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Has the Muslim society declined in research and Science since the Islamic Golden Age? If yes, why and to what extent?

Signified by the statement of Dr. David Lindberg, a medieval science historian and professor at the University of Wisconsin, 'The west had a thin version of knowledge, the east had it all,' the Islamic golden age was truly an era of scientific reformation (Overbye). Expanding from the seventh to the sixteenth century, the Islamic golden age ranged from advancements in Medicine, Philosophy, Theology, Mathematics, Natural Sciences, and Art. In my opinion, Dr Jamil Ragep, current Professor of Islamic studies at McGill University and Canada Research Chair in the History of Science in Islamic Societies put it best while commenting on the diversity and impact of the advancements of science in the Islamic golden age, 'Nothing in Europe could hold a candle to what was going on in the Islamic world until about 1600,' (Overbye). Research, according to the *Cambridge dictionary*, is 'the detailed study of a subject in order to determine new information,' (Cambridge University Press). Science on the other hand, is 'the study of the structure and behaviour of the physical world,' (Cambridge University Press). When combined, they provide an important pillar for the creation of various theories and consequently new technology, without which the world would have stagnated. The contention of this research is to establish whether or not the Muslim society has declined in taking initiative and providing new

theories to understand the working of this world, and if it has, to what extent and the reasons due to which the research output has decreased.

The various number of Quranic verses and Hadiths' by the prophet led the Islamic community to pursue knowledge. A verse in the *Quran* states 'Behold in the creation of the heavens and the earth, and the alternation of night and day, there are indeed signs for men of understanding (3:190),' (Hilali). This portrays a perspective of finding knowledge in order to strengthen a Muslim's belief in God. Moreover, it provides a foundation for research to be carried out on various natural phenomenon. Additionally, the prophet himself is believed to have said, 'The seeking of knowledge is obligatory for every Muslim, (Hadith 74)' (Khaliyl). Verses and Hadiths' like these directed the Islamic community towards the pursuit of knowledge. All these quotes did point toward Islam and its teachings as a major contributor for Muslims to think creatively and out of the box. To ensure my claim and reach a final conclusion, I got the opportunity to interview Nidhal Guessoum, astrophysicist and a professor at the American University of Sharjah. Having attended National STEM School, I was able to use my contacts to land an interview with him. As I questioned him on the importance of education in Islam, he pointed towards one specific verse in the *Quran*, 'Follow that of which you have not the (certain) knowledge of (17:36) (Hilali).' While explaining he said, 'were it not for the importance of education and knowledge in Islam, Muslims might not have been able to achieve the accomplishments that they credit themselves for in the Islamic golden age,' (Guessom).

Dennis Overbye, an avid science article writer and a physics graduate from the Massachusetts Institute of Technology, has written the article, 'How Islam Won, and Lost, the Lead in Science,' from which most of the expert opinions are taken in the above paragraph. The credentials of the author and the professor led this article becoming a very reliable source to quote

in my research. Critics, on the other hand, would argue that the article was written and published in the year 2001, which would be considered outdated in this day and age. However, the article discusses the achievements of the Islamic society in the Islamic golden age, incidents that have already occurred and hence has no effect on the reliability of the source.

Dennis Overbye was appointed the deputy science editor of *The New York Times*, one of the most renowned newspaper publishers in the world and the location of the article describing the success attained by the Islamic Golden Age. All these points lead to an article which has strong credibility for reliable information. The *Holy Book of Quran* is the religious book that was revealed to the Prophet of Islam, Muhammad PBUH. Being a book that contains words spoken by God himself, as Muslims believe, it is highly regarded around the world with the reliability of it being the only book to not have even a single word changed after its revelation. The verse quoted acts as a pillar to support the significance of attaining education in the Islamic Society. Moreover, the hadith that was taken from *Sunan al-Tirmidhi*, one of the six authentic books which are said to contain exact sentences that were spoken by the Prophet himself. This helps to substantiate the claim to a high degree which the reader cannot dispute. While researching on Nidhal Guessoum, I found various publications that led me to assurance that he was one of the most direct and credible sources I would have access to. A columnist for both The Gulf News and The Huffington Post, Nidhal Guessoum had a huge international scientific following, which ensured that he had a motive to remain credible. Moreover, his contributions towards instilling scientific methodology in modern Muslim culture have created him a reputation on Islamic science like no other. His book, 'Islam's Quantum Question: Reconciling Muslim Tradition and Modern Science,' which uses biological and human evolution to argue that modern science must be inculcated into the modern

