UNIVERSITI MALAYA	BAHAGIAN HAL EHWAL PELAJAR *(STUDENT AFFAIRS DIVISION)* REFLEKSI AKTIVITI *(ACTIVITY REFLECTION)* **GKI 1001** **PENYELIDIKAN BEBAS** ***(INDEPENDENT RESEARCH)***

(A) REFLEKSI AKTIVITI
ACTIVITY REFLECTION

Maklumat Laporan bertulis
Information of Written report

Hasil daripada aktiviti kajian harus dijelaskan dalam refleksi ini. Pelajar diharapkan dapat berkongsi hasil penemuan kajian pada minggu 13 dalam laporan bertulis. Pelajar juga adalah diharapkan untuk berfikir tentang hasil, kemahiran yang diperoleh dan sumbangan/kesan/aplikasi dari program/aktiviti penyelidikan yang telah dilaksanakan.

The outcome of the research activities should be described in this reflection. Students are expected to share the result of the research findings in week 13 in a written report. Students are also expected to reflect the outcome, skills acquired and the significant contribution/impact/possible application from the completed research activities/programs.

1. Laporan kajian *(Written Report)*

Laporan kajian adalah termasuklah:
The research report includes:

1. Tajuk kajian *(Research Title)*

Old title: Quantum Leap: Study in Awareness, Understanding and Potential of Quantum Technology in Malaysia

Revised title (if applicable): Quantum Leap: University Malaya Student's Awareness, Perception and Understanding Towards Quantum Technology (QT) and Its Potential in Malaysia

2. Abstrak *(Abstract) – 300 words*

The objective of this study is to determine the level of awareness and understanding of University Malaya (UM) students towards QT. It also investigates the perception of UM students towards QT. Finally, it investigates about UM student's perception towards the potential for QT development within Malaysia.

Method of obtaining data in this study is through surveys using Google Forms. The questionnaire consists of three parts, each investigating the objectives as stated previously. Questionnaires are distributed online through social media like Facebook, Whatsapp and Telegram. In addition, questionnaires were also distributed physically (through QR code) to respondents. The target demography of this study are UM students from the Faculty of Science, Engineering and Computer Science. Respondents are required to sign a consent form before participating. There were 105 respondents in total. Finally, data was analysed using Google Forms and Excel.

The key findings of this study are that for **Section A: Knowledge and Awareness:** majority (i) have heard about QT but do not know much about it, (ii) rated themselves to have little to no knowledge about QT, (iii) are unaware about Quantum 2.0, (iv) know little to no applications of QT due to Quantum 2.0. For **Section B: Perception Towards QT:** majority believe that (i) it will be a significant technology in the future, (ii) it is important for Malaysia to pursue in this decade, (iii) it will have a significant impact on AI, computing and sensors, (iv) it will benefit society in the long run, (v) widespread adoption will take at least 10+ years. For **Section C: Potential of QT in Malaysia:** majority (i) have never heard of local QT initiatives/start-ups, (ii) believe Malaysia is a starter or not yet ready to pursue QT, (iii) agree that pre-university system did very little to increase awareness and expose the quantum field. In this section, students were also (i) Split 50-50 on whether Malaysia should invest in QT, (ii) are evenly spread on methods to expose public to QT. Finally, all students agreed on the methods listed in questionnaire to improve awareness of quantum field to public.

3. Kata kunci/keywords (3 to 6)
Quantum Technology (QT), Awareness, Perception, Understanding, Potential

4. Pengenalan/ *(Introduction) – (500 words)*

In recent years, there has been a global rise in Quantum Technologies (QT) because it is being seen as a **strategic priority** by many nations (Skyrme, 2024). An estimated $55 billion dollars have been invested into this field as of 2024, with even greater investments expected in 2025

(Duranton, 2024). This is because QT, particularly the field of *Quantum Computing* offers several advantages over classical technology such as an exponential speed up in computation, revolutionary data processing in Artificial Intelligence (AI) and Machine Learning (ML). It and also enables complex simulations of climate, materials, chemistry and even drug synthesis (Hassija et al., 2020). There have been reports of early quantum chips performing calculations at extremely high speeds, solving problems which would have taken a classical supercomputer thousands of years to compute (Wang, 2022). In fact, QT is actually a far wider field which includes *Q-Sensing, Q-Cryptography, Q-Communications,* and more (University of Waterloo, n.d.).

Malaysia progress in quantum technologies (QT) has been limited compared to other countries with well-established QT initiatives such as China, USA and Germany. It is only recently, in September 2024, that there has been some form of initiatives in the QT sector proposed by Digital Minister Gobind Singh Deo during a conference (Aimie, 2024). Other than that, the country has had very little investments and interest in this field. To illustrate this, first, there is serious lack of any homegrown quantum-focused startups and research into the field in Malaysia (Dargan, 2024). Second, the country's lack of attention towards the quantum field in NCSP 2006 weakens the country's safeguarding of private information. Third, the country's STEM education system which lacks emphasis on the field of quantum physics (Markus, Sungkim & Ishak, 2021). Thus, the level of awareness and understanding of QT of Malaysians is a question to be asked.

5. Pernyataan masalah/kerangka konseptual/ Persoalan kajian *(Problem statement /hypothesis/conceptual framework Research questions)*

Malaysia's lack of preparation and investment into Quantum Technologies (QT) has resulted in little support, headlines and initiatives from the government regarding QTs. Moreover, Malaysia's outdated education system is such that, it is difficult to teach Secondary School Quantum Physics with the nation's Integrated STEM Education (Markus, Sungkim & Ishak, 2021). Thus, it is no wonder the majority of Malaysians are not aware and do not understand QT despite growing global interests.

In addition, unlike other Asian countries like Japan, Korea, Singapore, Thailand, and Vietnam, there is a serious lack of any homegrown quantum-focused startups and research into the field in Malaysia (Dargan, 2024). The nation lacks professionals and researchers in various QT sectors, especially in the field of quantum computing (Sivanisvarry, 2024). Thus, it is difficult for people interested in the field to see the potential and future prospects of QT in Malaysia as there are no *'clear'* communities or market for it.

6. Matlamat kajian *(Aim of the study)*

The aim of this study is to evaluate the level of awareness, perception and understanding of Quantum Technology (QT) among University of Malaya students from the Faculty of Science, Engineering, and Computer Science. In addition, to discover student's perceived potential of QT to revolutionize Malaysia's technology landscape.

7. Objektif kajian *(Objective(s) of the study)*

i. To determine the level of awareness and understanding of UM students towards QT.
ii. To investigate the perception of UM students towards QT.
iii. To investigate UM student's perception towards the potential for QT development within Malaysia.

8. Kepentingan kajian *(Significance of the study)*

The significance of this study is that it provides an insight to the level of awareness and understanding among University of Malaya students from the Faculty of Science, Engineering, and Computer Science towards Quantum Technology (QT). This information is important because it allows the government to identify gaps and establish strategies to build a well-informed society for QT integration. In addition, this study also discusses the potential of QT in Malaysia's technological sector. Knowing well what QT can provide to Malaysia's technological sector will bolster interest and development on new QT, increase research output, provide more job opportunities within the nation.

9. Kajian literasi /Literature review (1500 words)

Meaning of 'Quantum'

The word quantum originates from the Latin word 'quantus' which means "how much" or "how great". Nowadays, the word is used scientifically to describe objects or phenomena that occurs at microscopic levels (Oxford English Dictionary, n.d.).

First Quantum Revolution

The first quantum revolution began in the early 1900s where key physicists like Albert Einstein, Max Planck, Niels Bohr, and Werner Heisenberg, developed quantum **mechanics (QM),** a successful model which was able to **describe matter interaction**s at the **subatomic level** (*Schweber, 2015).* This breakthrough in our understanding of nature led to many practical applications in all fields that transformed the world as we know it. QM allowed for development of semiconductors, transistors, lasers, magnetic resonance imaging (MRI), atomic clocks, LED, GPS, nuclear power plants, electron microscope, scanning tunnelling microscope and so many more

(*Caltech Science Exchange, n.d.).* However, it is important to note that this first revolution made use of the **foundations** of the theory, but did not fully harness the more exotic properties of quantum systems.

