



**Universidade do Minho**  
Instituto de Educação

Imad Adel Husni Ayed

## **Oman Higher Education Institutions Dealing with Artificial Intelligence**

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## **Oman Higher Education Institutions Dealing with Artificial Intelligence**

Doctoral Thesis  
PhD Thesis in Educational Sciences  
Specialty of Educational Technology

Work developed under supervision of  
**Prof. António José Meneses Osório**

February 2022

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I would also like to thank the faculty in the Scientific College of Design – SCD in the Sultanate of Oman, and the staff members from other higher education institutions, as well as the experts from the Oman community who participated in the questionnaire and interviews.

## **STATEMENT OF INTEGRITY**

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledged the Code of Ethical Conduct of the University of Minho.

## RESUMO

### **Instituições de ensino superior de Omã lidando com inteligência artificial**

Investigação abundante em inteligência artificial (IA) e nos avanços da tecnologia tem-se focado na melhoria da capacidade de tomada de decisão e correspondentes transações rápidas de um sistema computacional. Neste projeto, estudou-se a implantação da IA e de novos sistemas em Instituições de Ensino Superior (IES), para alcançar estratégias institucionais. Os seus objetivos visaram examinar a eficiência das tecnologias de IA atualmente adotadas em relação à atividade educacional das IES, para identificar as percepções e visões dos seus estudantes e colaboradores sobre a introdução da IA na sua atividade académica, para investigar o impacto da IA no planeamento, implementação e melhoria da sua atividade académica e para recomendar várias ações corretivas para superar os desafios enfrentados pelas IES na implementação de procedimentos de IA.

IA é uma tecnologia emergente que evoluiu na forma de Aprendizagem de Máquina, Processamento de Aprendizagem Natural, Interação Homem-Máquina, etc. Inicialmente, a IA foi amplamente adotada no setor corporativo e, recentemente, no Ensino Superior. O principal objetivo das Instituições de Ensino Superior é experimentar a tecnologia e colher os benefícios do novo sistema. No entanto, tal adoção é marginal, havendo ainda um longo caminho a percorrer para a IA no contexto do processo de ensino-aprendizagem e para substituição de um instrutor por uma máquina/robô. Esta investigação procurou determinar o estado atual da IA no setor de Ensino Superior no Sultanato de Omã, estudou as oportunidades associadas e explorou os desafios que se colocam. A investigação também abordou a perspectiva dos especialistas sobre IA, as dificuldades de aceitação e a formação necessária para os membros do corpo docente. Para o conseguir, usando o *Monkey Survey*, foi realizado um inquérito em Instituições de Ensino Superior em Omã, envolvendo funcionários de tecnologia da informação e docentes, para entender os seus pontos de vista sobre oportunidades e desafios associados à implementação de novos sistemas de IA no ensino superior. Os dados foram analisados com médias ponderadas. Além disso, esta pesquisa estudou a prontidão do mercado local para adaptar IA na educação, deu sugestões adequadas para aproveitar potenciais oportunidades e avaliou soluções para o crescimento das Instituições de Ensino Superior no Sultanato de Omã.

Palavras-chave: Desenvolvimento Educacional; Ensino Superior; Inteligência Artificial; Omã; Tecnologia Educativa

## **ABSTRACT**

### **Oman Higher Education Institutions Dealing with Artificial Intelligence**

Extensive Research in artificial intelligence (AI) and advancement in technology focused on improving the decision-making capabilities of a system/computer and thereby fast transactions. This research studied the implementation of AI in Higher Education Institutions and implementation of new systems to achieve corporate strategies. The objectives of this research aimed to examine the efficiency of current adopted AI technologies in relation to HEIs' educational activity, to identify students' and HEIs staff's perceptions and views on the introduction of AI in their academic activity, to investigate AI's impact on planning, implementing and improving HEIs academic activity and to recommend various remedial actions to overcome challenges faced by HEIs in implementing AI procedures.