Islamic society. Guessoum asserted the significance of Muslims taking scientific and quantum questions seriously if they want to recover their true integrity and heritage.

There would be no renaissance or industrial revolution in the west, were it not for the contributions of the East. Al-Biruni, a Muslim mathematician, astronomer and geographer who wrote around 145 books, created a huge sociological and geographical study of India (Sparavigna). Born in 981 A.D modern day Uzbekistan, Ibn Sina was a Muslim physician and philosopher. His contribution in compiling the first ever medical encyclopaedia, *'The Canons of Medicine,'* has earned him the title *'Father of Modern-day Medicine,'* (Flannery). Or we could look at Muhammad Ibn Musa Al Khwarizmi, a Persian mathematician and astronomer, of the 8th century, who contributed to the creation of arithmetic and algebra (Ayyubi). Without Al Khwarizmi's contribution in algebra, algorithms might not have been created and without algorithms I would not have the ability to write or print this very research report, further signifying the title he was given of being the *'Father of Algebra,'* (Ayyubi).

While we observe at the numerous achievements of Muslims in the Golden Age, we tend to forget the reasons that Muslims even pursued avenues that led them towards scientific revolution. There were two very important reasons that allowed scientific research to flourish after Prophet Muhammad's (PBUH) death.

After the Prophet's death, one reason why advancement occurred was due to the translation movement in the capital of the Abbasid Caliphate, Baghdad. A Yale Historian, Dimitri Gutas has said that the program was quote, 'equal in significance to the Italian renaissance.' The translation of knowledge from various languages to Arabic allowed the foundation of science to become easily accessible to scholars (Ofek). This was considered to be an anomaly by Gutas in his book, *'Greek Thought, Arabic Culture.'* The translation movement was independent of any organizations and

was for the majority of it run by people with high socio-economic status in the society, the elite of the Arab society as they would call it. It consisted of bankers, military leaders, civil servants and most important scholars and scientists (Gutas). Related to this distinction is the fact the Abbasid society contained a major Persian community. Consequently, this torpedoed efforts to legitimize their rule over Persia by adopting Persian language and culture which at the time being was deeply involved in Greek Thought (Gutas). Hence, significant efforts were made to translate Greek scientific texts. Poetry, drama or even history for that matter were not given importance as Muslims at the time considered these subjects inferior. Reason being they didn't help provide solutions for common problems. This issue transcends the millennium and is still present in the twenty-first century regardless of scientific performance by the Muslim community. Initially, Arab Muslims themselves did not seem to care much about the translation movement and the study of science, feeling that they had 'no ethnic or historical stake in it,' as Gutas explains. This began to change during the reign of al-Mamun¹, the seventh Abbasid caliph. For the purposes of opposing the Byzantine Empire, al-Mamun reoriented the translation movement as a means to recovering Greek, rather than Persian, learning.

Published in 1998 by Routledge, the book, *'Greek Thought, Arabic Culture: The Graeco-Arabic Translation Movement in Baghdad and Early Abbasid Society'* was written by Dimitri Gutas. In the book, Dimitri explains the transmission of Greek knowledge into Arabic and then describes the ripples it created and analyses the effect it had on the socio-political landscape of the Islamic Golden age. Dimitri Gutas, a Yale professor of Arabic and Islamic Studies and an American Arabist, did his undergraduate and graduate work in classics, history of religions, and Arabic and Islamic studies, making him an expert on this topic. This translation movement also

¹ Died 833

obligated Dimitri to investigate the social history of the Abbasid Caliphate. He has also spent most of time on the study of Arabic philosophical tradition. Moreover, Dimitri is a highly regarded professor who is on the editorial board of various scholarly periodicals that publish content on Arabic philosophy, including but not limited to the leading journal, *Arabic Sciences and Philosophy*, published by *Cambridge University Press*. These credentials allow Dimitri's book to become an authentic source to refer to while discussing the Greek translation movement and the significance of it on allowing scientific research to prosper in the Islamic Golden Age.