Second Quantum Revolution

The second quantum revolution emerged in the late 20th century and continues today. Unlike first revolution, this revolution is focused on harnessing the more **exotic properties** of **superposition** and **entanglement** *(Jaeger, 2018)*. Quantum technologies (QT) of this class can exceed the limitations of existing classical technologies in areas of computing, cryptography and sensing to name a few (Campbell, Thomas, 2023). The potential this second revolution holds has fuelled global interest and investments from private companies and governments alike. In 2024, a total $55 billion has been invested by companies like Google, Microsoft, IBM and governments, led by China, USA and Germany (Duranton, 2024). In fact, UNESCO has even announced 2025 to be 'International Year of Quantum Science and Technology' which will further global efforts in this field (*International Year of Quantum Science and Technology*, n.d.).

Malaysia's Lagging Quantum Field

Malaysia was **successful in adapting** to the **first quantum revolution** integrating technologies such as semiconductors, lasers, and MRI into various sectors. In fact, Malaysia is a key player in the semiconductor industry, supplying up to 13% of global semiconductor demands and with plans to further increase production (*Liew,* 2020). In contrast, Malaysia has been **slower to adapt** to the **second quantum revolution**. In 2022, a survey done by the Canadian Institute for Advanced Research found that 46 countries have taken a systematic approach to funding QT—Malaysia was not among them (*Rais Hussin,* 2024). Even Malaysia's research into QT appears to have dried up over the years, despite at once time having significant contribution to the quantum communications field was well-recognised by the international community (*Rais Hussin,* 2024). Hence, it is important to have a gauge on Malaysian citizens awareness and understanding on QT and also explore the potential of QT in Malaysia's technological sector for when QT inevitably arrives.

10. Metodologi/*(Methodology)*

10.1. Experimental Design

Quantitative method via distribution of surveys will be used in this study. A standardized online questionnaire will be distributed to respondents of the survey, which contain questions that test the level of awareness and understanding respondents have on Quantum Technologies (QT) during the *Quantum Revolution 1 (QR 1) and Quantum Revolution 2 (QR 2).*

10.2. Population Size

Simple random sampling will be used in this study. The population of this study will be students from the Faculty of Science, Engineering and Computer Science. The target sample size is 100 students.

10.3. Instrumentation for Data Collection

Online questionnaires will be made using 'Google Forms'. The first section will include simple questions related to QR 1 and QR 2, to gauge respondent level of awareness and understanding. The second section will include questions to obtain respondents opinion(s)/perception towards QT. The final section requires respondents to give their evaluation regarding QT's potential in Malaysia. The questionnaires will be distributed via email and social media such as Facebook, Instagram, Whatsapp, Telegram and more.

10.4. Data Analysis Techniques

The data collected will be analysed using suitable statistical tools such as Excel and Google Docs.

10.5. Ethical & Confidentiality issues (if applicable)

- Not applicable

10.6. Consent required

Interviewee will be asked for consent in participating in the survey at the start of the questionnaire. They are required to tick a check mark in order to confirm their participation in the survey.

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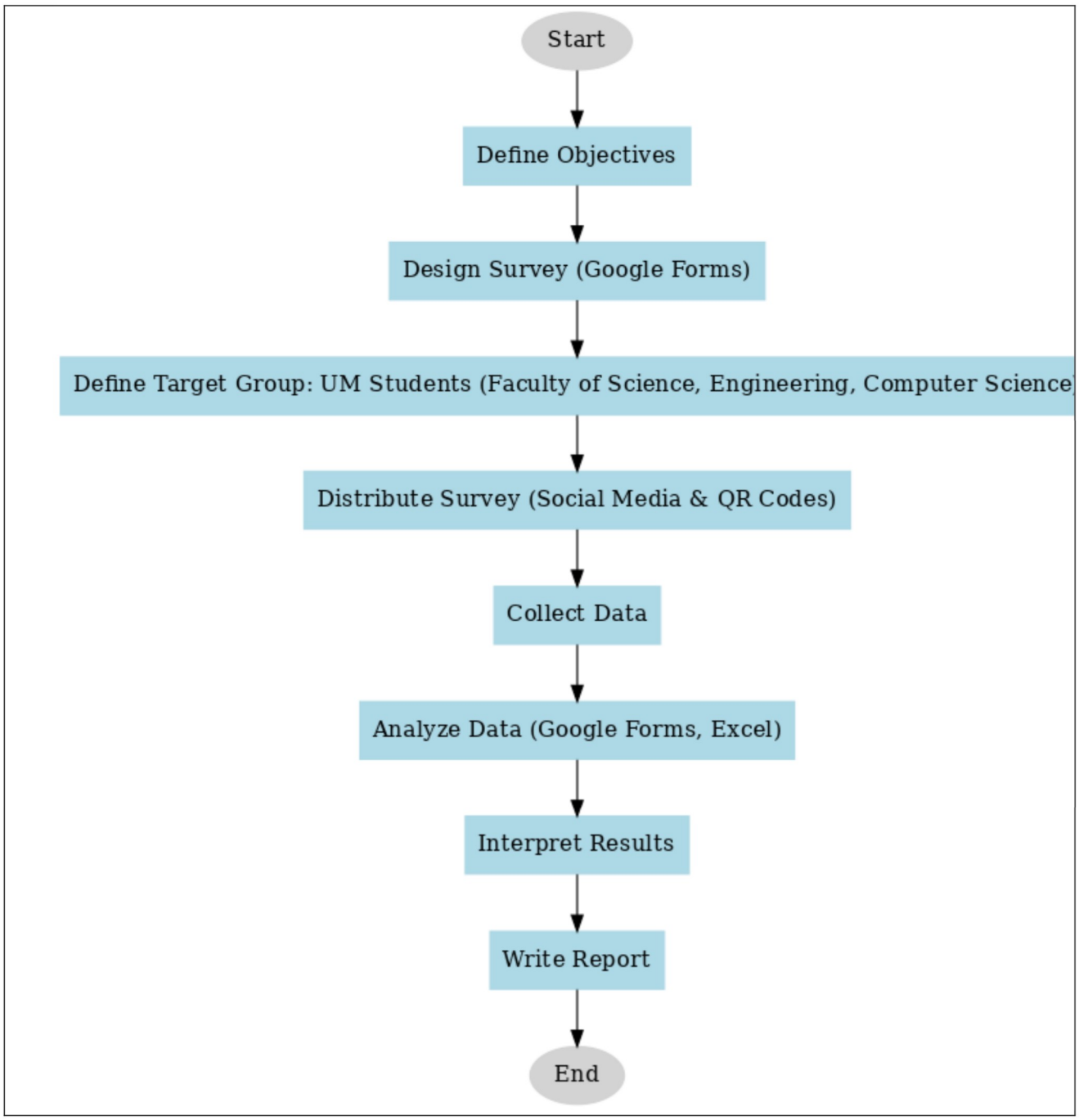

11. Penemuan & Perbincangan *(Findings & Discussion)*

Consent Form

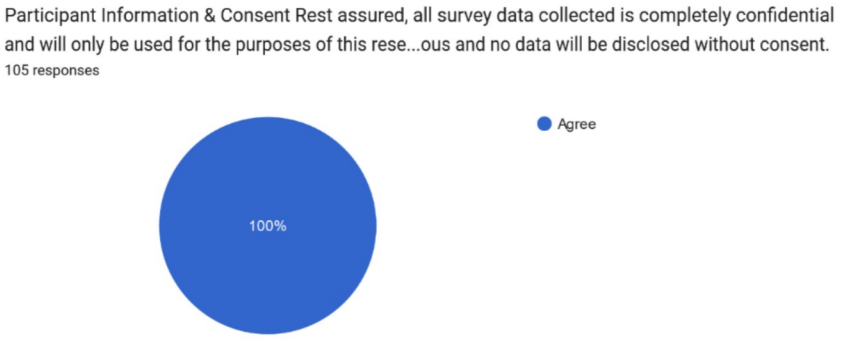

Diagram: Consent Form

Data shows a total of 105 respondents, all of whom agreed to participate in this survey.

