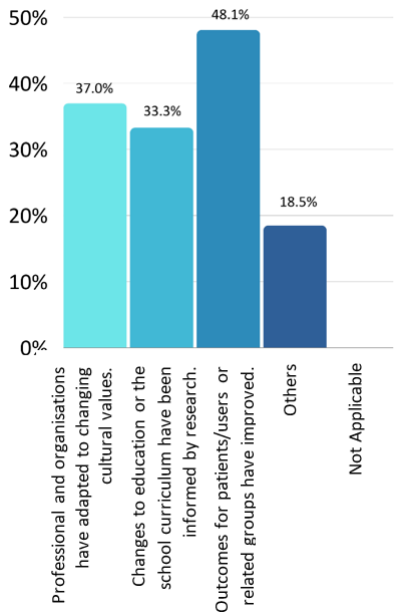

Figure 8(i): Impacts on understanding, learning and participation

Health, well-being of people and animal welfare

The highest percentage in relation to impact indicators was that public health or well-being had improved (37.0%). For example, in the *Be Able* study on technology and innovation for people with disabilities, the positive effects include continued learning and a decrease in inequality. This followed by the outcomes for patients/users or related groups which improved (33.0%) such as a project focused on improving the well-being of breast cancer survivors by assessing their dietary intake and nutritional status. Other indicators of impact included reduction of pollution from kitchen waste (29.6%), and improved quality of life in a developing country (25.9%) study on *Train The Trainers* to promote exercise - *360° TitaniUM Core Strength Exercises.*

Creativity, culture, and society

For this area, the highest indicator was the ability to generate new ways of thinking that influenced creative practice (70.4%) such as a project on reducing illiteracy among Federal Land Development Authority (FELDA) children using the *Asas Membaca Murid Pendalaman* or AMUD [*Basic Reading for Children from Rural Areas*] 4M (*Menyebut, Menyanyi, Melakon dan Mengeja* [*Saying, Singing, Acting and Spelling*]) curriculum module. Other indicators were the use of organic fertiliser for landscaping (purposes (22.2%) and being able to collaborate with museum professionals resulting in heritage preservation (7.4%).

Social welfare

In terms of social welfare, the highest indicator for this area was that their research contributed to community regeneration or development (63.0%). For example, the *Safe School Safe Surrounding and Safe City* project which emphasized the importance of this theme to the community by effectively addressing a range of child safety concerns, notably the prevalent issue of bullying within the local

neighbourhood. This was followed by other indicators, e.g., enabling the local community to establish vermicomposting set-ups (25.9%) and changes to social policy that have been informed by research (14.8%).

Commerce and economy

A total of 36% of the respondents indicated that social enterprise initiatives had been developed. Other indicators included the sale of products to generate side-income.

Public policy, law and service

The indicators in this section included the following: risks to the security of nation-states have been reduced (12%); international policy development has been influenced by research (12%); and research stimulates critical public debate that leads to the non-adoption of policy (12%). There were many other indicators as well mentioned by 64% of the respondents, and these included feedback about sexual harassment policy from the project #itubukancinta: Programme to Enhance Healthy Relationship Practices and Discourage Unhealthy Relationships.

Production

A total of 18.5% of the respondents mentioned that their projects had created routes to international innovation and market impact while another 18.5% indicated that they were able to increase production yield or enhanced quality and that waste had been reduced. Another 55.6% of them indicated other impact in terms of production (e.g., enhanced composting process allowing the production of better-quality compost).

Practitioners and delivery of professional service, or ethical practice

The indicators in this section included professional standards or guidelines that had been influenced by research (33.3%) and the quality, efficiency or productivity of a professional service had improved (33.3%). Other indicators (37.0%) were an improved sense of awareness of student and health clinic staff regarding issues related to relationships among the students.

Environment

The indicators for impact on the environment included the re-use of waste to build a gazebo; influence on professional practice or codes (33.3%); changes in practices or policies affecting biodiversity (7.4%) and the management of environmental risks or hazards that have changed (3.7%). Sixty three percent indicated impact on other aspects of the environmental.

Understanding, learning and participation

The highest indicator for this area was outcomes for patients/users or related groups which improved (48.1%); professionals and organisations having adapted to changing cultural values (37.0%); changes to education or the school curriculum informed by research (33.3%) and other indicators such as understanding and learning new skills and participating in the building of the gazebo in an area called *Laman STEM* (18.5%).

Sustainability

The sustainability of all CE projects under UMCares were measured based on the level community empowerment specifically the following:

i) independently sustain the practices that were introduced through the project (88.9%)
ii) continuity of the impact beyond the programme/ project duration (85.2%).

For 88.9% of the respondents their projects had empowered their target groups/communities. For 37.0% of them, their projects were sustainable in terms of social economy, and for 48.1% of them, their project was sustainable in terms of the environment.

4. Discussion

Research will have to undergo several phases before impact is created and often the process is described by a logical framework of the pathway to real impact for university-community engagement. In this study, we identified the UMCares' pathway to an intended real impact as represented in Figure 9.