While not a primary reason, practical religious motives also played their part in Muslims pursuing translation of various texts. Muslims are required to pray five times a day while facing towards the Qibla and that became a problem in the Abbasid Caliphate, where the Muslim Empire became so huge that finding the direction of Qibla accurately became a challenge. To tackle this situation Al Mamun, the seventh caliph of the Abbasid Dynasty, ordered the scholars of his kingdom to find a way to precisely find the position of Kaaba from anywhere in the empire. For this to happen, the scholars first needed to find a way to calculate the radius of the Earth. Publishing his first book at the age of 22, Al Biruni was one of the greatest minds in Muslim Scientific history. He is the scholar, employed by Caliph Al Mamun that managed to devise a method to calculate the radius of the Earth (Sparavigna). Using trigonometric functions, an astrolabe and a mountain with a flat horizon he calculated the radius of the Earth to within 4% of the actual value (Khan Academy). This innovation in the technique was prospered by religion itself, had Muslims not had the need to find the direction of Qiblah, they would have never been able to find the diameter of the earth. This example portrays the exact epitome of the Urdu proverb, 'Zarorat ejad ki maa hai,' which means 'Necessity is the mother of innovation,' (Farooq).

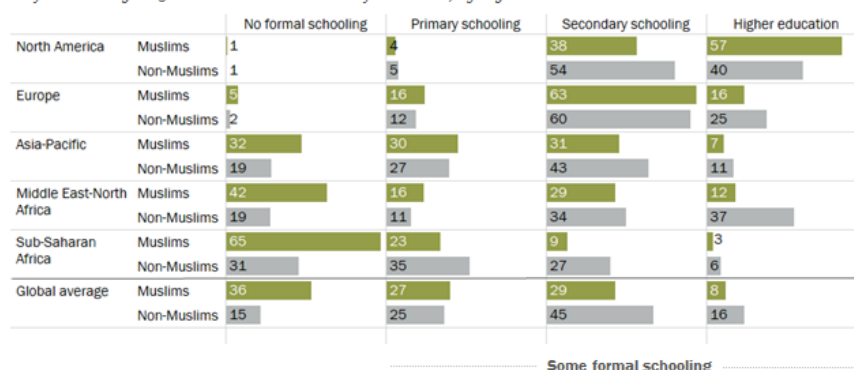
There has been this notion that Islamic science is now abysmal. Dr. Abdus Salam, the first Muslim to win a Nobel Prize in Physics has been at the forefront of accepting this idea and had devoted most of his life to improving the situation. But have the Muslims really declined in research and innovation?

A report published by ISESCO (*Islamic Educational and Scientific Organization*) in 1986 provides various statistics that help us answer the question. In Muslim majority countries, there are approximately 628 science and technology research institutes and centres (Esposito). 173 of them are engaged in agricultural research, 4 desert institutes, 58 centres of medical research, 47 for veterinary sciences, 45 for energy and 44 for industrial research, 9 centres for nuclear studies, 8 for space research, 7 for biotechnology, 9 for oceanography and 4 in computer sciences (Esposito). The quality of these research institutions has been significantly lower than advanced countries. A small-scale study conducted in 1986 presented that out of a sample of 416853 physics papers released only 46 had Muslim authors (Esposito). The same situation can be seen in other scientific subjects.