AI is an emerging technology which has evolved in the form of Machine Learning, Natural Learning Processing, Human-Machine Interaction etc. Initially AI has been widely adapted in the corporate sector and recently in Higher Education. The main objective of Higher Education Institutions is to experiment with technology and reap the benefits from the new system. However, it is marginal because there is still a long way to go for AI in the context of teaching-learning process and replacing an instructor with a machine/robot. This research tried to determine the current status of AI in the Higher Education sector in the Sultanate of Oman, studied opportunities associated with it and explored challenges. This research also addressed the community experts' perspective on AI, difficulties in accepting and training needed to faculty members. To achieve this, a survey was conducted using Monkey Survey on Higher Education Institutions in Oman by involving information technology staff and faculty to understand their viewpoints on opportunities and challenges associated with implementation of new AI systems in higher education. Data was analyzed using weighted average. Also, this research studied local market readiness to adapt AI in education, gave reasonable suggestions to grab potential opportunities and assessed possible solutions for the growth in Higher Education Institutions in the Sultanate of Oman.

Keywords: Artificial Intelligence; Educational Advancement; Educational Technology; Higher Education; Oman



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## **Abbreviations**

AI: Artificial Intelligence

HEIs: Higher Education Institutions

MOHERI: Ministry of Higher Education, Research and Innovation (Sultanate of Oman)

RQ: Research Question

SCD: Scientific College of Design

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## **DEDICATION**

The mission behind completing this work is dedicated to the soul of my father, who encouraged me to continue my higher studies, to my beloved mother Khadhrah, my brother and Godfather Mohammed Adel Husni, for his endless support, as my family was very supportive, I would like to extend my gratitude to my wife and children for their tolerance.

**Love you all**

## **CHAPTER 1 - INTRODUCTION**

Artificial Intelligence (AI) is an emerging topic in computer science and an extensive study is going on from decades due to the challenges that it raises. This research focuses on examining the background of AI from theory to its application in the educational sector and highlights on a few other sectors/industries where AI is vastly implemented. Over the past half century, AI took many advances in machine learning algorithms, natural language processing, image processing, data mining, integrating statistical analysis and vast advances in search algorithms. At present, AI has many benefits, especially in the field of education. It is already witnessed that there is rise in education technology in today's classrooms especially through a host of adaptive learning platforms. With virtual reality (VR) making inroads at a rapid pace and coding being taught to students, we see that educators are embracing technological advancements as an integral part of the teaching system just like chalk and blackboards. It is not the simple matter of whiteboards in place of blackboards or the obsolescence of textbooks. From kindergarten to graduate school, one of the best ways AI will affect education is through the application of greater levels of individualized learning (Barros & Osório 2017).

AI essentially studies its environment to adapt to it at a rate faster than humans do; this could be helpful in making learning more individualized. Students in each class have different levels of understanding and intelligence but still have to learn with the pace of the class. AI allows us to create tailor-made digital learning systems, which will help students learn at their own pace. It will allow students to explore, experience and be involved in a subject as if they are actually present in that environment or place, which is such a remarkable learning experience.

My choice of this topic was because of my interest in the area of AI and its effect on people's lifestyle. Furthermore, at professional level it gives an opportunity to understand and know different technologies used in the educational sector in the Sultanate of Oman. As a developing country in the education field and with an increasing competition over a decade, it is very important to obtain state-of-the-art technology and its advancements in the field. Moreover, in professional level working into administration and supporting the institution in strategic planning, this research will advance my knowledge and help to guide the institution where I work to suggest advanced technologies in the field, which can be adopted for growth.