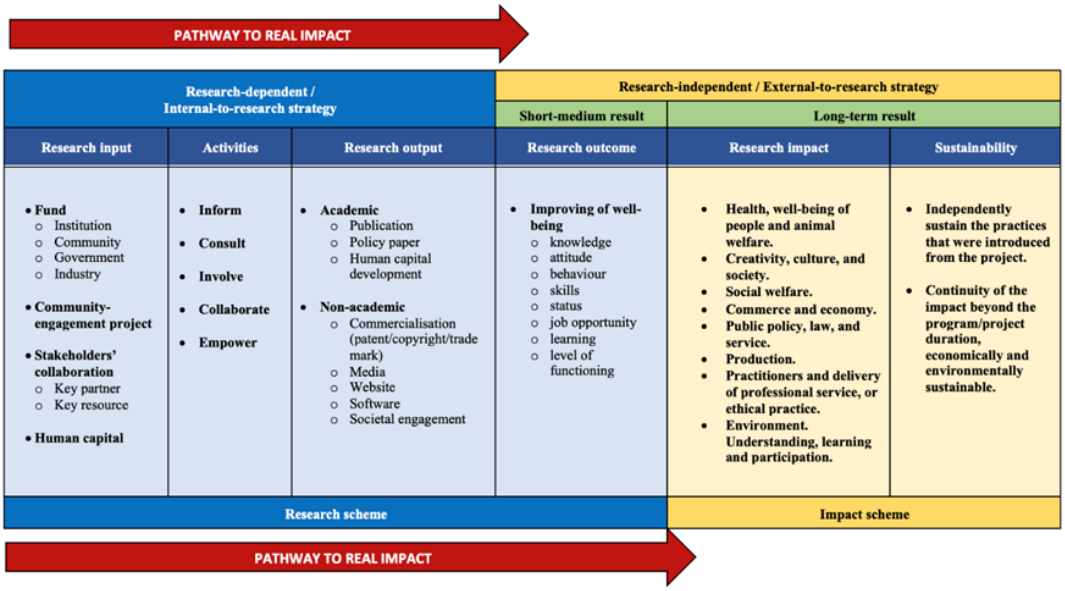

Figure 9: Logical framework of the pathway to real impact for community engagement

The evaluation of these CE projects indicates the resources they utilised to carry out the activities and in transforming the inputs into outputs. This study provides insights into the structure and resource allocation of various projects by examining financial contributions, key partners, resources in-kind, basic infrastructures, and human capital. The distribution of these inputs can have significant implications for project outcomes and sustainability. Most of the projects received institutional support (58.6%), i.e., from the RU allocation, reflecting a trend towards traditional funding mechanisms within the sector. The contribution from other stakeholders indicate a move towards a shared value approach that benefits all stakeholders, suggesting a strategic move towards more collaborative financial models. The various financial contribution structures also reflect a landscape in which traditional funding predominates but is supplemented by innovative, collaborative approaches. Under the management of UMCares, several

criteria were set for the CE projects, for example, the number of communities involved, sustainable projects, quick execution, low cost, and positive changes from the community in terms of knowledge, skills, behaviours, or aspiration. The success of many projects (including community-related projects) can be attributed to the participation, contribution and support of internal and external partners.

Engagement with the community is an ongoing process that requires active interaction in order to build trust, confidence, and partnership. This paper evaluated the various levels of CE from “inform” to “empower”. At each level, the impact is expected to increase. The IAP2 Spectrum of Public Participation posits that the highest level of impact is attained when public participation empowers individuals or communities. The information dissemination landscape is changing quickly, and the variety of channels utilised and their varied degrees of engagement reflect this, as shown by the data in this study.

The digital transformation that has taken place in the communication space is demonstrated by the prominence of "Social Media" as the main channel for information dissemination at “inform” level, as noted by 59.3 percent of respondents. This change is in line with the more general digital revolution in communication techniques. Researchers can use social media as a platform to disseminate their findings, updates, and instructional information quickly and easily to a large audience.

The results indicate that the participants preferred using the community for "consultation." "Surveys" reveal that 51.9 percent of participants highlight the continued value of surveys in gathering quantitative data. Surveys provide an organised way to gather feedback from a broad audience, making it easier to identify patterns and trends in public opinion. Close preference for "Interviews" (48.1%) among respondents shows how important qualitative information from in-person interactions is. Through rich narrative data that surveys frequently fail to capture, interviews enable a thorough understanding of participant perspectives. The preferences point to a nuanced approach to public participation, where digital tools are used in conjunction with traditional methods and direct interaction is valued in addition to anonymous feedback. An adaptable and comprehensive engagement strategy is reflected in this well-balanced methodological mix.

The most innovative forms of public engagement for “involve’ are interactive techniques such as workshops. The wide range of instruments that are emphasised suggests that a comprehensive strategy that can be tailored to the particular goals and target audiences of each engagement project is required. The inclination towards interactive and cooperative approaches implies that forthcoming tactics ought to prioritise bidirectional communication, guaranteeing that public involvement is not only acknowledged but also incorporated into the process of making decisions.

The most popular option for “collaborate” was "dialogue and roundtable," which was endorsed by half (50.0%) of the respondents. This predominates popularity highlights the modern focus on encouraging candid dialogue and idea sharing in public engagement activities and indicate strong commitment to collaborative approaches in community engagement. Prioritizing dialog ensures that community engagement transcends simple consultation to true partnership and shared decision-making. Communities are encouraged to collaborate, share perspectives, and produce solutions that are reflective of the collective voice.

The practise of 66.7 percent of entities "co-developing a programme or service and final decision" is extremely pertinent to initiatives aimed at empowering and engaging the community. Participatory governance provides the framework for communities to be actively involved in the design, development, and execution of policies and programmes that impact them, in addition to being consulted. This strategy is in line with community empowerment programmes that provide locals the tools they need to make changes in their communities. Involving people in programme co-development strengthens their ownership and utilises their local knowledge and creativity as well as produces powerful and enduring solutions.

The information on the method of engagement in each level shows that the projects under UMCares were able to maximise the participation of their targeted community using various types of platforms. However, there is a limitation of data in knowing the most preferred type of community engagement i.e., inform, consult, involve, collaborate, empower each project. Obtaining information on such data may help to observe the level of impact brought about by each of the projects.

As for outputs or the direct results achieved from the activities, the CE projects have produced both academic and non-academic outputs. Our results showed that the highest academic output was human capital development including research assistants and students. Human capital development is essential as it is related to increasing human capital effectiveness (Marimuthu et al., 2009). This can lead to an increase in performance in organisations involved in these projects. However, this cannot be accomplished without efficient research project administration, which needs initiative categorization and coordinated support for human capital capacity building. This is in line with the study of engaging universities in capacity building for sustainable development in local universities by Shiel et al. (2016), who emphasised that ample human capital who are skilled with the adequate technical capability will be engaged with the right collaborative engagement for sustainable development.

In the realm of research impact, societal or community engagement is essential since it extends beyond academia to affect real-world change. This engagement is about the range of ways that the public can be informed about the work and benefits of higher education and research. To utilise research findings and knowledge to address social concerns, it entails collaboration between researchers and external stakeholders, including industry, the public sector, and the broader community. The finding that the greatest non-academic output was societal engagement suggests that the research community is beginning to recognise how important it is to expand the scope of research beyond scholarly publication and direct academic application. According to this tendency, researchers are progressively becoming as agents of change, making an effort to make sure that their findings influence public policy, advance economic growth, improve people's quality of life, and benefit society as a whole. Haseeb (2020) highlights the importance of this kind of engagement which a vital step for research to create a real impact on the community and suggests that the true measure of research should be based on its ability to influence and interact with societal stakeholders rather than being limited to the parameters of traditional academic metrics like citations and journal impact factors. In order to close the gap between academic research and society demands, this involvement can take many different forms, such as public lectures, policy briefs, community projects, participatory research, and joint ventures. Research organisations and individual researchers can improve their responsiveness to the short- and long-term

needs of the communities they serve by encouraging this kind of interaction. Research goals that are in line with society interests facilitate the co-creation of information that is both academically sound and practically useful. It also builds public trust in the research process, as people witness the tangible benefits of research in their daily lives. The acknowledgment of societal engagement as a significant output thus underscores the evolving role of research in society and the increasing emphasis on the social accountability of academia.

The analysis of the impact of the projects under UMCares for the past five years was mainly the impact on the practices area. The projects have had an impact on several key areas including health and well-being, culture, economics, policy influence and the environment impact. These findings support the top four SDGs alignments of the CE projects which are (1) Goal 1 (No Poverty), (2) Goal 2 (Zero Hunger), (3) Goal 3 (Good Health and Well-being), (4) Goal 4 (Quality Education) (5) Goal 11 (Sustainable Cities and Communities), (6) Goal 12 (Responsible Consumption and Production), Goal 16 (Peace, Justice, and Strong Institutions), and Goal 17 (Partnerships for the Goals).

5. Conclusion

Through UMCares, UM has been able to enable communities to benefit via various funded projects over the past five years. The evaluation in this paper indicates that the projects funded by UMCares have created impact in the following areas:

- health of human and animals
- creativity, culture and society
- social welfare
- commerce and economy
- public policy, law and service
- production
- ethical practices
- Environment
- understanding, learning and practices.

These projects have also displayed engagement with the community or beneficiaries at several different levels. Given that the survey in this study had a low return rate (26.3%), the findings cannot be generalised about all the community engagement projects that have been supported by UM from 2015 to 2020. In addition, the study relies on self-reported responses from respondents; thus, recall bias, social desirability bias, and information bias should be addressed. There should be careful consideration, as respondents tend to over- or under-report the frequency and actual impact of project.

The data highlights the necessity of developing a more robust impact evaluation framework for Community Engagement (CE) funding in order to guide future planning and strategic direction. A thorough database under UMCares' management would enable real-time monitoring and assessment of project outcome, ensuring a transparent and accountable framework for impact measurement. In addition to making the mapping of ongoing initiative easier, this resource would be essential for determining areas of need, influencing future funding decisions, and aligning with both domestic and international agendas. Furthermore, into the long-term impact and sustainability of CE initiatives can

also be gained through the longitudinal monitoring of projects. Selected projects can be revisited to identify best practises and areas for improvement. This information can then be used to develop adaptive strategies for current and future engagements. UMCares stands to benefit from such a structured approach to data management as a facilitator of this community engagement. It has the potential to result in more strategic funding allocations with a clear focus on evidence-based outcomes. This ensures that investments are not just reflective to immediate community needs, but also in line with UM's overarching mission and vision for societal impact. Finally, the development and maintenance of a dedicated database, in combination with periodic, systematic impact assessments, can considerably improve the strategic deployment of CE awards. By doing so, UM would not only increase the effectiveness and visibility of its community engagement programmes but would also help to foster a culture of continuous improvements and accountability in the field of academic-driven societal development.

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References:

Benneworth, P., Humphrey, L., Charles, D.R., & Hodgson, C. (2008). Excellence in community engagement by universities. *Proceeding of 21st Conference on Higher Education Research (CHER)*, September 10–13, Pavia, Italy (pp. 1– 43).

Farrar, M., & Taylor, R. (2009). University–community engagement: Analysing an emerging field. In S. Denton & S. Brown (Eds.), *A practical guide to university and college management: Beyond bureaucracy* (pp. 159–178). Routledge.

Haseeb, A.S.M.A. (2020). How university research can create impact. *Journal of Research Management & Governance*, *3*(1), 42–44. https://doi.org/10.22452/jrmg.vol3no1.4

International Association for Public Participation. (2021, April 27). IAP2 spectrum of public participation.. Retrieved from https://cdn.ymaws.com/www.iap2.org/resource/resmgr/pillars/Spectrum_8.5x11_Print.pdf

Marimuthu, M., Arokiasamy, L., & Ismail, M. (2009). Human capital development and its impact on firm performance: evidence from developmental economics. *The Journal of International Social Research* 2(8), 60-67.

Mtawa, N.N., Fongwa, S.N., & Wangenge-Ouma, G. (2016). The scholarship of university- community engagement: Interrogating Boyer's model. *International Journal of Educational Development 49* (C), 126–133. https://doi.org/10.1016/j.ijedudev.2016.01.007

Research Excellence Framework 2021. (2022, May 4). *Index of revisions to the 'Panel criteria and working methods' (2019/02)*. Retrieved from https://www.ref.ac.uk/media/1450/ref-2019_02-panel-criteria-and-working-methods.pdf

Shiel, C., W.L. Filho, A., & do Paco, L.B. (2016). Evaluating the engagement of universities in capacity building for sustainable development in local communities. *Evaluation and Program Planning* 54, 123–134. https://doi.org/10.1016/j.evalprogplan.2015.07.006

Syed Kechik, S.Y., Arshad, M.A., Abdul Hamid, N.K., & Mazlan, M.N.H. (2019). *University-community engagement leadership toolkit sharing best practices*. Universiti Sains Malaysia

UMCares. (2013). *UM Community Engagement Policy*. Universiti Malaya.

Wróblewska, M. N. (2021). Research impact evaluation and academic discourse. *Humanities and Social Sciences Communications*, *8*(58). https://doi.org/10.1057/s41599-021-00727-8

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RESEARCH ARTICLE

Research Classification using the Malaysian Research and Development Classification System (MRDCS)

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ABSTRACT

Classifying research projects or research publication into research areas is crucial in many statistical analyses including for example in bibliometric analysis. Research publication classification usually takes place at the level of journals, where subject categories based on available databases like the Web of Science or SciVal are some of the popular classification systems. However, journal-level classification systems have limitation especially when classifying multidisciplinary journals. To overcome this limitation, it is suggested that a classification system that can classify research be constructed based on the areas of research proposals and their related publications. Successful grant applications/research projects and their publications were clustered into research areas based on the Malaysian Research and Development Classification System (MRDCS) (6th Edition). A total of 1738 research projects managed by Universiti Malaya's Research Cluster from year 2015 to 2017 were mapped. The strengths and the limitations of the proposed classification system are also discussed. Results indicate that out of the 20 research categories, Medical and Health Sciences, Social Sciences, Economics, Business and Management, Humanities, and Engineering and Technology emerge as the top five research categories with the highest critical mass value based on the number of projects. Classification mapping also found Engineering and Technology, Medical and Health Sciences, Material Sciences, Social Sciences, and Applied Sciences and Technologies to be the top five research categories that produced the highest number of outputs in terms of publications.

Keywords: Research grant mapping; Classification system; Research University; Research management

1. Introduction

In any bibliometric or scientometric research related to research outputs, a classification system is an essential tool to assigns journals or individual publications based on its research areas. Such systems can be used to simplify and assist in literature search, to expand the analysis to the structure of research disciplines, or even to facilitate bibliometric research evaluation. Various methods and identification system are being used to catalogue and classify the research areas. This paper explores several types of classifications and methods on how research or niche areas of projects and publications can be identified. The three major methods are: the Thomson Reuters' Web of Science databases, SciVal and the Malaysian Research and Development Classification System (MRDCS). By understanding the 'rules' underlying each of the methods, existing datasets are matched to ensure that the chosen classification system will cover all the subject areas of the projects.

According to Reindert et al. (2010), a research area should be able to show basic and noticeable level of activity, which are measurable in terms of the number of publications. The research areas of surveyed publications can be identified through their electronic bibliographies, supplemented by additional research classification information. (Fuchs et al., 2011). Vertakova et al. (2016) presented the methodological guidelines for carrying out morphological analysis and synthesis of research where one of the aims was to identify the formation of new areas in ongoing research. The analytical calculation results can then propose the new areas and themes of the research studies.

The most popular classification system for bibliometric and scientometric research is the system currently in use by Thomson Reuters' Web of Science database (Waltman & Eck, 2012). There are about 250 research area/ subject categories in this system. The Web of Science covers scholarly books, journals and conference proceeding based on evaluation impact (Wáng et al., 2014). A somewhat similar system to Web of Science is the Elsevier's Scopus database where both classification systems work at the level of scientific journals (Waltman & Eck, 2012). Within these systems, journals are categorized with one or more research areas. Although individual articles lack direct research area tags, the assignment of research area(s) to each publication is determined by the journal responsible for its publication. Hence, classification systems based on journals have demonstrated limitations in providing detailed information, particularly when dealing with multidisciplinary journals. (Waltman & Eck, 2012).

Another tool is SciVal which assists evaluation and comparison of research based on data from Scopus, the world's largest abstract and citation database for peer reviewed publications. It consists of three integrated modules; overview, benchmarking and collaboration. Scopus utilizes All Science Journal Classifications (ASJC) codes to systematically classify and categorize published research based on its subject area. Serial titles undergo classification within the ASJC scheme by in-house experts at the initiation of Scopus coverage. This categorization relies on the aims and scope of the title, as well as the content it disseminates. The ASJC system further organizes research into 4 overarching subject areas encompassing 30 specific subject area classifications. This can, for example, be an institution's strategic priority to demonstrate areas of research strengths and identification of emerging areas of science or any other topic of interest. For each specified research area, SciVal furnishes comprehensive information on the institution's involvement, encompassing the number of publications and citations. Additionally, it offers an overview of the top-contributing institutions at regional, national, and global levels, facilitates

benchmarking against other institutions, and identifies existing and potential research collaboration partners (Elsevier, 2014). The major advantage that SciVal has over other metrics and reporting tools is the high volume of data. SciVal uses supercomputer technology to process more than 32 million publication records from almost 22,000 journals from 5,000 publishers across the globe, mostly from the Scopus database (Dresbeck, 2015). However, since the data is mainly extracted from the Scopus database, SciVal will not be able to provide a comprehensive situational analysis, especially in the fields of arts, humanities some social sciences. The attention of research often focuses on the output especially the classification system at the journal level such as via Web of Science and Scopus. Classification systems at the journal level normally consists of at most a few hundred research areas, and they often face difficulties in dealing with multidisciplinary journals such as *Nature (https://www.nature.com/)* and *Science (https://www.science.org/journal/science)*. There is a need to use a combination of bibliometric tools for a better classification system.

Yet another tool is the Malaysian Research and Development Classification System, better known as MRDCS, is a classification system tool of that was designed for classifying and describing research activities in Malaysia to the highest detail and accuracy (MASTIC, 2012). MRDCS was first introduced in the 1992 National Survey of Research and Development and published by the Malaysian Science and Technology Information Centre (MASTIC), Ministry of Science, Technology and Innovation (MOSTI) in 1993. To date, the ministry has published six editions of the MRDCS. These updates are to keep up with the explosion of technological advances, changes in national economic policies and science, key focus areas in technology and innovation (ST&I), hence resulting in a more dynamic classification of research areas while addressing emerging research areas. The classification of research activities is anticipated to establish the foundational framework for measuring and analysing research and development (R&D) endeavours in Malaysia. It aims to serve as a valuable indicator for the direction of future R&D efforts, ultimately benefiting all stakeholders, including researchers, decision-makers, and the public.

The present study will use MRDCS to conduct a preliminary analysis based on its broad areas which will be matched with available datasets to construct a theoretical framework for a method used for visualisation purposes. MRDCS will be used as it is a tool that has been designed primarily to meet the needs in classifying research activities in a more consistent and structured manner which are relevant in the Malaysian context.

In comparison to earlier classification systems of research areas, the method introduced in this study has several advantages. Firstly, the method works at the level of individual research grant applications and related outputs in terms of publications rather than classification at the journal level. This allows for a more detailed classification of research areas without facing difficulties when classifying multidisciplinary journal. The classification method is also more transparent and relatively simple with minimal researcher engagement involved. MRDCS (6th edition) is described in detail (https://mastic.mosti.gov.my/mrdcs/v6). Anyone with enough data access and computing resources should be able to replicate the steps taken during the classification of research output using this tool.

2. Research Clusters at Universiti Malaya (UM)

Research activities in University of Malaya (UM) are managed and governed by the Institute of Research

Management and Services, or its Malay acronym, IPPP. Previously known as the Research & Development Unit (R&D Unit), IPPP was established in October 2000 as part of UM's aspiration to become a premier research university in Malaysia. IPPP acts as a central coordinator for all research activities as well as a 'one-stop' centre for all research information for the university.

Prior to being accorded the Research University (RU) status on October 11, 2006, research that was carried out in UM as loosely clustered according to various disciplines at the faculty level. Upon being granted RU status and cognizant of the objectives of the establishment of RUs, there was an urgency to redefine research clusters to be more focused to champion more efficient research strategic planning and the mobilisation of various research groups and units. Research clusters are not centres of excellence (CoE) but defined as "broad-based thematic areas of research" that act as umbrellas to support CoE (Research Cluster Office, 2023). The research clusters are instrumental in directing the university's research activities and assisting in galvanizing university research activities now and in the future. This is because the research clusters provide a broad direction for developing the university's research agenda. Each cluster incorporates interdisciplinary approaches and coordinates research activities from different disciplines. Since its inception in 2009, the research clusters have transitioned to the following (see Figure 1):

i) Innovative Industry & Sustainability Science
ii) Frontiers of the Natural World
iii) Health & Well-Being
iv) Social Advancement & Happiness

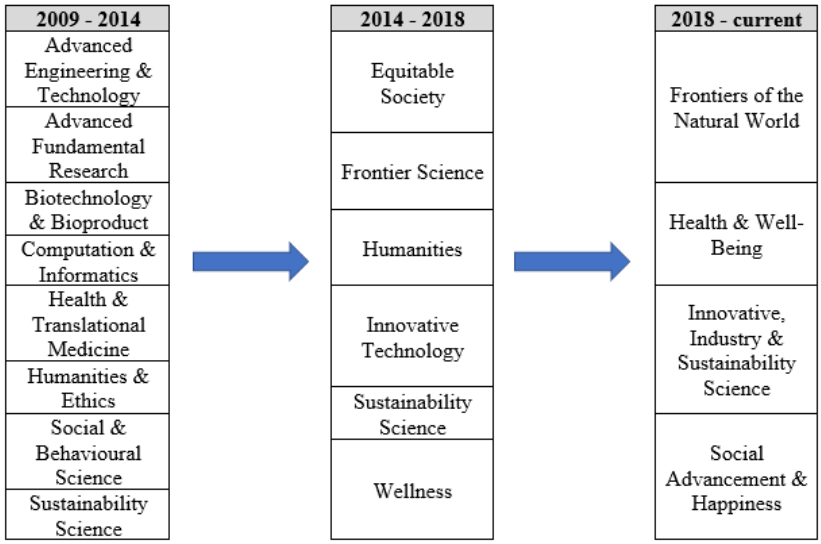

Figure 1: Transition of Research Clusters 2009 – 2023.

3. Methodology

MRDCS

MRDCS classifications provide the basis for the measurement and analysis of R&D activities and statistics that are useful guidelines to government policy makers, industrialists and researchers. Additionally, they

function as a useful indicator for discerning the direction of R&D and technological change. As technological advances become increasingly dynamic, there are no limitations to the introduction of new researchable areas. The 7th edition of MRDCS is a continuation and contains latest updates to address technological gaps and barriers. The established standard framework in these classifications enables efficient prioritization, funding allocation, and maximization of national R&D efforts. Additionally, it serves as a clear indicator for international comparisons.

The proposed method for constructing research grant applications and its publication-level classification system of research areas using MRCDS can be divided into three steps:

Step 1: Determining the related research grant applications and their publications.
Step 2: Clustering research grant applications and their publications into research areas.
Step 3: Labelling research areas.

Step 1: Determining the related research grant applications and its publications

Firstly, each research cluster sorted the UM Research Grant (UMRG) applications according to the year of application. The identified year of research grant application for this study was from 2015 to 2017. The number of publications for each research project was also recorded. This sorting process can be done via the online Research Project Management System (RGMS) developed by UM Centre for Information Technology. Between the years 2015 and 2017, there were a total of 1738 research grant applications and 2457 publications were identified as having fulfilled the criteria for classification.

Step 2: Clustering research grant applications and its publications into research areas

The Field of Research (FoR) represents R&D activities classified according to their scientific and academic disciplines. These disciplines tend to be universally applicable, with national variations arising from the grouping of different research fields. The MRDCS follows a hierarchical structure, with codes F representing the Field of Research (FoR) and codes S representing the Socio-Economic Objective (SEO). The descending characters in the MRDCS, following codes F and S, identify its Division, Category, Group, and Area. The broader the subject area or research discipline, the higher the hierarchy. Specific sub-codes are assigned within the FoR classifications hierarchy to illustrate hierarchical differences. This classification enables the categorization of R&D activities based on the field of research, focusing on the nature and methodology rather than the activity or purpose of the performing unit.

The FoR classification consists of discrete categories which identify research fields through various disciplines and major subfields investigated by universities, national research institutions and related tertiary institutions, organisations and emerging areas of study. It reflects the expansion of research activity from the former 2 division- to the present 9 division-classification unit. The inclusion of new research areas is inevitable with the accelerated pace of the country's R&D. The latest edition classified all the R&D activities into 9 Divisions, 20 Categories, 271 Groups and 3297 discrete Areas.

The FoR has four hierarchical levels, starting at the Division (broadest level), Category, Group and Area (finest level where research project is allocated). Each level is identified with a unique number or code for easy reference. The figure below shows the approach to the FoR hierarchical structure;

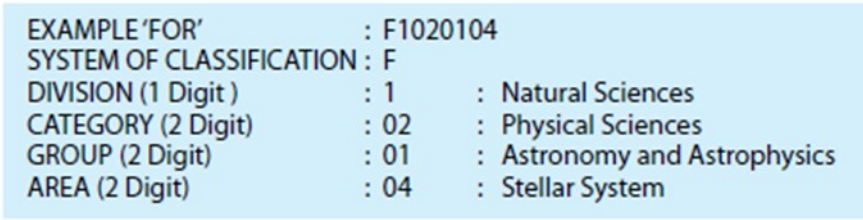

Figure 2: Example of the FoR Hierarchical Structure.

The methodology provides a classification system in a hierarchical structure that can be utilised to cluster research grant applications and publications into various available research areas and the research areas are then automatically organized into the higher hierarchical structure.

Step 3: Labelling research areas

There are 9 possible Divisions which represent broad subject areas or research disciplines, while Categories, Groups and Areas at the lowest level representing more detailed dissections of the categories which allow the entry of more possible areas for future expansion. The Division level was first be identified and labelled and this then progressed to the lower level of the hierarchy (Category, Group and Area). These labels were identified and obtained by extracting the keywords or terms from the titles or abstracts of the research grant proposals and its publications. A single keyword or term is usually not enough to indicate the research division clearly. Thus, labels for each research division following a set of terms can be used:

i) Identification of terms in titles and abstracts of publications

At this stage, all keywords or terms occurring in the titles, abstracts from the research grant applications and its publications were identified.

ii) Selection of the most relevant terms

The most relevant keywords or terms to the respective research divisions (highest level of the classification system) were selected and applied. Up to five relevant keywords or terms for each research division could be selected. The description of the steps of the proposed methodology was now complete.

4. Results and Discussion

There are four levels in this classification system. The highest level (i.e., level 1 – Research Division) of the classification system was studied, followed by the upper-mid. level (i.e., level 2 – Research Category), then the lower-mid level (i.e., level 3 – Research Group) and finally the lowest level (i.e., level 4 – Research Area). Of the 1738 research grant applications and 2457 publications which researchers applied into the classification system, only one (1) research grant application could not be included in the system.

During the process of labelling the research area, the following notation was used to label the research divisions in MRCDS:

- Research Division z: A research area at level 1 of the system.

- Research Category y.z: A research area at level 2 of the system which is one of the sub-areas of area z (level 1).
- Research Group x.y.z: A research area at level 3 of the system which is one of the sub-areas of area y (level 2).
- Research Area w.x.y.z: A research area at level 4 of the system which is one of the sub-areas of area x (level 3).

Level 1

At level 1, the classification system consists of 9 divisions. Figure shows the distribution of research grant application and its publication over these divisions. The average number of research grant applications and their publication per division was approximately 193 and 273, respectively. The largest division included 357 research grant applications with 709 publications, while the smallest research area covered only 19 research grant applications and 35 publications.

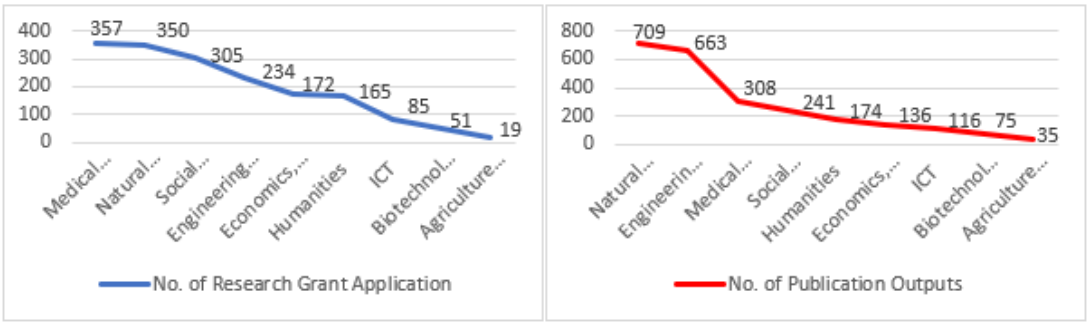

Figure 3: Distribution of research grant applications and their publications over the 9 research divisions at level 1 of MRDCS.

To label the 9 research divisions at level 1 of MRDCS, suitable keywords or terms for the research areas were manually identified and obtained. One main concern raised is that there were research areas that corresponded closely with well-known broad scientific disciplines such as science, social sciences, computer science, engineering, and education. Interestingly only a partial correspondence was found between MRDCS research areas and these traditional disciplines. This result indicates that traditional disciplines (e.g., science, social sciences, computer science, engineering, education) may not reflect UM's actual scientific research at the point that this study was carried out.

The lack of correspondence between the research divisions in MRCDS and traditional scientific disciplines created a difficulty for labelling the research divisions. For instance, no clear distinction between disciplines such as science and technology, law, Islamic studies, material science, and astronomy was found based on MRCDS research divisions. Therefore, the labelling was further refined to the research areas at level 2 or the upper-mid level of MRCDS, namely the research category. Table 1 lists the distribution of research grant applications and their publications over the 9 research divisions at level 1 of the MRDCS.

Table 1: Distribution of research grant application and its publications over the 9 research divisions at level 1 of the MRDCS.

Distribution of research grant application			Distribution of its publications		
Division	**Name of Division**	**Percentage**	**Division**	**Name of Division**	**Percentage**
5	Medical and Health Sciences	20.6%	1	Natural Sciences	28.9%
1	Natural Sciences	20.1%	3	Engineering and Technology	27.0%
7	Social Sciences	17.6%	5	Medical and Health Sciences	12.5%
3	Engineering and Technology	13.5%	7	Social Sciences	9.8%
9	Economics, Business and Management	9.9%	8	Humanities	7.1%
8	Humanities	9.5%	9	Economics, Business and Management	5.5%
4	ICT	4.9%	4	ICT	4.7%
2	Biotechnology	2.9%	2	Biotechnology	3.1%
6	Agriculture and Forestry	1.1%	6	Agriculture and Forestry	1.4%

Level 2

Level 2 of MRDCS consists of 20 research categories. The average number of UMRG research grant applications and their publications per category was approximately 86 and 122, respectively. The largest category included 357 research grant applications and 485 publications, while the smallest research category covered only one research grant application with no publication output.

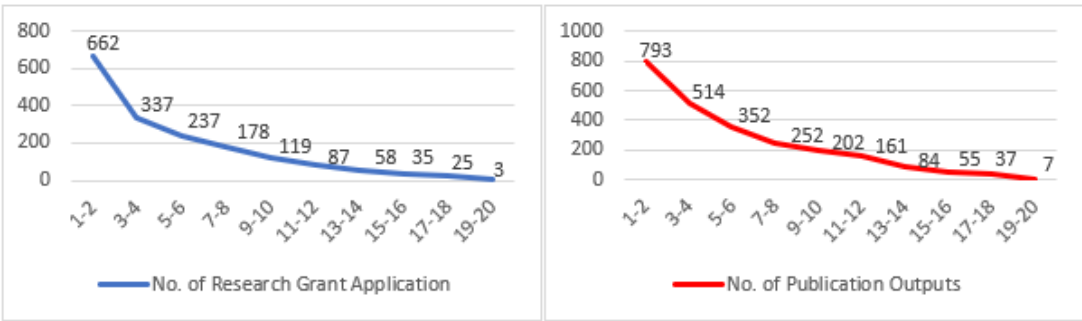

Figure 4: Distribution of UMRG research grant applications and their publications over the 20 research categories at level 2 of MRDCS.

Figure 5 shows the mapping of 1738 UMRG research grant applications and 2457 publications at both levels 1 and 2 of the MRCDS classification system. The research areas have been grouped into nine divisions represented by circles with different colours. Each division corresponds with one or more research categories at level 2 of MRCDS classification system. The size of the circles indicated the critical mass or the number of research grant applications in each research category.

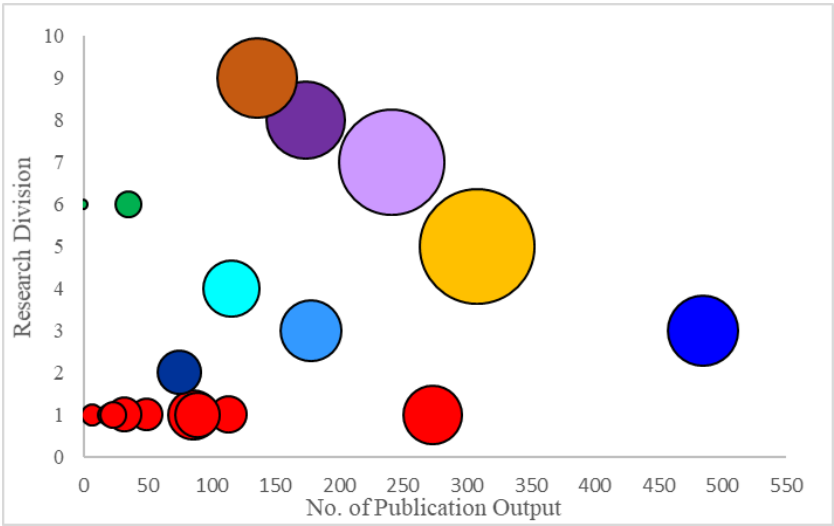

Figure 5: Mapping of the 1738 UMRG research grant applications and 2457 publications at both levels 1 and 2 of MRCDS classification system.

It was found that the top three producing research divisions in terms of publications and their research category were Natural Sciences, Engineering & Technology and Agriculture & Forestry (see Table 2). The keywords from the research grant applications and publications of research division 1 (Natural Sciences) reflected research mostly from the categories of Nuclear Sciences, Physical Sciences and Material Sciences. While keywords labelled under research division 3 (Engineering & Technology) and 6 (Agriculture & Forestry) also reflected research under their respective categories.

Table 2: Top three producing research divisions in terms of publications and their research categories.

Research Division	No. of grant application (a)	No. of publications (b)	(a):(b)	Research category
1 (Natural Sciences)	350	709	1:2.03	Nuclear Sciences (1:17.00); Physical Sciences (1:3.14); Material Sciences (1:2.94)
3 (Engineering & Technology)	234	663	1:2.83	Engineering and Technology (1:3.62)
6 (Agriculture & Forestry)	19	35	1:1.84	Agricultural Sciences and Technology (1:2.06)

Level 3 and Level 4

The UMRG research grant applications and publications can be additionally grouped into research groups and research areas, corresponding to levels 3 and 4 in the MRDCS classification system. It's noteworthy that, at present, the research cluster office has not undertaken this clustering based on expert opinion. The identification of the most pertinent keywords or terms for clustering grant applications and their publications at levels 3 and 4 needs to be conducted with expert input. Therefore, collaboration with experts possessing a broad understanding of the scientific literature in specific disciplines is crucial for advancing the clustering processes. This undertaking also mandates further data collection to establish a comprehensive database of pertinent keywords or terms before initiating the clustering of UMRG research grant applications and publications at levels 3 and 4 of the MRDCS classification system.

5. Conclusion

This paper discussed the utilisation of the MRCDS (6^{th} edition) classification system to group or cluster research grant applications and their publications. Each grant application and publication are assigned to a research division, then their research category, research group and lastly research area that are all organized in a hierarchical structure. At the highest level, research divisions may, for instance, correspond with broad research disciplines. At the lowest level, it corresponds to a specific research area.

In line of the underlying aim of research to discover new knowledge and inform action, the classification of research can shed light on key and emerging research areas. It can also assist in contextualizing research findings within a larger body of research. Apart from that, the findings can facilitate decision-making regarding the relative worth or potential impact of the research areas and develop new niche areas, and thus, the information derived can be used for strategic planning for research areas. In addition, the results could be used to justify potential areas for policy development and future project implementation.

In this paper, a clustering of 1738 UMRG research grant applications and 2457 publications were carried out up to research categories (level 2) where an average of 86 of UMRG research grant applications and 122 publications were clustered per category. However, further clustering requires a more comprehensive database of relevant keywords or terms which has to obtained from experts with a broad overview of the scientific literature in specific disciplines. Despite the limitations of this study, the results indicates that the MRCDS classification system is a suitable method to classify research grant applications and their publications. Hence, future studies should focus on creating the comprehensive database of keywords to cluster future research grant applications and its publications into specific research areas.

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References:

Buter, R.K., Noyons, E.C.M., & van Raan, A.F.J. (2010). Identification of converging research areas using publication and citation data. *Research Evaluation*, *1*(1), 19-27. https://doi.org/10.3152/095820210X492503

Dresbeck, R. (2015). SciVal. *Journal of the Medical Library Association*, 3(3): 164–166.

Elsevier. (2014). Scival user guide. Retrieved from https://www.acu.edu.au/__data/assets/pdf_file/0007/622654/SciVal_user_guide.pdf

Fuchs, L., Pernul, G., & Sandhu, R. (2011). Roles in information security – A survey and classification of the research area. *Computers & Security*, *30*, 748-769.

MASTIC. (2012). Malaysian Research and Development Classification System (6th Edition). Malaysian Science and Technology Information Centre (MASTIC). Retrieved from https://mastic.mosti.gov.my/mrdcs/v6/code

Research Cluster Office. (2023). *About Us*. Research Cluster Office. Retrieved https://researchcluster.um.edu.my/about-us

Vertakova, Y., Klevtsova, M., & Babich, T. (2016). Identification of the new research areas and development of the existing ones by methods of morphological analysis and synthesis. *Economic Annals*-XXI, *157*(3-4(1)), 4-7. http://dx.doi.org/10.21003/ea.V157-0001

Waltman, L., & Eck, N.J.V. (2012). A new methodology for constructing a publication-level classification system of science. *Journal of the Association for Information Science and Technology*, *63*(12), 2378-2392. https://doi.org/10.1002/asi.22748

Wáng, Y.J., Arora R., Choi Y., Chung H., Egorov V.I., Frahm J., Kudo, H., Kuyumcu, S., Laurent, S., Loffroy, R., Maurea, S., Morcos, S.k., Ni, Y., Oei, E.H.G., Sabarudin, A., & Yu X. (2014). Implications of Web of Science journal impact factor for scientific output evaluation in 16 institutions and investigators' opinion. *Quantitative Imaging in Medicine Surgery*, *4*(6), 453-461. https://doi.org/10.3978/j.issn.2223-4292.2014.11.16

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