There are currently 1.8 billion Muslims in the world that is approximately a quarter of humanity. Yet 36% of Muslims globally have no formal schooling (Pew Research Center). Most Muslims that have no formal schooling live in either

Around the world, nearly four-in-ten Muslims have no formal schooling

% of Muslims ages 25 and older with each level of education, by region



Note: Based on adults ages 25 and older as of 2010 (or latest year available). Rows may not add to 100% due to rounding. The Latin America-Caribbean region is not shown due to lack of sufficient data on Muslims.

Source: Pew Research Center analysis. See Methodology for more details.

"Religion and Education Around the World"

PEW RESEARCH CENTER

Figure 1: % of Muslims ages 25 and older with each level of education, by region, Research Conducted by the Pew Research Center

Asia, the Middle East or Africa as seen by figure 1. This is coupled with the fact that the highest percentage of Muslims with a Post-Secondary degree live in the Western continents, Europe and North America. This evidence is consistent with the fact that Muslims have the highest levels of schooling where they are a religious minority as shown by figure 2, by the *Pew Research Center*.

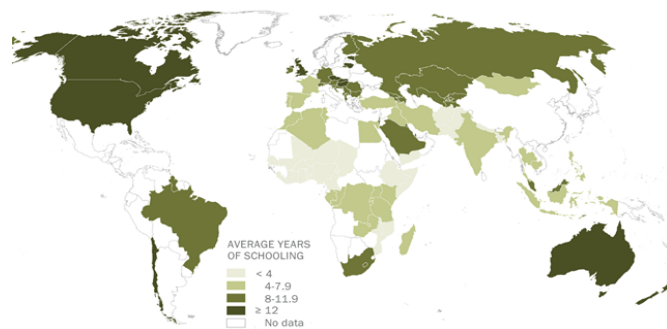
While only 10% of Muslim men and 6% of Muslim women have a post-secondary degree, 43% of all Muslim women and 30% of all Muslim men don't even have formal school education. Furthermore, even more alarming was the fact that globally Muslims have an average of only 5.6 years of schooling and the highest levels of schooling are in countries where they are a religious minority as shown by Figure 2 (Pew Research Center). This proves that most Muslims aren't even provided the opportunity to pursue a secondary education, rather a post-secondary degree which automatically substantiates the fact that the scientific output has decreased over the years.

A nonpartisan fact tank, the *Pew Research Centre* informs the public about the issues, attitudes and trends shaping America and the world. Thus, providing reliable and credible statistics from research they conducted themselves hence proving to be a highly reliable source.

Head turning advancements in numerous Muslim countries show an opposite picture of the scenario. They suggest a regeneration in the science and innovation abilities of the Islamic world.

Muslims have highest levels of schooling where they are a religious minority

Average years of schooling for Muslims ages 25 and older around the world



Highest average years of schooling in countries where Muslims are a...

RELIGIOUS MINORITY	RELIGIOUS MAJORITY
1 New Zealand 14.2 years	1 Uzbekistan 11.5 years
2 United States 13.6	2 Kuwait 11.0
3 Canada 13.5	3 Kazakhstan 10.7
4 Lithuania 13.4	4 Qatar 10.6
5 Slovakia 13.4	5 Tajikistan 10.5
Median when minority (71 countries) 8.3	Median when majority (35 countries) 6.0

Average years of schooling in countries with

LARGEST ADULT MUSLIM POPULATIONS
Indonesia 7.9 years 115.3 million
India 4.2 76.4 million
Pakistan 3.8 72.4 million
Bangladesh 3.9 64.3 million
Iran 5.4 40.5 million
Global median 8.0 672.6 million

Note: Based on adults ages 25 and older as of 2010 (or latest year available).
Source: Pew Research Center analysis. See Methodology for more details.
"Religion and Education Around the World"

PEW RESEARCH CENTER

Figure 2: Average years of schooling for Muslims ages 25 and older, by region, Research Conducted by the Pew Research Center