## **1.1 Rationale for the Study**

In fact, AI will have a great impact upon the advancement of the higher education sector. Yet, the traditional form of education will always have its place. However, with the advancements in technology and its implementation in the education system, it is clearer that new types of online education and usage of AI are becoming more and more important (AlDahdouh & Osório, 2016). This study is significant as it focuses upon exploring AI usage in different levels of education and as well in administrative work at Higher Education Institutions. The study will broaden the horizon about how AI can facilitate advanced customizable approaches in teaching-learning process. It will also focus on how learning analytics can accelerate the investigation and innovation of new tools/technology for personalized education. Furthermore, this study identifies how teaching staff will be able to conceive educational needs using AI and to explore gaps in these methods. On the other hand, this study aims to perceive if students will be able to move smoothly in their education through adopting new technologies initiated by higher education institutions (AlDahdouh et al., 2015).

## **1.2 Purpose of the Study**

The purpose of this research is to kindle intellectual discussions in the field of AI in higher education, which is supported by the “National AI Research and Development Strategic Plan,” released in 2016 by former US president Barack Obama. This research elicits that “barriers between human and AI systems are beginning to erode”. Anyway, depending solely on AI technology is a dangerous path; human beings should be still involved in identifying risks, critique and detect privacy requirements. Technology implementation in higher education learning is to augment an educational process, enhance teacher and student thinking but not to reduce a set of procedures in delivering the program and assessment. Frank Pasquale in his book “The Black Box Society” mentioned that software encodes thousands of rules and computes in seconds (Pasquale 2015). In this book, he revealed that we didn’t have a quasi-concentrated and strong monopoly over those solutions, but also lack of transparency on algorithms and their usage.

In moving forward, AI has reached a long way in the last decade. Yet, there is a lot of research needed to develop AI. The continuous experiments and research have given the machine a good account and a common sense by allowing it to learn. Understanding how a machine precisely understands inputs and gives necessary outputs is very important to have strong AI. Furthermore, detecting human emotions and actions are also necessary. Thus, advancement in AI will require advancements in linguistics, natural language processing, image

processing, psychology and human beings' behavior to detect and analyze human body language and expressions.

Oman higher education sector is in a developing stage by initiation of new educational institutions with different academic programs in order to offer education with varied range of fields. MoHERI supported this by licensing academic programs such as Bachelor in AI at GUTech University. On the other hand, HEIs started to use AI related programs in student admission, academic advising, counselling (program will be launched in September 2022 at SCD). This guarantees nations core aims to advance in the field of AI and implementation of different systems in the education sector and other sectors. Therefore, I focused in this research on collecting and analyzing the perspectives of stakeholders, students, faculty and professionals in the field of IT. Elaborated results are presented in chapter 5, and this will contribute to the country's 2040 vision and strategies in the HE sector.

### **1.3 Research Objectives**

Research objectives are the areas planned by the researcher to accomplish over the period of three years:

- i. To examine the efficiency of current adopted AI technologies in relation to HEIs' educational activity.
- ii. To identify students' and HEIs staff's perceptions and views on the introduction of AI in their academic activity.
- iii. To investigate AI's impact on planning, implementing and improving HEIs academic activity.
- iv. To recommend various remedial actions to overcome challenges faced by HEIs in implementing AI procedures.

Furthermore, in this study at the theoretical level, the researcher will develop a survey instrument based on the theoretical framework for evaluating AI implementation efforts at HEIs. On the other hand, at the practical level of the study, the researcher aims to understand AI growth over a decade in its literature part. Lastly, at the personal level, this study responds to the researcher passion towards understanding the crux of AI and its role in educational institutions.

#### **1.4 Importance of the Study**

In brief, this study is significant due to the following reasons:

- i) Adoption of AI challenges in HEIs are too critical to be ignored.
- ii) Specialized literature indicates that AI as a subject has a vast theoretical framework. Hence, extensive research is encouraged.
- iii) There is a vast research going on in this field. Yet, there is a lot to investigate mainly in HEIs in Oman. Therefore, this study is expected to contribute to scholarly literature and to encourage further similar studies in the region.
- iv) At present very few higher education policy makers are aware of the importance of AI. This study is thus expected to inform HEIs in Oman about its importance and generate an interest in the region.
- v) Especially at the subject of HEIs, this study initiates strategies with a specific budget for improving AI in the educational sector.