Section O: Demography

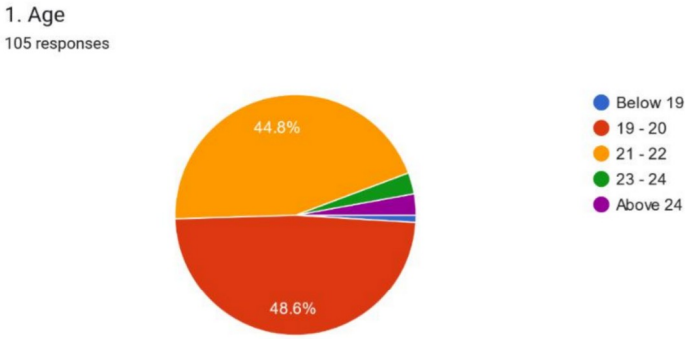

Diagram O.1: Respondent Age

From the pie chart, majority (48.6%) or 51 respondents are between **19-20** years old followed by 44.8% or 47 whom are **21-22** years old. The remaining 6.6% are spread between ages below 19, 23-24 and above 24 years old. Interestingly, there is 1 respondent who is **below 19**, meaning he/she entered university early. Meanwhile, there are equal number of respondents who **23-34** years old and **above 24** years old, that is 3 respondents (2.9%). Respondents above 24 years old are most likely postgraduates.

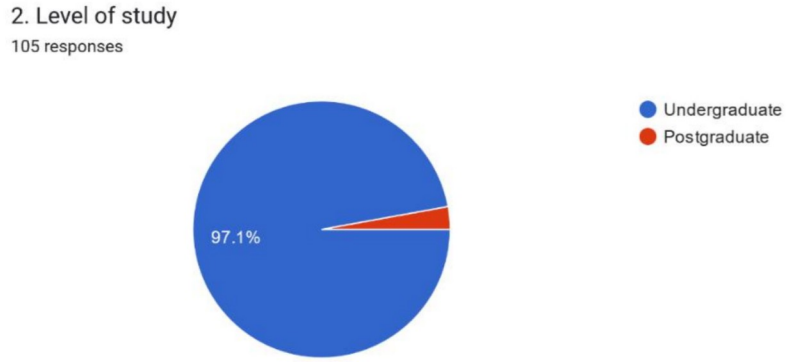

Diagram O.2: Respondent Level of Study

From the pie chart, majority (97.1%) or 102 respondents are **undergraduates** while 2.9% or 3 respondents are **postgraduates**. This aligns with the prediction previously regarding postgraduates and age.

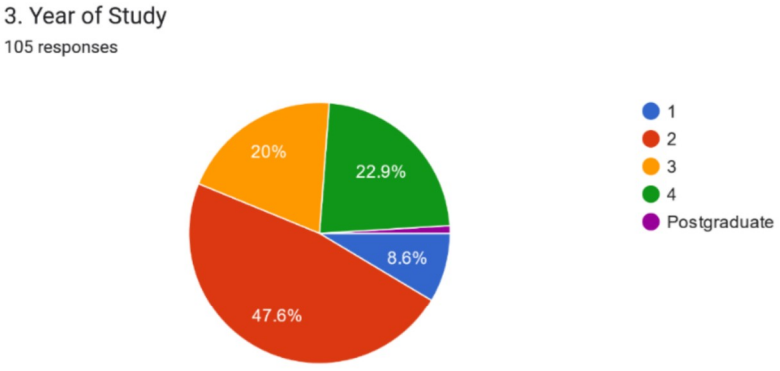

Diagram O.3: Respondent Year of Study

From the pie chart, majority (47.6%) or 50 respondents are **Year 2 Undergraduates,** followed by 22.9% or 24 respondents who are **Year 4 Undergraduates**. Next are the **Year 3 Undergraduates** with 20.0% or 21 respondents followed by **Year 1 Undergraduates** with 8.6% or 9 respondents. Finally, minority of respondents are the **Postgraduates** with only 2.9% or 3 respondents.

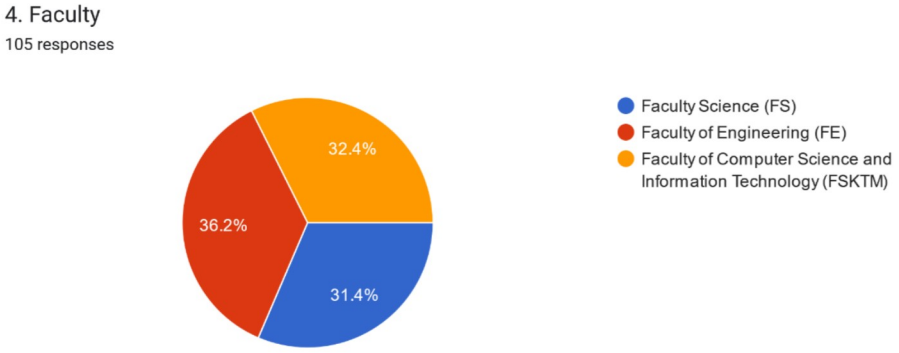

Diagram O.4: Respondent Faculty

From the pie chart, all respondents are from either one of the following 3 faculties; that is Faculty of Science (FS), Faculty of Engineering (FE) and Faculty of Computer Science and Information Technology (FSKTM). The distribution of respondents is *roughly equa*l between the 3 faculties. Majority (36.2%) or 38 respondents are from **FE**, followed by 32.4% or 34 respondents from **FSKTM** and the minority (31.4%) or 33 respondents from **FS.**

Section A: Knowledge and Awareness

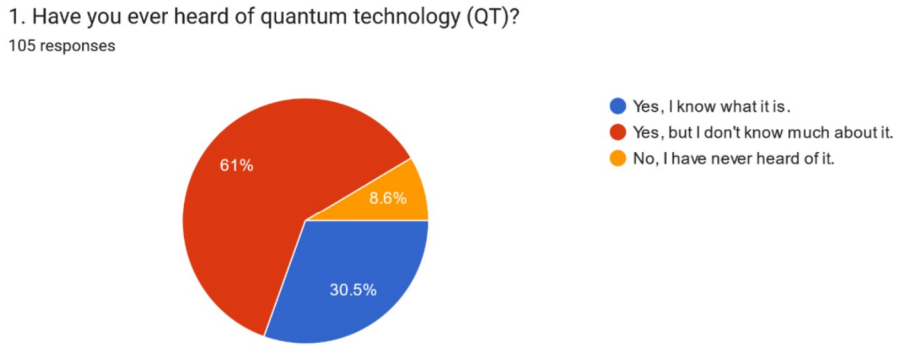

Diagram A.1: Have respondents heard about QT

From the pie chart, majority (61.0%) or 64 respondents **have heard but do not know much** about quantum technology (QT) This is followed by 30.5% or 32 respondents who **have heard and know** about QT. Finally, minority (8.6%) or 9 respondents have **never heard** about QT.

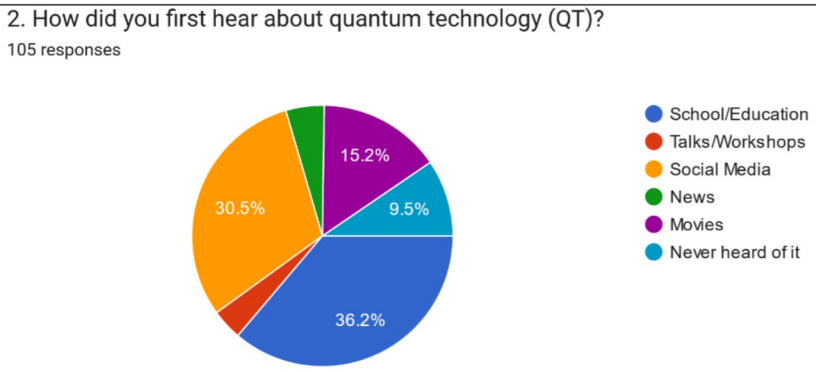

Diagram A.2: How did respondents first hear about QT

From the pie chart, majority (36.2%) or 38 respondents first heard about quantum technology (QT) from **school/education**. This is followed by 30.5% or 32 respondents who heard about QT through **social media**, likely through platforms such as Youtube, Facebook, Instagram and more. Next, followed by **movies** that is 15.2% or 16 respondents, likely from movies such as Interstellar and Ant-Man: Quantum Mania. Next, surprisingly 9.5% or 10 respondents have **never heard** of QT before. Finally, the minorities are through **news** and **talk/workshops,** with 4.8% or 5 respondents and 3.8% or 4 respondents respectively.

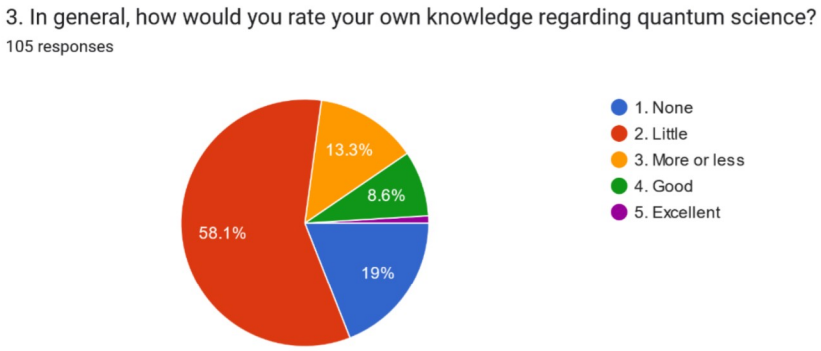

Diagram A.3: Respondents rate their own knowledge regarding quantum science

From the pie chart, majority (58.1%) or 61 respondents perceive that they have **little knowledge** regarding quantum science. This is surprisingly followed by 19.0% or 20 respondents who feel that they have **no knowledge at all** about quantum science. Next, followed by 13.3% or 14 respondents who have **more or less knowledge** about quantum science and 8.6% or 9 respondents who have **good knowledge** about quantum science. Finally, minority (1.0%) or 1 respondent has **excellent knowledge** on quantum science. Overall, majority of respondents (77.1%) rated themselves to have little to no knowledge regarding quantum science.

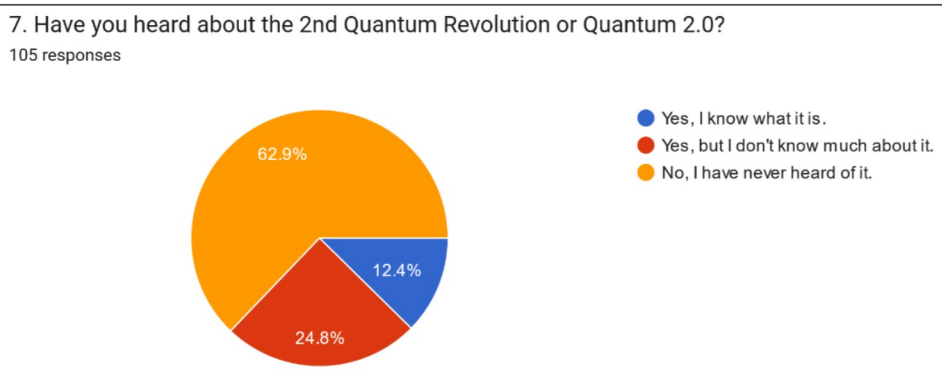

Diagram A.4: Have respondents ever heard about the 2nd Quantum Revolution/Quantum 2.0

From the pie chart, majority (62.9%) or 66 respondents have **never heard** about the 2st Quantum Revolution or Quantum 2.0. This is followed by 24.8% or 26 respondents who **have heard but do not know much** about Quantum 2.0. Finally, minority (12.4%) or 13 respondents **have heard and know well about** Quantum 2.0.

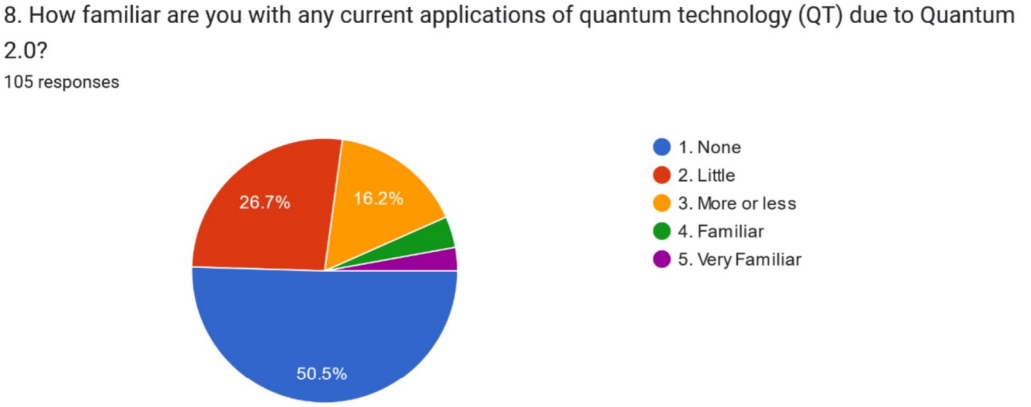

Diagram A.5: Are respondents familiar with any current application of QT due to Quantum 2.0

From the pie chart, surprisingly half (50.5%) or 53 respondents have **no familiarity** on any current applications of quantum technology (QT) due to Quantum 2.0. This is followed by 26.7% or 28 respondents and 16.2% or 17 respondents, who have **little familiarity** and **more or less familiarity** respectively. Finally, followed by 3.8% or 4 respondents and 2.9% or 3 respondents that are **familiar** and **very familiar** respectively. Overall, it is noticed that the majority of respondents (77.1%) have little to no knowledge regrading QT due to Quantum 2.0, while minority (6.7%) are familiar or very familiar with QT due to Quantum 2.0.

Section B: Perception on Quantum Technology (QT)

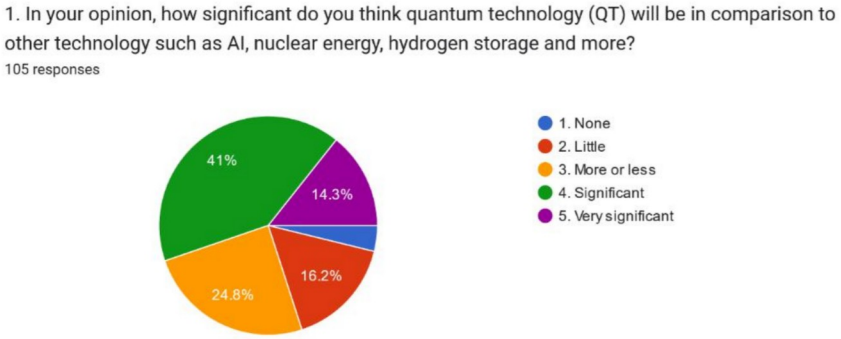

Diagram B.1: Respondents opinion about significance of QT compared to other technologies

From the pie chart, interestingly majority (41%) or 43 respondents believe that quantum technology (QT) will be a **significant technology** in comparison to others such as AI, nuclear energy, hydrogen storage and more. This is followed by 24.8% or 26 respondents and 16.2% or 17 respondents who believe that QT will **be more of less significant**, and have **little significance** in comparison to other technology respectively. Meanwhile, 14.3% or 15 respondents believe that QT will be a **very significant** technology in the future. Finally, surprisingly, 2.7% or 4 respondents think that QT will have **no impact** as a future technology. Overall, more than half of the respondents (55.3%) believe that QT will be a significant technology in the future. Meanwhile, roughly a fifth of respondents (18.9%) believe QT have little or no impact on future technology.

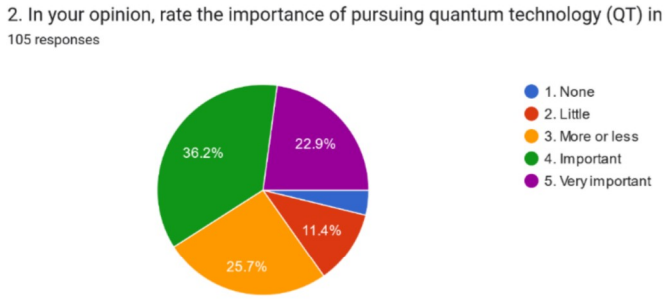

Diagram B.2: Respondents opinion about importance of pursuing QT in this decade

From the pie chart, majority (36.2%) or 38 respondents believe that it is **important** to pursue quantum technology (QT) in this decade. Following that, 27 respondents or 25.7% who believe it is **more or less** important. Next, 24 respondents or 22.9% believe it is **very important** to pursue QT in this decade. This is followed by 12 respondents or 11.4% who believe it is of **little importance**. Finally, 4 respondents or 3.8% believe it is **not important** to pursue QT this decade. Overall, more than half of the respondents (59.1%) believe it is important to pursue QT this decade. Meanwhile, 15.2% of respondents believe it is of little to no importance to pursue QT this decade.

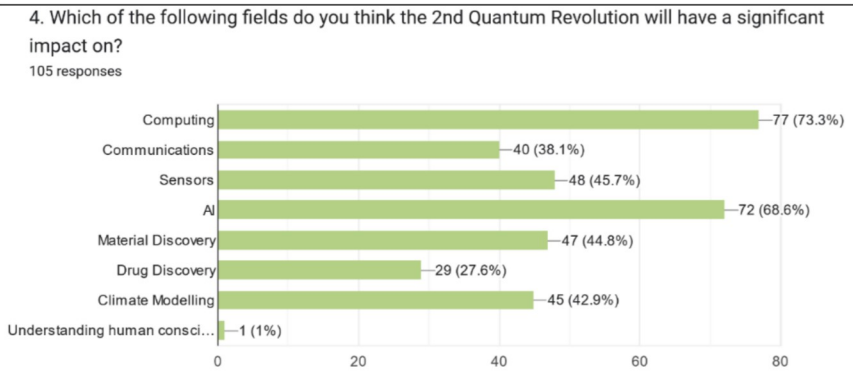

Diagram B.3: Respondents opinion on fields Quantum 2.0 will have a significant impact on

From the bar graph, majority (73.3%) or 77 respondents believe that Quantum 2.0 will have an impact on **computing**, which is followed closely by **AI** with 68.6% or 72 respondents. Following this, 45.7% or 48 respondents believe that **sensor technology**, followed by 44.8% or 47 respondents in the field of **material discovery** and 42.9% or 45 respondents in **climate modelling** respectively. Meanwhile, 38.1% or 40 respondents and 27.6% or 29 respondents believe **communications** and **drug discovery** sectors respectively. Interestingly, there was one respondent who believe that Quantum 2.0 will **enable a deeper understanding of human consciousness**. Overall, three quarters $^{3}/_{4}$ of respondents $(\sim 70\%)$ believe that Quantum 2.0 will have a significant impact on computing and AI, whereas about half $^{1}/_{2}$ the respondents $\sim(40-46)\%$ believe in sensors, material discovery and climate modelling.

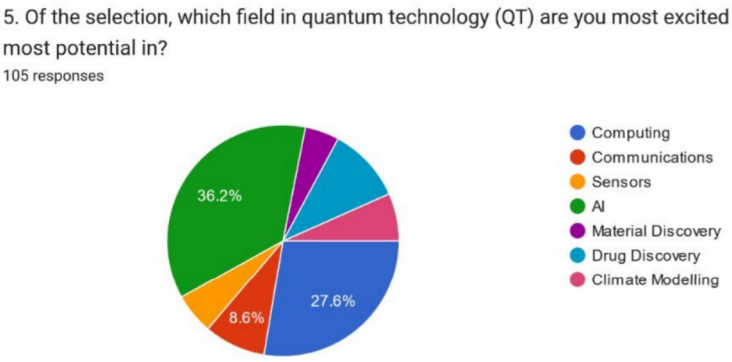

Diagram B.4: QT fields respondents most excited about/see most potential in

From the pie chart, it is noticed that there are two main field in quantum technology (QT) that respondents see most potential it. The first is **AI** with majority (36.2%) or 38 respondents. This is followed by 27.6% or 29 respondents who see the most potential in **computing**. The next significant field respondents see most potential is **drug discovery** with 10.5% or 11 respondents. From here, the remaining fields have less than 10 respondents and are roughly even distributed. The first field is **communications** with 9 or 8.6% respondents, followed by **climate modelling** with 7 or 6.7%, followed by **sensors** 6 or 5.7% and finally the minority is 5 respondent 4.8%. It is noticed that there are 2 fields that respondents see the most potential is, that is AI and computing. Meanwhile, the are 4 fields that have less than 10% which is communications, climate modelling, sensors and material discovery.

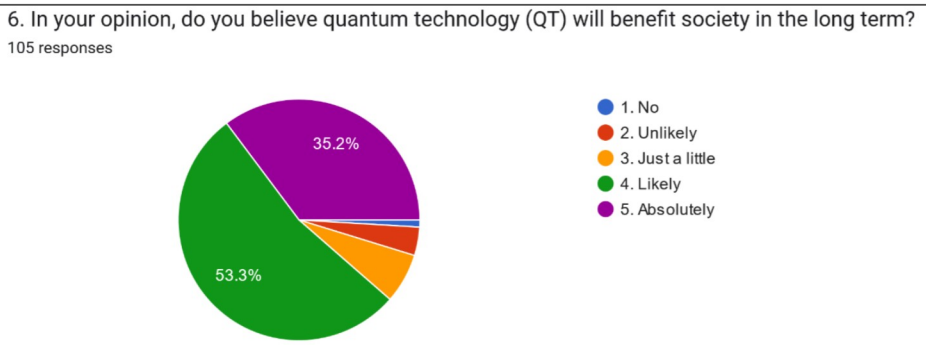

Diagram B.5: Respondent opinion on how QT will benefit society in the long term

From the pie chart, majority (53.3%) or 56 respondents believe that quantum technology (QT) are **likely** to benefit society in the long term. This is followed by 37 respondents or 35.2% who believe QT will **absolutely** benefit society. The rest of the categories have less than 10% of respondents. The first is 7 respondents or 6.7% believe that QT will benefit **just a little**, followed by 4 respondents or 3.8% who believe it is **unlikely**, and surprisingly only 1 respondent or 1.0% believe that QT will **not benefit** society in the long term. Overall, most respondents ~88.5% believe that QT will likely and absolutely benefit society. Surprisingly, only 1 respondent believe QT will not benefit society in the long term.

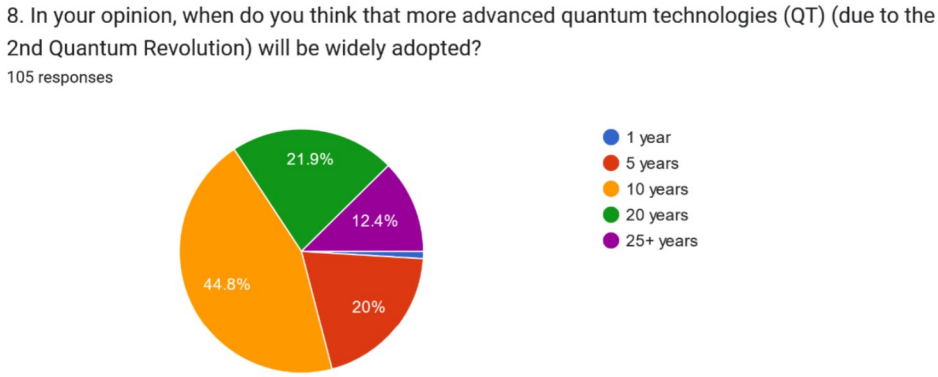

Diagram B.6: Respondents opinion on when advanced QT (Quantum 2.0) will be widely adopted

From the pie chart, majority (44.8%) or 47 respondents believe that advanced quantum technologies (QT) due to Quantum 2.0 will be widely adopted in **10 years**. This is followed by 23 respondents or 21.9% and 21 respondents or 20.0% who believe advanced QT due to Quantum 2.0 will be widely adopted in **20 years** and **5 years** respectively. It is noticed that between these two years, the percentage of respondents are distributed almost equally. Following this, 13 respondents or 12.4% believe that advanced QT due to Quantum 2.0 will be widely adopted in **25+ years**. Surprisingly, there was 1 respondent or 1.0% who believe that QT will be widely adopted in **1 year**. Overall, most respondents ~79.1% believe that advanced QT due to Quantum 2.0 will be widely adopted at least 10+ years in the future.

Section C: Quantum and Malaysia

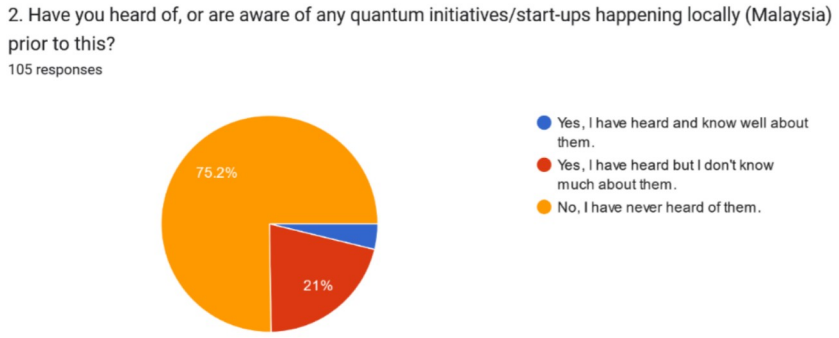

Diagram C.1: Have respondents heard about local (Malaysia) quantum initiatives/start-ups

From the pie chart, it was found that majority (75.2%) or 61 respondents have **never heard** of quantum initiatives/start-ups happening in Malaysia. This is about three quarters $^{3}/_{4}$ of all respondents. This is followed by 22 respondents or 21.0% who have **heard but don't know much** about quantum initiatives/start-ups in Malaysia. Finally, minority (3.8%) or 4 respondents **have heard and know well** about quantum initiatives/start-ups in Malaysia. Overall, three quarters $^{3}/_{4}$ of respondents have never heard about quantum initiatives/startups in Malaysia in contrast to the quarter $^{1}/_{4}$ who have heard.

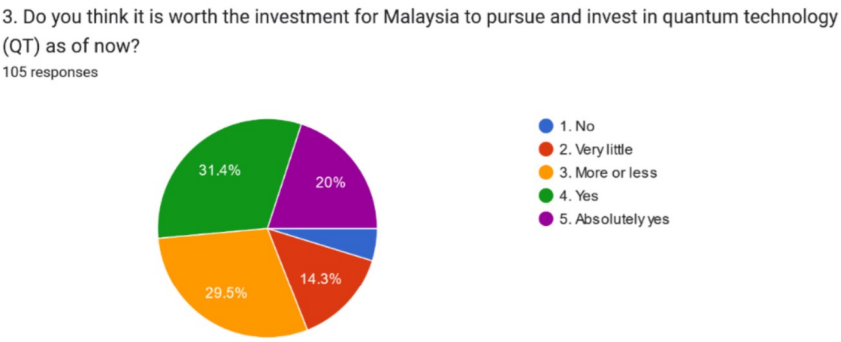

Diagram C.2: Respondents opinion on whether it is worth for Malaysia to pursue and invest in QT

From the pie chart, it is found that majority (31.4%) or 33 respondents believe that **it is worth** the investment for Malaysia to pursue and invest in quantum technology (QT) as of now. This is followed by 31 respondents or 29.5% who believe Malaysia should **more of less invest**. Next, 21 respondents or 20.0% believe Malaysia should **absolutely invest**. This is followed by 15 respondents or 14.3% who believe Malaysia should pursue and **invest very little**. Finally, surprisingly 5 respondents or 4.8% believe Malaysia should **not pursue and invest** in QT as of now. Overall, from the pie chart, we can see that it is split about $50 - 50$ between respondents who believe moderately and strongly that Malaysia is pursue and invest in QT as of now while the other believe more or less to no investment should be made.

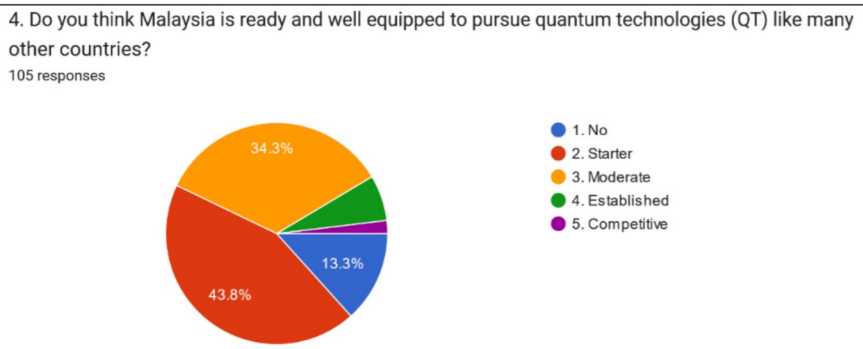

Diagram C.3: Respondents opinion on whether Malaysia is ready and well-equipped to pursue QT

From the pie chart, majority (43.8%) or 46 respondents believe Malaysia is only at **starter level** in readiness and 'well-equipped' to pursue quantum technologies (QT). This is followed by 36 respondents or 34.3% who believe Malaysia is **moderately** ready and equipped to pursue QT. Next, 14 respondents or 13.3% believe Malaysia is **not ready** or equipped to pursue QT. Following this, interestingly 7 respondents or 6.7% believe Malaysia is **established** and well-equipped to pursue QT. Finally, surprisingly, 2 respondents or 1.9% believe Malaysia is **competitive** and well-equipped to pursue QT. Overall, majority (57.1%) of respondents believe Malaysia is starter or is not ready to pursue.

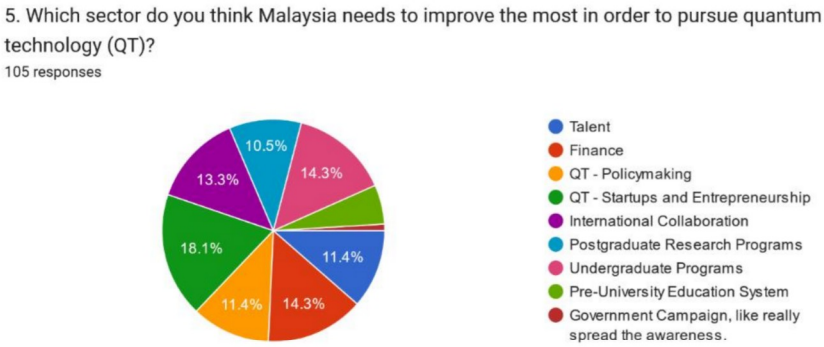

Diagram C.4: Respondents opinion on the most important sector to improve in order to pursue QT

From pie chart, it is noticed that respondents are about equally divided on what Malaysia needs to improve the most in order to pursue quantum technologies (QT), with a minority outlier (1 respondent or 1%) in **Government Campaigns**. Majority (18.1%) or 19 respondents believe that **QT – Startups** and **Entrepreneurship** is most vital to improve in order to pursue QT. This is followed by improving **Finance** and **Undergraduate Programs**, both with 15 respondents or 14.3%. Next, 14 respondents or 13.3% believe Malaysia should improve **International Collaboration** in order to pursue QT. This is followed by improving **QT – Policymakin**g and **Talent**, both with 12 respondents or 11.4%. Next, 11 respondents or (10.5%) believe improving **Postgraduate Research Programs** is most important for Malaysia to pursue QT. Finally, 6 respondents or 5.7% believe improving **Pre-University Education System** is most important for Malaysia to pursue QT. Overall, respondents are divided about evenly on all aspects to improve for Malaysia to pursue QT.

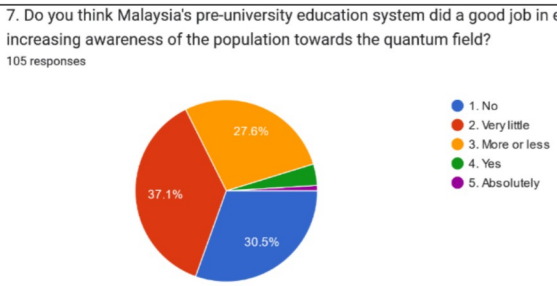

Diagram C.5: Respondents opinion on whether Malaysia's pre-university system did a good job exposing and increasing awareness of the population towards the quantum field

From the pie chart, majority (37.1%) or 39 respondents believe Malaysia's pre-university education system did **very little** to expose and increase awareness of the population towards the quantum field. This is followed by 32 respondents or 30.5% who believe did they **did not at all**. Next, 29 or 27.6% of respondents believe they did **more or less** in exposing and increasing awareness towards quantum field. This is followed by 4 respondents or 3.8% who believe they did a **good job** in exposing and increasing awareness towards the quantum field. Surprisingly, 1 respondent or 1.0% believe they done an **absolutely good job** in exposing and increasing awareness towards the quantum field. Overall, it is clear that majority of respondents (64.7%) think that Malaysia's pre-university system did very little to no effort well in exposing and increasing awareness towards quantum field. In addition, less than 5% of respondents think that Malaysia's pre-university system did good and absolutely well.

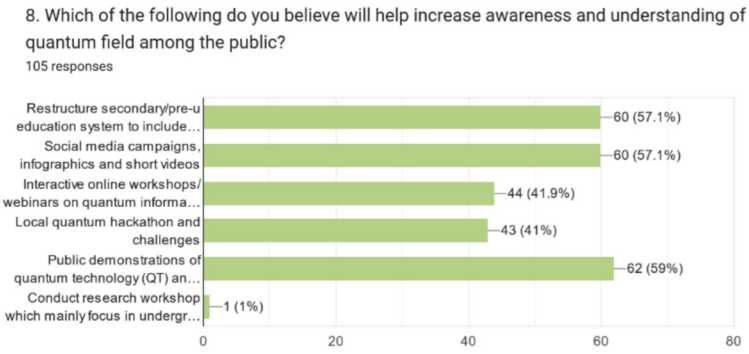

Diagram C.6: Respondents opinion on efforts which will increase awareness and understanding of quantum field among the public

From the bar graph, majority (59.0%) or 62 respondents agree that **Public Demonstration of Quantum Technology (QT) and it's Applications** is a good method to increase awareness and understanding of the quantum field among the public. This is followed by **Restructuring Secondary/Pre-U Education System to Include More Extensive Topics in Quantum Science** and **Social Media Campaigns, Infographics and Short Videos**, both with 60 respondents or 57.1%. Next, almost the same number of respondents agree that **Interactive Online Workshops/Webinars on Quantum Information Science and Local Quantum Hackathon and Challenges** with 44 respondents (41.9%) and 43 respondents (41.0%) respectively. Interestingly, one respondent suggested **Conducting Research Workshops which Mainly Focus on Undergraduate and Postgraduate**. Overall, most respondents agree that Public Demonstration of Quantum Technology (QT) and it's Applications, Restructuring Secondary/Pre-U Education System to Include More Extensive Topics in Quantum Science and Social Media Campaigns, Infographics and Short Videos (all $> 55\%$) are good methods to increase awareness and understanding of the quantum field among the public.

Discussion

Level of awareness and understanding towards QT

The majority of UM students (61.0%) from Faculty of Science, Engineering and Computer Science have heard about QT but do not know much about it. Following this, majority (36.2%) first head about QT through school/education. Next, majority (77.1%) rated themselves to have little to no knowledge about QT. Next, majority (62.9%) have not heard about the 2nd Quantum Revelation/Quantum 2.0. Following that, majority (77.2%) know little to no applications of QT due to Quantum 2.0.

The findings indicate most UM students have heard about QT, but they have relatively low level of awareness and understanding of QT. This is evident from the result that majority do have not heard about Quantum 2.0 and even more so the applications of QT due to Quantum 2.0. This gap in knowledge and understanding is likely due to the lack of government policies and initiatives to build a 'quantum' ecosystem within the country alongside the lack of educational emphasis towards the quantum field in Malaysia's education system (Stadermann et al., 2019).

Perception Towards QT

More than half of UM students (55.3%) believe that QT will be a significant technology in the future. Next, more than half the students (59.1%) believe it is important to for Malaysia to pursue QT in this decade. Next, students perceive the following field will be significantly impacted by QT in descending order: computing, AI, sensors, material discover, climate modelling, communications and drug discovery. Following that, majority believe QT (AI) are most excited about/see most potential in. Next, an overwhelming majority (88.5%) believe QT will benefit society in the long run. Finally, majority believe that in 10 years, QT due to Quantum 2.0 will be widely adopted.

Overall, despite limited understanding regarding QT, UM students demonstrate optimism about the potential of QT. Over half the students recognize QT as a significant technology for the future, and believe it is crucial for Malaysia to actively pursue QT this decade. Furthermore, the overwhelming number (88.5%) believe that QT will benefit society in the long term, which reflects a generally positive outlook on the technology. However, this optimism contrasts with their self-reported lack of knowledge, indicating that general enthusiasm for technological progress may influence perceptions more than specific understanding (optimism bias) (the Decision lab, n.d.). indicates an appreciation of the transformative potential of QT, even if its nuances remain unclear to most.

Potential of QT in Malaysia

About three quarters of UM students (75.2%) have never heard about quantum initiatives in Malaysia. Next, students were split about 50-50 with the opinion that, it is worth and not worth for Malaysia to pursue and invest in QT. Following that, more than half (57.1%) believe that Malaysia is a starter or

not yet ready to pursue QT. Next, students were spread pretty much evenly on all the sector most vital to improve in order for Malaysia to pursue QT. Next, majority (64.7%) think that Malaysia's pre-university system did very little to no effort in exposing the quantum field to the public. Finally, students agreed on all the methods listed in the questionnaire to improve awareness of quantum field to the public.

The data highlights that Malaysia still has a long way to go before being a competitive player in QT. This is evident by the fact that three quarters of students were unaware of any local quantum initiatives/startups. Moreover, the split opinion (50-50) on whether Malaysia should invest in QT suggests scepticism/worry about the country's readiness and resources to pursue QT as of now. Furthermore, this is backed by the perception by more than half the students that Malaysia is a still a "starter" or "not yet ready" in QT. This sentiment may stem from the relatively slow development of infrastructure and research capabilities in QT compared to leading nations (Aziz & Aziz, 2022). Finally, students agreed on all the methods proposed to improve knowledge and awareness towards the quantum field, that is; workshops, public lectures, and media campaigns. This could serve as a foundation for collaborative efforts to promote QT at both institutional and national levels.

12. Kesimpulan *(Conclusion)*

1. **Level of awareness and understanding towards QT**
   Overall, the majority of UM students (61.0%) from Faculty of Science, Engineering and Computer Science have heard about QT but do not know much about it. Following this, majority (36.2%) first head about QT through school/education. Next, majority (77.1%) rated themselves to have little to no knowledge about QT. Next, majority (62.9%) have not heard about the 2nd Quantum Revelation/Quantum 2.0. Following that, majority (77.2%) know little to no applications of QT due to Quantum 2.0.

2. **Perception towards QT**
   Overall, the more than half of UM students (55.3%) believe that QT will be a significant technology in the future. Next, more than half the students (59.1%) believe it is important to for Malaysia to pursue QT in this decade. Next, students perceive the following field will be significantly impacted by QT in descending order: computing, AI, sensors, material discover, climate modelling, communications and drug discovery. Following that, majority believe QT (AI) are most excited about/see most potential in. Next, an overwhelming majority (88.5%) believe QT will benefit society in the long run. Finally, majority believe that in 10 years, QT due to Quantum 2.0 will be widely adopted.

3. Potential of QT in Malaysia

Overall, about three quarters of UM students (75.2%) have never heard about quantum initiatives in Malaysia. Next, students were split about $50-50$ with the opinion that, it is worth and not worth for Malaysia to pursue and invest in QT. Following that, more than half (57.1%) believe that Malaysia is a starter or not yet ready to pursue QT. Next, students were spread pretty much evenly on all the sector most vital to improve in order for Malaysia to pursue QT. Next, majority (64.7%) think that Malaysia's pre-university system did very little to no effort in exposing the quantum field to the public. Finally, students agreed on all the methods listed in the questionnaire to improve awareness of quantum field to the public.

13. Batasan dan cadangan untuk penyelidikan masa depan *(Limitations and suggestion for future research)*

Limitations

1. Sample size
   The research had a small sample size of 100 respondents. This is not really a good enough to represent all of UM's students from Faculty Science, Engineering and Computer Science.

2. Data gathering instruments
   Only one method was used to gather data, that is by using Google Forms (quantitative). Actually, an interview with professors and industry experts was planned, however due to time constraints had to be scrapped.

3. Lack questions to accurately determine level of understanding of respondents
   Level of understanding is based on respondents own personal view about themselves. There were no questions explicitly testing the respondent about a concept in quantum. Thus, *Dunning-Kruger* effect (Duignan, 2021) may affect the result.

Suggestions

1. Increase sample size
   By increasing sample size, a clearer picture of the population can be obtained.

2. Method of approach
   Add qualitative interviews with respondents to get a better understanding of what they perceive QT to be. Also, have interviews professors and industry experts to provide deeper insights to the potential of QT in Malaysia.

3. Add additional questions to determine level of understanding of respondents
   Add a few simple 'general' questions about quantum mechanics concept or QT to test the respondent true knowledge on the subject.

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15. Lampiran *(Appendices)*

Appendix A: Turnitin First Page

Appendix B: Questionnaire and Survey Data (link)
https://docs.google.com/forms/d/17TXHw0GNxZPZECX3iOKcUQMMmeAdptBeYtfvgQywzPY/edit

Appendix C:
https://docs.google.com/spreadsheets/d/1AFmo07Kv0da3p_qj01LnKy0FeiFWY_o7_CuKB3YRj0o/edit?gid=1558386699#gid=1558386699

2. Pembentangan melalui video selama 3-5 minit
Research Report Presentation and 3-5 min video presentation

Pada akhir kursus ini, setiap pelajar dijangka menghasilkan:
By the end of this course, each student is expected to produce:

- **Persembahan video selama 3-5 minit, di mana pelajar membentangkan ringkasan penemuan utama kajian**
  A 3-5-minute video presentation, wherein the student presents a summary of the research's key findings

Link for the video: https://youtu.be/CceWGQCU3hc

3. Kemahiran dan kecekapan yang diperoleh daripada aktiviti-aktiviti penyelidikan yang telah dilaksanakan
Skills and competencies acquired from the completed research activities

Kenalpasti kemahiran dan kecekapan anda yang diperolehi selepas menjalankan aktiviti penyelidikan. Nilaikan tahap penguasaan berdasarkan kepada skala mengikut sebelum dan selepas pelaksanaan aktiviti-aktiviti penyelidikan. Contoh kemahiran dan kecekapan adalah seperti kemahiran membaca, kemahiran

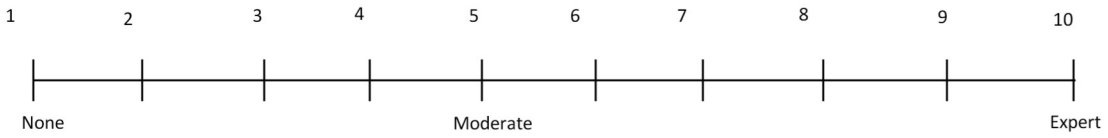
UNIVERSITI MALAYA	BAHAGIAN HAL EHWAL PELAJAR *(STUDENT AFFAIRS DIVISION)* REFLEKSI AKTIVITI *(ACTIVITY REFLECTION)* **GKI 1001** **PENYELIDIKAN BEBAS** ***(INDEPENDENT RESEARCH)***

menulis, pemikiran kritikal, kemahiran merancang, kemahiran teknikal, kecekapan menganalisis dan lain-lain.

Identify your skills and competencies acquired after the research activity implementation. Evaluate the level of mastery based on the scale according to before and after the execution of the research activities. Example of skills and competencies such as reading skills, writing skills, critical thinking, planning skills, technical skills, analysis competency and others

Tahap Penguasaan

Level of Mastery



Kemahiran dan Kecekapan *Skills and Competencies*	*Tahap Penguasaan* *Level of Mastery*
1) Information Seeking and Assembling Skills	Sebelum *Before*: 5 Selepas *After*: 7
2) Data Analysis using Google Forms and Excel	Sebelum *Before*: 5 Selepas *After*: 7
3) Planning skills (such as choosing suitable demographic, email professors, preparing questionnaire and conducting physical surveys)	Sebelum *Before*: 6 Selepas *After*: 8

4. Sumbangan (Langsung/Tidak Langsung)
Contribution (Direct/Indirect)

Terangkan sumbangan anda terhadap komuniti/syarikat/hos dan pihak lain yang berkaitan daripada segi sumbangan yang langsung dan tidak langsung daripada program/aktiviti yang telah dilaksanakan.

UNIVERSITI MALAYA	BAHAGIAN HAL EHWAL PELAJAR *(STUDENT AFFAIRS DIVISION)* REFLEKSI AKTIVITI *(ACTIVITY REFLECTION)* **GKI 1001** **PENYELIDIKAN BEBAS** ***(INDEPENDENT RESEARCH)***

Describe your contribution towards communities/company/hosts and other relevant parties in terms of direct and indirect from the completed programs/activities.

Sumbangan (Langsung) /Contribution (*Direct)*

i. Improved UM student's awareness and knowledge towards quantum technology (QT), in particular quantum computing and quantum computers.
ii. Increased UM student's interest into QT.
iii. Increase literacy in programming (Python) of students in the Physics Department.

Sumbangan (Tidak Langsung) /*Contribution* (*Indirect*)

i. Gave a 'rough idea' of the level of exposure of UM students towards quantum technology, in which the university management can take steps to improve.
ii. The Government IT and Internet Committee (JITIK) can use the results of this survey investigate the potential of quantum technology (QT) in Malaysia and create effective policies to encourage further development and research in this field.
iii. Inspire more researcher to conduct the same research, but on a larger scale, such as on the population of Malaysia.

(B) Pencapaian hasil kursus (Sila tandakan (✓) yang mana berkenaan)
Course outcome achievement (Please tick (✓) the appropriate box)

Nilaikan hasil pencapaian kursus.
Evaluate the course outcome achievement.

Hasil kursus ***Course outcome***	**Status Pencapaian** ***Status of achievement***		
	Tidak tercapai ***Not achieved***	**Separa tercapai** ***Partially achieved***	**Tercapai** ***Achieved***
1. Mencadangkan cadangan penyelidikan bagi topik yang dipilih *Propose research proposal on selected topic*			/
2. Melaksanakan projek penyelidikan dalam jangka masa dan sumber yang ditetapkan			/

UNIVERSITI MALAYA	BAHAGIAN HAL EHWAL PELAJAR *(STUDENT AFFAIRS DIVISION)* REFLEKSI AKTIVITI *(ACTIVITY REFLECTION)* **GKI 1001** **PENYELIDIKAN BEBAS** ***(INDEPENDENT RESEARCH)***

Perform the research project within stipulated time frame and resources			
3. **Melaporkan penemuan penyelidikan kepada pihak berkepentingan terpilih** *Report the research finding to selected stakeholders*			/

(C) PENILAIAN KENDIRI (Sila tandakan (✓) bagi setiap kategori)
SELF-EVALUATION (Please tick (✓) one from each category)

A. Tarikh penyerahan
Submission Deadline

/	Penyerahan dilakukan selewat-lewatnya pada hari Jumaat minggu ke-14 (5 markah) *Submission done latest by Friday in the 5th Week (5 marks)*
	Penyerahan dilakukan selepas pada hari Jumaat minggu ke-14 (0 markah) *Submission done latest by Friday in the 5th Week (0 mark)*

B. Kesempurnaan
Completeness

/	Laporan bertulis mengandungi semua perkara seperti di dalam borang templat (20 markah) *The report contains all items as per template (20 marks)*
/	Menyerahkan video berdurasi 3-5 minit yang menerangkan keputusan kajian (10 markah) *Submit a 3-5-minute video explaining the research findings (10 marks)*

C. Pembangunan Kemahiran dan Kecekapan
Skills and Competencies Development

/	Lebih daripada 3 kemahiran dan kecekapan dibangunkan daripada program (6 markah) *3 or more skills and competencies were developed from the program (6 marks)*
	Hanya 2 kemahiran dan kecekapan dibangunkan daripada program (4 markah) *Only 2 skills and competencies were developed from the program (4 marks)*

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	Hanya 1 kemahiran dan kecekapan dibangunkan daripada program (2 markah) Only 1 skill and competency were developed from the program (2 marks)
	Tiada kemahiran dan kecekapan dibangunkan daripada program (0 markah) *There were no skills and competencies developed from the program (0 marks)*

D. Sumbangan
Contribution

/	Terdapat 2 sumbangan langsung/tidak langsung dikenalpasti daripada program (4 markah) There were 2 direct/indirect contribution were identified from the program (4 marks)
	Hanya 1 sumbangan langsung/tidak langsung dikenalpasti daripada program (2 markah) Only 1 direct/indirect contribution was identified from the program (2 marks)
	Tiada sumbangan langsung/tidak langsung dikenalpasti daripada program (0 markah) *No direct/indirect contribution were identified from the program (0 marks)*

E. Pencapaian Hasil Kursus
Course Outcome Achievement

/	Semua hasil kursus dapat dicapai (5 markah) *All of the course outcomes were achieved (5 marks)*
	Tiada hasil kursus yang dapat dicapai (0 markah) *No course outcomes were achieved (0 marks)*

Jumlah markah yang diperolehi/ *The total marks obtained:* 50