The international community realizes the importance to understand the opportunities and constraints to ensure further progress in Science. Countries like Turkey, Iran, Qatar and Saudi Arabia have started to invest heavily to ensure that their future contribution in science attains a high level of authenticity and consideration. An example could be seen in Saudi Arabia where King Abdullah University of Science and Technology (KAUST) opened in 2009 with an endowment of US \$20 billion (The Royal Society). With such a large endowment, KAUST has been attracting a large number of highly competent postgraduate students and professors from around the world. Neighbouring Saudi Arabia, Qatar in 2010 had aimed to spend 2.8% of their GDP on research which equates to approximately US \$1.5 billion (The Royal Society). Furthermore, the government of Qatar has created numerous initiatives, totalling US \$133 billion that plan on turning Qatar from a crude oil relying economy to a knowledge-based economy. Due to the lack of financial transparency in Qatar these values could not be confirmed. Beyond the Gulf states, Turkey, which made spending on research and development a priority in 1990, has increased its budget on research by 566% between 1995 and 2007 which is more than Finland, Norway and Denmark (The Royal Society). We could also take a look at Pakistan, where the research budget increased by 6000% between 2001 and 2003, along with the higher educational budget which increased by 2400% between 2004 and 2008 (The Royal Society). Or we could take a look at Iran, which announced a 20 year comprehensive plan for plan in 2009, which includes a US \$2.5 billion dollar nanotechnology research centre and an increased Research and development budget of 4% of the GDP (The Royal Society). Malaysia has become an extensive scientific hub due to Prime Minister Mahathir's Vision 2020 in which huge investments were made in R&D. Consequently, this has allowed patent applications to become one of the highest in any Muslim country around the world.

Eric Chaney, Associate Professor at Harvard University wrote a paper in 2016 under the title, '*Religion and the Rise and Fall of Islamic Science*,' in which he analyses the scientific literature output of the Muslim World over a millennium. Having obtained a Mathematics and Economics degree from Stanford and a PhD in Economics from UC Berkeley, Chaney has used various statistical formulas on the scientific literature produced and stored in two different Libraries, Harvard's Library, which is the largest university library in the world and the oldest in the United States, and libraries in Istanbul. He uses various statistical calculations to determine that the conclusions drawn from the data collected is reliable and authentic. The results he gathered confirm the rise of Science in Muslim societies during the Islamic Golden Age. During that time period, around 10 % of all the books that were being produced were on scientific, this decreased to 5% in 1100s and by the 1700s it was only 2% which has decreased to less than 0.5% in 20th century (Chaney).

Using the results that Chaney produced, I am able to establish that 1.8 billion Muslims of the world contribute an extremely small share of new knowledge on science. This is coupled with the fact that only 3 Muslims from 57 of the Muslim Majority countries have been able to obtain a Nobel Prize in any of the science. Moreover, university rankings, which use various metrics of research to establish a hierarchy, in Muslim countries prove that the research output has declined. This can be observed by counting the number of Muslim universities in the top 400 of world rankings. Beyond the facts presented, there is a widely shared view that Muslims have been lagging significantly in science.

Ziauddin Sardar, a British Pakistani scholar, who was also named as Britain's top 100 intellectuals published an article in the periodical science journal *Nature*. In the article, this

academic who specializes in Muslim thought, the future of Islam, futurology and science and cultural relations, described the various reasons due to which Islamic golden age, and specifically Islamic research had declined. He outlined the following reasons for the decline (Sardar):

1. Distortion of basic concepts
2. Cultural reasons
3. Colonialism
4. Narrowing of faith
5. Communication and Finance

The decline of such a society can be seen as the product of distortion in various concepts that form the foundation of Islam itself. Ilm (Knowledge), Ijma (consensus), Istislah (Civic Interest), and Ijtihad (Journey for continuous reasoning) are all part of the basic concepts that were distorted which drastically reduced the creative ability of Muslims. Scholars or Alims were confined to those that had ample religious knowledge and a scholar of any other subject was disregarded. Ilm or knowledge has been detained to the knowledge between the pages of the Quran. This shift of thinking is evident by Al-Azhar University in Cairo, which became a theological school and ceased pursuit of scientific knowledge (Ofek). Ijma, upon which the basis of democracy was set up, became a tool in the downfall as it increasingly became constricted to scholars with religious knowledge only. This caused decisions for the Muslim society to be controlled by a select few, disregarding various scientific scholars and hence narrowing reasons for Arabic scientists to continue research into fields other than religion. Another significant value that was distorted over the years was Jihad. Jihad, during the golden age, was intellectual struggle, this however narrowed to only on field warfare (Sardar). Therefore, crippling Muslim scientists' efforts in pursuit of

research. Funding was only provided to scientists that devised experiments to find knowledge that was present in the Holy Quran but hasn't yet been discovered by scientists. An example would be from Pakistan in the mid 1990's to harness the energy of Jinns (Sardar). As Ziauddin described it, using an example of hadith, The Muslim Umma- Community is like a human body, the current state of the body is one without a brain. Hence, it lives and functions but is paralyzed while it thinks. This led rational scientific thought to be erased from the Muslim community, crippling the advancement in science after the fifteenth century.

Another interesting point concluded by Ziauddin tunnelled towards the relationship between Science innovation and cultural values. He argued this with the fact that Hadith and the Quranic verses have not changed since their inception. According to Ziauddin, 'Science never emerges in a vacuum; it always has cultural context; it is fed and shaped by the conditions of its time and place.' Just as it was throughout history, scientific research has been a significant factor in the development of society. City planning, city building, city management and sewage construction became significant skills that benefited enormously from the application of scientific knowledge. Astronomy, Geography, map making, and compass making simplified long-distance trade. The Muslim State became a huge benefactor for the research community (Sardar). The institutions created by the state took upon itself that science flourished and served society. Europe would have had no need to destabilize the Muslim world, if it had not been such a vivacious, powerful and mounting concern. 'The age of exploration,' as the Europeans called it was a deliberate approach, carefully pursued to ensure that the Muslim stranglehold on European economies could be broken (Sardar). This led the Europeans to colonize most of the Islamic Empire by the sixteenth century.

Colonialism was the cause of two significant outcomes that led to the decline of Islamic science. By introducing new systems of administration, law, economy and education, Muslims were forced to abandon meaningful cultural activities. Moreover, all of these systems were designed to implant dependence and subservience among the new colony. This coupled with *Maslow's Hierarchy of needs* enlightens the process in which they bound the Muslims to dependence. Figure 3 shows the pyramid created by Maslow to

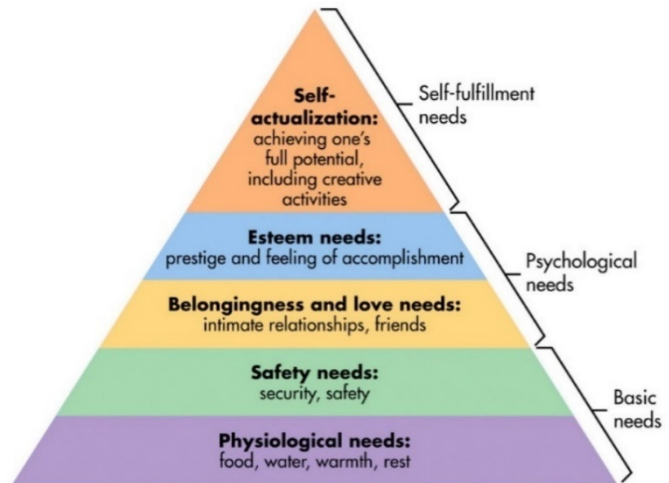


Figure 3: Maslow's Hierarchy of Needs (McLeod)

define the needs of a normal human (McLeod). As the Europeans colonized various parts of the world, they ensured that they introduce systems that would result in people scouring to meet their Physiological and Psychological needs. They prevented their colony from achieving the top part of the pyramid: self-actualization. This as portrayed by the diagram, is the highest portion of Maslow's Pyramid. As people are prevented from attaining self-actualization, they abandon their creative abilities as they try and fulfil their basic and psychological needs. Western education distorted facts and taught the colonized to accept that their own inventions were irrelevant and their medical science was irrelevant. This 'Modern' education that was supposedly offered to the colonized to offer them a path to success was in reality proposed to produce people that were able to serve colonial needs. Another consequence of colonialism was the shift in attitude towards attaining knowledge; it turned from a broad cultural activity into a narrow religious one. A journal written by Pervaiz Hoodbhoy, a famous Physicist in Pakistan, for *The Oxford Encyclopedia of The*

Modern Islamic World, describes that a combination of hurt pride and defiance led the Muslims to resist Western learning. This can be supported by the fact that during the year 1876-1877 and 1885-1886 only 51 Muslims took the Bachelor of Arts Degree at Calcutta, in comparison to 1338 Hindus (Hoodbhoy).

Roshaan Bukhari, a renowned astrophysicist in Pakistan, Astronomy Resource at Oxbridge Innovative solutions, and an instructor of astronomy at various institutions in Pakistan, also provided an expert opinion during an interview. In his opinion, the decline in innovation in the Islamic society happened due to two major reasons, one is the decline in scientific query of youth. Secondly, he emphasized the importance of free thought and the decline of free thought in Muslim majority countries and the lack of patience to observe the effect of scientific query (Bokhari). Both of these reasons are in line with Sardar's analysis of the decline and provide logical reasons

By briefly comparing Christianity and Islam a huge difference is evident that may have created the divide in innovation between the two societies that is apparent in the modern world. Christianity allows people the authority of public-private distinction and allows the followers of the library to outline the majority of their social and political lives. Alternately, Islam enforces rules even on the most private parts of day to day life and denies Muslims the liberty to live their own lives on their own terms. This interdependency between religion and politics has been one of the defining features of Islam, proving that Islam is a religion that provides a code of conduct for every aspect of life. For Muslims to be inquisitive in nature, the state has always been required to provide its support to the educated community and their endeavors, both socio-politically and financially. During the end of the fifteenth century the Christians re-conquered Spain, resulting in the west taking over the magnanimous libraries in Córdoba and Toledo, which of full of books on

research conducted by the Muslim scholars of the time (Overbye). As the Christians took control of the libraries, the Muslim community lost two of the most significant things required for scientific research, financial support and communication. While science in the West was financially independent and could pay for itself using new technology such as the steam engines to attract financing, in the East it remained highly dependent on the wealth provided by the sultans and caliphs. And since the power of such empires declined as colonization occurred, the financing decreased. Dr. Farouk El-Baz, an Egyptian American Scientist, and Director of the Remote Sensing at Boston University, while describing Ottomans said, 'The Ottomans who took over the Arabic lands in the 16th century, were builders and conquerors, not thinkers,' (Overbye).

Having conducted this research after having numerous questions that were pertinent to one specific lecture, I have realized the significance of thinking deeply about simple things. While conducting interviews for this research I have been able to create more contacts and even network with professors and experts while only being a student doing A level. Before I wrote this research report, I had always believed that this decline was due to the lack of freedom in scientific query throughout the centuries. However, I have found various social, political and economic reasons that have led to the decline of science in the Muslim world. Moreover, I have been able to find various statistics and theories related to the decline in the Islamic societies since the medieval period. Furthermore, I have constantly reflected upon the strength of the sources that I have used to ensure that the research that I have conducted and written is authentic and reliable.

Throughout the Muslim world, there has been this nostalgia for the past, to the time where they could confidently contend themselves as the originators of science. So, yes, the Muslim world has declined in research and science since the Islamic golden ages but the progress that the Islamic

world has been able to achieve in the past twenty years is remarkable. Additionally, enough evidence suggests that a new renaissance of Islamic science could be happening. To ensure that the Islamic world flourishes in science, larger investments in people, cultural attitude, freedom of thought and intellectual infrastructure is required. Apart from that, a wider view of religion is required to ensure that scientific query is acknowledged and given time to prosper. Moreover, Muslims need to enhance tolerance for ideas outside the contemporary boundaries defined by religion and society if they wish to stand at the forefront of science in the future.

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