## CHAPTER 2 - LITERATURE REVIEW

Over the last few decades, a vast and drastic advancement was noticed in AI solutions. This leads to a very high potential to change the infrastructure in the higher education administrative and academic services. However, this also opens a door to a varied set of challenges. According to a research paper: “The National Artificial Intelligence Research and Development Strategic Plan”, AI solutions help to automate the systems, yet challenging to envisage in future due to the complexity of tasks in the teaching-learning process. The supercomputers’ difficulty pertaining data is reduced based on algorithms that help to search factors such as repetition in a transaction, punctuations, key phrases, etc. (Tsur, Davidov & Rappoport, 2010). “The new hype in AI is high, but one has to stay aware of the actual limits in AI solutions in a higher education system. For instance, unquestioned trust in AI capabilities led to the death of a driver in May 2016, as the car was set on auto-drive mode and the software was unable to detect tractor” (Popenici & Kerr 2017, p. 2). Another example was “Microsoft’s inaccuracy trusting AI powered bot named Tay to go on Twitter. Very soon, it has discovered that Tay turned into a racist and hate-spreading account, leading Microsoft to shutdown Tay in only 16 hours. Tay was a social and cultural experiment, but some users taken Tay’s commenting as an abuse” (Perez 2016). Discussions in research show a consistent evidence that AI solutions are opening new possibilities for administrative and teaching-learning in the higher education sector. However, the current technology advancement does not support to replace academic faculty with AI but is augmenting to a real possibility. This requires careful analysis from an academic perspective, mainly while replacing wide-ranging instructional solutions.

From the education perspective, advancement of technologies has resulted in a change of habits by much of the global population. People have modified the ways in which they connect, interact, read, write, and become informed through to the use of new technologies (Leer & Ivanov, 2013).

In this scenario, education must adapt to the current era and societal norms. As a result, integrating Information and Communication Technologies (ICT) into the classroom to be focused by the education sector. In this regard, ICT in higher education is a potent tool for bringing universities closer to the European Higher Education Area by promoting a methodological shift in the teaching–learning process. In this way, incorporating technology into the classroom allows

for new dynamics of engagement, resulting in transformative processes and the application of student-centered learning methodologies (Hinojo-Lucena et al. 2019). In a period of four to five years, deployment of Artificial intelligence will be in higher education according to global reports such as the Horizon Report, a reference in educational technology (Becker et al. 2017). In a research paper it was stated, “Artificial intelligence is an emerging technology aimed at the creation of computational systems that present intelligent and adaptive behaviours, with the ability to learn from their environment, just like human beings” (Hinojo-Lucena et al. 2019, p. 1). Additionally, “in relation to the main systems on which artificial intelligence is applied in an educational context, research scholars found, for example, intelligent tutors and intelligent teaching systems distributed over the internet” (Hinojo-Lucena et al. 2019, p. 2).

Intelligent tutors serve as learning guides by identifying students' progress in learning, based on their material knowledge and personal traits, whereas distributed intelligent teaching systems stimulate student participation through software programs that support and encourage interactions. Personalization systems (student knowledge and tailored adaptation), software agents (intelligent programs and robots with autonomy and the ability to learn), and ontologies and semantic web were highlighted in this research as three artificial intelligence strategies in education (which gather knowledge from multiple spaces and Big Data). These systems and techniques, when created and implemented in education, can be effective tools for improving the teaching–learning process because they can create a virtual teacher that is fully trained and possesses human traits while being able to connect with students everywhere (that is, at any time and place). As a result, an estimate was developed to determine which studies had the biggest influence. This search turned up some fascinating information about artificial intelligence's evolution in higher education over time as well as its future development (Lemaignan et al. 2017).

As we move forward in literature, areas such as characterization of artificial intelligence and its growth covering machine learning, natural language processing, human-machine interaction are covered. Furthermore, details in role of artificial intelligence in education, applications of AI for learning and its role in higher education are stated. A focus in developments of artificial intelligence in the context of higher education and impact of AI in higher education are stated. Additionally, due to the current pandemic and education sector moving to online

platforms, a study on current theories for satisfaction in e-learning, its readiness and accessibility are covered.

## **2.1 Characterization of AI**

The characterization in the field of Artificial intelligence covers areas such as deep learning, automation of simple and repetitive tasks, cloud computing etc. In general, AI is a window for the future of higher education. This field has an impact upon many industries, rather in every industry because of the emerging technologies and robotics. As we proceed in this section, explanation in artificial intelligence characteristics and better/effective use of it in different dynamics of higher education sector are stated.

In the field of AI, advancements to new possibilities are very high. These advancements are in use in the teaching-learning process in higher education institutions. This is leading the future of higher education system very closely to be associated with implementation of new intelligent machines and augmenting the internal IT infrastructure of higher education institutions. Since 1950's, AI has been advancing with Alan Turing answering why a system developed by human is 'intelligent'. The imagination game proposed by Turing implicated the capability of a human listener to a distinct conversation with a machine. Alan Turing, the Father of AI, further took this subject forward. In 1950, he wrote *Computing Machinery and Intelligence*. His main aim was to answer the question "Can Machines Think?" to answer this he developed an "Imitation Game" using two subjects in the game and named this game as "Turing Test". That game involved two subjects who did not see, hear and sense each other but communicated in a written format to sense the other subject. The first subject tried to figure out whether the second subject was a human or a machine using written communiqué. That lead to, *Computing Machinery and Intelligence* could not tell or if opted incorrectly, then Turing declared that Turing Test proved that machines could think and respond (Turing, 1950).

During 1956, John AcCathy coined AI for the first time and held the first academic conference. However, much before this period, research started to study the process and journey to understand if a robot/machine could think or not. Further, he defined AI in 1956 as 'a research project to advance an estimation that the feature of intelligence can be described by asserting that an intelligent computer can be programmed to replicate it' (Russell & Norvig, 2010). AI

influences various fields such as biology, linguistics, psychology, medicine, chemistry etc. However, the question is whether a computer is actually thinking or responding based on the programming. Searle formally covered those 30 years later in 1980 in a thought experiment called “The Chinese Room”. In that experiment, “the focus was given to address the idea that the machine in Turing Test is only following the programming/symbols without understanding the concept. The Chinese Room experiment used correspondence of a native English speaker without having any knowledge of how to speak/write/read Chinese who is given a set of rules in English. These rules connect input in Chinese to process output also in Chinese; however, the translator speaks only English. This led various researches in AI to analyze Natural Language Processing and Machine Learning (Searle, 1980).

For this study, a definition inspired by the previous literature in the field is proposed. Hence, AI is a computerized system that enables to involve and engage student-educator in teaching, learning, data analysing, creating and in usage of information for processing different tasks. In this connection, advanced AI systems will support the education sector in enhancing academic and administrative tasks. This is done by virtual teaching-learning, auto-correction, automatic feedback to students, system generated academic advising/counselling, student registration etc.

With drastic advancements in the field of AI, there are new programs and software that apply different elements of AI. These advances are extensively used. For example, Machine learning actively used in the Google search bar, in the Gmail spam filter; Natural Language processing exists in Apple and Google voice, Image processing used for Facebook face identification and Data Mining is a buzzword in software industry etc.

### **2.1.1 Machine Learning**

In AI, the ability to analyze and acquire new knowledge, as well as develop associations between concepts is referred to as machine learning. A machine cannot code accurate responses to all stimuli, yet through this method, a programmed machine can imitate human interaction continually, which gave rise to an extensive study into innovative data-driven learning systems. Ullah et al. mentioned, “in the area of smart cities performed a research. