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The impact of extreme weather events due to climate change on students

(Case Study of University of Royal Melbourne Institute of Technology in Australia)

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Executive Summary:

The topic of the study was: the impact of extreme weather events due climate change on RMIT students. RMIT has identified there is a gap in understanding the impact of severe climate on weather types and its impact on RMIT students population. This paper is to further RMIT's understanding of the type and severity of impacts to students as a result of climate change and outline recommendations on how RMIT can assist its students in becoming more resilient during extreme weather events. The study was carried out to investigate the correlation of extreme weather events and RMIT students in terms of their attendance, progress and well-being. This analytical study was conducted on 100 students from various degree stages. Data were collected by questionnaire, consisting of two sections; the level difficulties among students when they are facing extreme weather events and students 'progress during extreme weather events. Collected data sets were analysed via RMIT Qualtrics software. The online questionnaire on Qualtrics survey platform, which advertised on the RMIT

Facebook page, and via email lists / discipline newsletters (with permission).The raw data has been analysed via quantitative method, which was one of the most significant methods in the data analysis phase; which formed different sets of graphs to facilitate reading the data output for each question. The study showed that extreme weather significantly affects the concentration of students and the average daily hours expected to be spent in self-study. Overall, the most influential weather types were rainy weather and thunderstorm. One of the unexpected results of this study is that hot weather is not very influential; this gives a strong indication that RMIT University has facilities equipped to cope with extreme heat waves during the summer, which helps students significantly in the conduct of their activities within the facilities of the University comfortably. Also, the study showed that extreme weather considerably affects the level of concentration among RMIT students and the average daily hours expected to be spent on self-study. The study illustrated that students require to be more resilient when they are experiencing extreme weather events to avoid or mitigate the negative influence caused by them. To assist students to be more resistant it is recommended that 1) RMIT develops its own RMIT forecast; 2) enhance the air quality for its enclosed buildings; 3) actively encourages students to follow the safety instructions during extreme weather events.

Keywords:
Extreme Weather Event – Climate Change- Study Progress- Wellbeing .

1. Introduction

Climate change refers to a significant long-term change in the statistical distribution of weather patterns, due to several reasons that will be mentioned in this literature. Climate change is caused by the dynamic processes of the earth, external forces and human activity (Houghton et al. 2001). Davidson and Janssens (2006) explain that climate change is a disturbance of the earth's atmosphere and causes a rise in the temperature of the planet, resulting in significant changes in relation to certain natural characteristics such as a change in the amount of solar radiation reaching Earth and volcanic eruptions that change the amount of solar radiation that lead to the continued deterioration of vegetation and environmental diversity.

Alexander et al (2001) explain that the phenomenon of climate disturbance has been studied by a number of scientists in terms of the warming of the oceans and atmosphere. The majority of studies conducted in this regard relate the phenomena of climate change to a number of causations, the most prominent being industrial activity and the resulting toxic gases that accumulate in the atmosphere. These gases have a severe impact on the regulation of the earth's temperature and the balancing of environmental phenomena (Alexander et al. 2001).

1.1 Aim and Objectives

The purpose of this research is identify the relationship between the extreme weather events due to climate change and RMIT' students on their attendance, study progress and wellbeing. All this will be done through a couple integration of research, which are collect the data and provide sufficient analysis based in the gathered information that received from the field study. Specific objective are:

- To find the effects of extreme weather events due to climate change on human behaviour, specifically in the education setting.
- To determine the effects of extreme weather events on students' ability to physically attend lectures.
- To clarify the relationship between students' attendance at RMIT University and extreme weather events climate change-induced cold or heat waves.
- To identify the relationship of extreme weather events to students' capacity to concentrate.
- To understand students' activities during extreme weather events at university.

1.2. Extreme weather and severe climate change in Australia

Extreme weather events have occurred in Australia on multiple occasions. Australia has seen a number of unusual weather events due to climate change, including severe heatwaves, increased rainfall, floods and forest fires.

The aforementioned extreme weather events have occurred in an atmosphere that is warmer and more humid than in the past 60 years (Cheng et al. 2005). Heatwaves have become hotter and last longer than ever before (Cheng et al. 2005). Rising sea temperatures have also caused extreme coral bleaching and result in the deaths of coral reefs (Ebi & Schmier 2005). It is important to note that global worming has led to extreme weather conditions, which significantly increase temperatures in Australia, sometimes resulting in forest fires. What's more, the storms in Australia has increased sea levels at the expense of coastal areas, resulting in increased coastal flooding due to global warming.

Throughout Australia, extreme weather events are expected to worsen due to increased global temperatures. The periods of drought are also expected to increase, especially in South Australia (Leblanc et al. 2009). The rising temperatures are expected to lead to increased desertification in the south and east of the country, resulting in the gradual destruction of local vegetation (Leblanc et al. 2009).

3. Results

3.1 Weather types that limit students' ability to come to RMIT campus

Figure1. Extreme weather events which is most likely to prevent RMIT students from coming to campus.

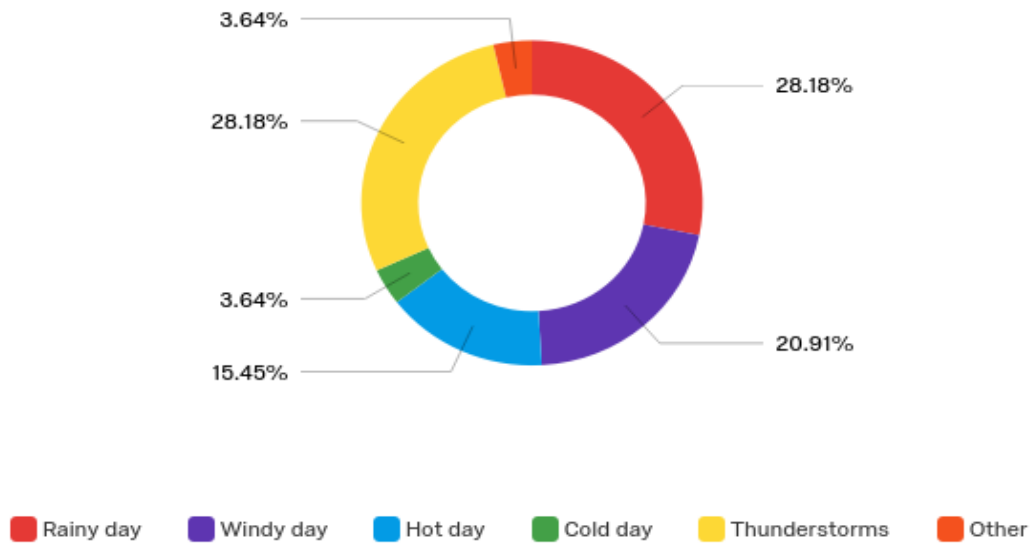

Table1. The number of participants about weather events which is most likely to prevent RMIT students from coming to campus.

#	Answer	Count
1	Rainy day	31
2	Windy day	23
3	Hot day	17
4	Cold day	4
5	Thunderstorms	31

6	Other	4
	Total	110

Table 2. Extreme weather events ranked from most (1) to least (6) impact based on students' perspectives.

#	**Most to least influential weather**	**Percentage**
1	Thunderstorms	30.84%
2	Windy day	19.63%
3	Rainy day	19.63%
4	Hot day	14.02%
5	Cold day	8.41%
6	Other	7.48%

Tabl3. presents the percentage of each extreme weather type via different ranking

#	Question	1		2		3		4		5		6		Total
1	Rainy day	19.63 %	21	29.91 %	32	23.36 %	25	14.02%	15	8.41%	9	4.67%	5	107
2	Windy day	19.63	2	28.97	3	26.17	2	13.0	14	11.21	1	0.93%	1	107

		%	1	%	1	%	8	8%		%	2			
3	Hot day	14.02 %	15	10.28 %	11	17.76 %	19	25.23%	27	24.30 %	26	8.41%	9	107
4	Cold day	8.41%	9	13.08 %	14	14.02 %	15	31.78%	34	29.91 %	32	2.80%	3	107
5	Thunderstorms	30.84 %	33	15.89 %	17	15.89 %	17	14.02%	15	17.76 %	19	5.61%	6	107
6	Other	7.48%	8	1.87%	2	2.80%	3	1.87 %	2	8.41%	9	77.57 %	83	107

3.2 Students' preferred location during extreme weather events

Figure2. Percentage of potential places that students most are likely to spend their times during extreme weather events.

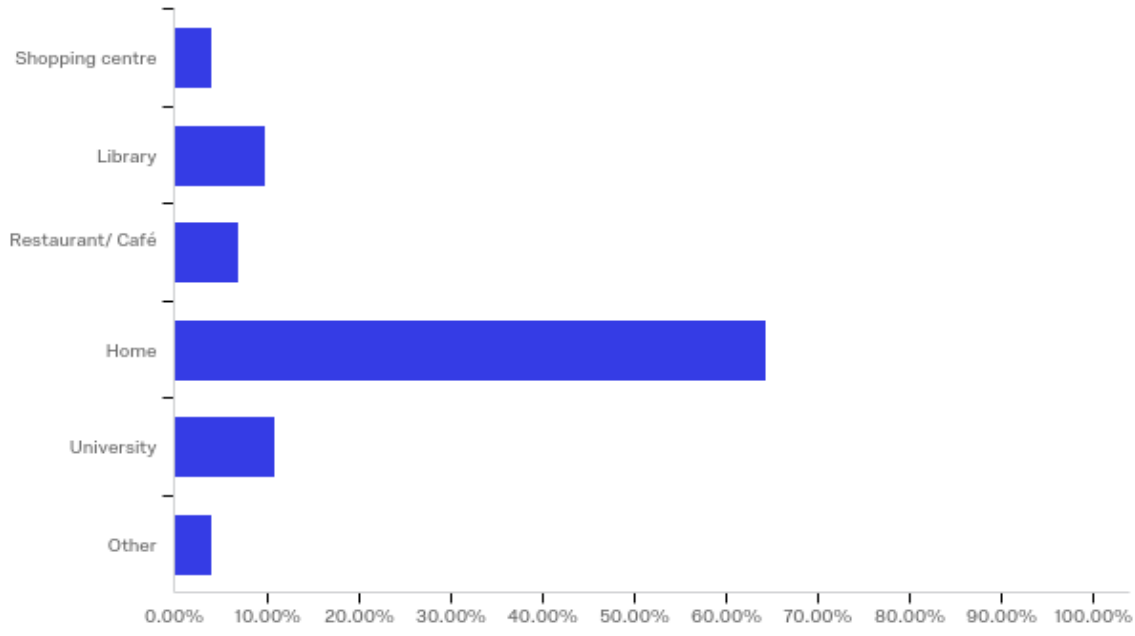

Table4. The potential places that students most likely spend their times during extreme weather events happening.

#	Answer	Count
1	Shopping centre	4
2	Library	10
3	Restaurant/ Café	7
4	Home	65
5	University	11
6	Other	4
	Total	101

3.3 The level of concentrations during school activities and the level of satisfaction towards the services outside while extreme weather events happening

Table 5. Students' responses to different statements based on Likert scale

#	Statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	During "extreme weather events" my ability to concentrate on study/lectures is negatively affected.	34.65%	33.66 %	18.81%	8.91%	3.96%
2	The amount of time I spend undertaking independent study is likely to decrease during "extreme	19.80%	47.52 %	20.79%	7.92%	3.96%

	weather events".					
3	My commute from Home to University will remain the same during "extreme weather events".	25.74%	27.72 %	11.88%	25.74%	8.91%

Table 6. The number of participants about students' responses for different statements based on Likert scale

#	Question	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total
1	During "extreme weather events" my ability to concentrate on study/lectures is negatively affected.	35	34	19	9	4	101
2	The amount of time I spend undertaking independent study is likely to	20	48	21	8	4	101

	decrease during "extreme weather events".						
3	My commute from Home to University will remain the same during "extreme weather events".	26	28	12	26	9	101

5. Discussion

5.1 Review the significant findings

5.1.1 Weather types that limit students' ability to come to RMIT campus

Somewhat surprisingly, RMIT students classified thunderstorms and rainy weather as the most extreme weather conditions that limit their arrival on campus (figure 1). The surprisingly, there is not that they chose the rainy weather, but that they gave an equal percentage of thunderstorms as an effect that limits students from coming to campus. This is indicative of the fact that a large group of university students are aware of how dangerous thunderstorms are as extreme weather event. The questionnaire statistics indicate that out of about 110 participants, 31 participants chose thunderstorms as one of the most extreme weather that may affect students to come to university, and exactly the same number has selected rainy weather (see Table1). There is a logical reason that these types of

extreme weather events are interconnected. Although extreme weather for thunderstorms does not happen much in Victoria, it causes extreme rainy weather (Shem & Shepherd, 2009). Both cause real risks to the community. As an example of the potential risks of thunderstorms are fires that can spread to large areas, which leads to many forest fire? These forests fire are usually accompanied by air pollutants cause respiratory diseases. Thunderstorms produce huge amounts of rain, and the reason is that the strong current of the thunderstorm traps huge amounts of water molecules and then releases them at once (Bowers et al. 2019). Heavy rains also cause damage and disasters, including flooding of rivers and floods in various regions. It also destroys forests and farmland, leading to poor quality crops, and causing significant soil imbalance, leading to disturbance of absorption in the roots, thereby increasing the negative impact on productivity (Stevens et al. 2019). A risk that may be directly related to the students' response is that heavy rains typically limit the movement and activities of students, which also affects public transportation (Stevens et al. 2019).

Twenty-three students of the sample size responded that the wind was increasing the rate of preventing students from coming to campus (Table 1). The reason for this is mainly because the winds cause storms and hurricanes. Hurricanes hit many areas of the country annually, and despite the experience of those areas scientific and practical in dealing with them, they incur in every hurricane significant financial and human losses (Potter, DiMarco & Knap 2019). Cyclones are accompanied by torrential rains, floods, floods, lightning and thunderbolts (Potter, DiMarco & Knap 2019). Cyclones cause waves to rise to the point of sinking ships and destroying property. Another reason is that winds effectively contribute to the spread of dust storms that limit visibility and mobility. This contributes greatly to the fact that students' activities may falter, such as going to university to attend lectures or even riding public transport, which may be adversely affected by dust storms (Middleton, P. Tozer & B. Tozer 2019).

5.1.2 Students' preferred location during extreme weather events

The results of this research project indicate that "Home" is one of the most expected places for students to be present during extreme weather (bar chart). Sixty five out of 101 students responded that the house is the preferred place to stay during extreme weather (Figure 2 & Table 4). There is a possibility that there are two reasons for the sudden change of weather. First, weather can be influenced by natural factors such as changes in volcanic activities, solar radiation, and the movement of the Earth around the sun. In increasing or decreasing extremism. Therefore, it does not reference it as the main factor (Slettebak, 2012). Secondly, it is likely that the reason for the sudden change of

weather, which is sometimes extreme, is that human activities directly contribute to the high proportion of carbon dioxide in the Victoria area, which contributes to the rise of heat, contribute directly and indirectly to the formation of extreme weather (Hennessy et al. 2005).

5.1.3 The level of concentrations during school activities and the level of satisfaction towards the services while extreme weather events happening

An interesting fact is that students are directly affected by extreme weather as it happens while they are doing school activities. The result of this study illustrates that the level of concentration among students is considerably affected, when RMIT students responded the statements that clarify their level of concentration during extreme weather is negatively affected or not. Approximately 69% of students' concentration significantly dropped in a total of 69 out of 101 students (Tables 5 and 6). The most likely reason for this percentage is the high level of tension between students, which is a natural reaction of the human body to the presence of events and external variables in the weather quickly, forcing them to plan ahead for the appropriate reaction after the completion of the lecture, workshops or during self-study. The problem, however, is the inability to adapt properly to those variables that have occurred to the weather while attending lectures, which may cause exaggerated and completely uncontrollable reactions. Consequently, students focus on external influences before encountering them, which may cause them not to focus on lectures.

The results of this research project show that more than half of RMIT students are clearly satisfied with the transportation service during extreme weather in the region. Proof of this is that about 54 out of 101 students responded to full satisfaction with the services available outside to transfer them form home to university during an unexpected weather (Tables 10 and 11). The reason for this probably due to the public transportations, which are the most important features of the civilization of Melbourne, and these means are many and varied as means of transport for long distances between cities and these are represented by high-speed and regular trains. In addition to the means of transport for close distances such as buses, subways and trams. Melbourne's public transport network is widespread, covering cities, villages, suburbs and neighborhoods within cities. Wherever you go, you will find a public transport that will take you to your own destination. However, a group of about 35 students out of 101 were not satisfied and their destination would not be the same during extreme weather (Tables 5 and 6). There is a possibility that some students live in different areas with different characteristics of well-being. Some of the suburbs are clearly affected during extreme weather, such as thunderstorms, heavy rain and strong winds. All of this contributes significantly to forcing students to

change their usual paths from home to university, which may affect their level of concentration during study and academic well-being.

6. Recommendations

6.1 For RMIT University:

Improve indoor air quality

RMIT students do not consider the extreme heat in the summer as a very big problem, because of the high efficiency in the occupied buildings in the university. However, due to the students' use of enclosed spaces in the university may contribute to the low quality of air between buildings. Indoor air pollution is one of the biggest public health risks worldwide due to the increasing number of diseases related-buildings and the spread of harmful bacteria and microbes among people (Tong et al. 2016). Studies have found that the concentration of indoor pollutants is much higher indoors than in open (outdoor) areas, and the ratio is about two to five times and sometimes a hundred times higher than levels in open (outdoor) areas (Barron and Torero 2017). Since most people spend 80% - 90% of their indoor lives, indoor air quality has a significant impact on spreading some diseases (Tong et al. 2016). In order to improve indoor air, it is advisable to use high-efficiency air filters; these filters prevent the movement of volatile organic compounds in the air, dust, spray types and ozone into the enclosed buildings. The use of high-quality filters such as Minimum Efficiency Reporting Value MERV filter has proven to be the most effective in filtering outdoor dust and microbes from increasing inside indoor pollutants (Leavey et al. 2017).

Establish RMIT forecast

Weather forecasts that are designed to notify RMIT students to provide them warning when extreme weather events are happening. This will significantly assist the students to cope with extreme weather types because different weather conditions affect students' daily activities. These conditions are also reflected in a person's health while going out in rainy weather or severe storms. The warnings issued by the university's aerial monitoring process help to prevent students from being obstructed and prepared for various weather conditions. Meteorological warnings contribute to determining the most appropriate way to deal with extreme weather by giving general advice to avoid certain roads that have been severely affected by extreme weather.

Workshops related to extreme weather

It is likely that the workshops will develop students cognitively in terms of increasing awareness among them regarding extreme weather. These workshops make students more resistant to the fact that different types of extreme weather do not cause significant harm to their academic level and attendance on campus. It also contributes significantly to meeting new colleagues with similar interests and goals in identifying new information related to extreme weather. Not only that, it helps students discuss extreme weather events, which helps motivate students to attend other workshops related to this topic with high enthusiasm.

Special consideration

Special consideration is one of the necessary things that the university gives to students in the event of extreme weather in the region, especially during examinations and important practical lessons that contain grades that may affect students. All this effectively contributes to making students more focused and delivering better performance in a period of days that does not contain extreme weather.

6.2 For RMIT to actively encourages students:

- Following safety measures are one of the most important things that can manage the risk of extreme weather events.
- During thunderstorms events try to move immediately to the nearest building, house and other places with a roof for your safety and avoid injury caused by electric charges.
- During thunderstorms, avoid standing under trees that may be prone to combustion, especially moistened trees due to rainfall; this water on the trees represents a route for the passage of electrical currents.
- Avoid using your mobile phone in open areas during thunderstorms, because the phone's electromagnetic waves help to attract lightning strikes, which contributes to the increased rate of electric shock among people.
- Make sure your books and notebooks are stored securely in indoor places, that all educational accessories are safe during heavy rain or strong wind.

- Heavy rains are often associated with lightning and strong wind; try to be safe by staying in your place until these events are significantly mitigated.
- When it is possible, park your car under the hood and delay travel until these extreme events are subsides.
- If you heading to university you fall into a severe storm and you feel it is not safe to drive, look for the cover, then wait until that storm stabilised.
- Do not stand under trees because there is a danger of falling twigs and debris.
- Make sure that you have all the emergency numbers, including friends from university saved on your phone if you get injured and make sure your family is fully informed of what to do and who you are with during extreme weather events are occurring.

7. Conclusion

To conclude, this research project has discussed the impact of extreme weather events due to climate change on RMIT students in terms of their attendance, study progress and well-being. This practical thesis used a binary method to identify the risks of climate change and extreme weather globally by literary readings and relying on basic research to obtain raw information. The questionnaire was used to obtain accurate data from RMIT students with the participation of 100 students. The study showed that extreme weather significantly affects the concentration of students and the average daily hours expected to be spent in self-study. The results explained that rainy weather and thunderstorms are the most harmful types of extreme weather to students' attendance and progress. Extreme heat has not had a significant impact on students, due to the high efficiency of university facilities during the summer. This research recommends the use of high-efficiency filters to improve indoor air quality among students due to the frequent use if enclosed spaces, in addition to the establishment of a special weather bulletin for university students to help them be more resistant in dealing with periods of extreme weather.

Future research should consider a larger sample of participants, at least 350 participants, so to avoid any margin of error. In addition, data collection relating to participants in different seasons of the year, effectively contributes to a more accurate result than that the sample is taken in a given period of the year. Also, it is possible in the future study to utilize down-scaling method to exactly know when and where the extreme weather events will occur the region. Down-scaling method refers to any procedure to infer high-resolution information from low-resolution variables. This technique is based on dynamical or statistical approaches commonly used in several disciplines, especially meteorology,

climatology, remote sensing and GIS. At last, future research on health aspect might extend the explanations of the impact of extreme weather events in terms of students' health. This will be useful in obtaining information covering all possible negative aspects through extreme weather on students. In this research project has been discussed the possible effects on students' attendance on campus and the extent to which their level of education was affected during extreme weather. It's important to obtain further knowledge that related to students' health by professionals in the field.

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Appendices

The letter below illustrates that this study is under supervision of an official authority to obtain reliable results.

RMIT UNIVERSITY

College of Science, Health & Engineering
College Human Ethics Advisory Network (CHEAN)
Email: seh-human-ethics@rmit.edu.au
Tel: [61 3] 9925 4620
Building 91, Level 2, City Campus/Building 215, Level 2, Bundoora West Campus

Notice of Approval

Date:	**16 August 2019**
Project number:	**52-19/22255**
Project title:	**The Impact of Extreme Weather Events due to Climate Change on RMIT Students**
Risk classification:	**Low risk**
Chief investigator:	**Dr Samantha Grover**
Status:	**Approved**
Approval period:	From: **16/08/2019** To: **30/11/2019**

The following documents have been reviewed and approved:

Title	Version	Date
Risk Assessment and Application Form	3	13/08/2019
Participant Information Sheet and Consent Form	3	13/08/2019
Recruitment Material	3	13/08/2019
Research Instrument	3	13/08/2019

The above application has been approved by the RMIT University CHEAN as it meets the requirements of the *National Statement on Ethical Conduct in Human Research* (NHMRC, 2007).

Terms of approval:

1. **Responsibilities of chief investigator**
   It is the responsibility of the above chief investigator to ensure that all other investigators and staff on a project are aware of the terms of approval and to ensure that the project is conducted as approved by CHEAN. Approval is valid only whilst the chief investigator holds a position at RMIT University.
2. **Amendments**
   Approval must be sought from CHEAN to amend any aspect of a project. To apply for an amendment, use the request for amendment form, which is available on the HREC website and submitted to the CHEAN secretary. Amendments must not be implemented without first gaining approval from CHEAN.

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3. **Adverse events**
   You should notify the CHEAN immediately (within 24 hours) of any serious or unanticipated adverse effects of their research on participants, and unforeseen events that might affect the ethical acceptability of the project.

4. **Annual reports**
   Continued approval of this project is dependent on the submission of an annual report. Annual reports must be submitted by the anniversary of approval of the project for each full year of the project. If the project is of less than 12 months duration, then a final report only is required.
5. **Final report**
   A final report must be provided within six months of the end of the project. CHEAN must be notified if the project is discontinued before the expected date of completion.
6. **Monitoring**
   Projects may be subject to an audit or any other form of monitoring by the CHEAN at any time.
7. **Retention and storage of data**
   The investigator is responsible for the storage and retention of original data according to the requirements of the *Australian Code for the Responsible Conduct of Research* (R22) and relevant RMIT policies.
8. **Special conditions of approval**
   Nil.

In any future correspondence please quote the project number and project title above.

Yours faithfully,

Associate Professor Barbara Polus
Chair, Science Engineering & Health
College Human Ethics Advisory Network

Cc Student Investigator/s: Mr Sufian Saleh Almubarak
Other Investigator/s: Dr Belinda Kennedy, Ms Hayley Cordes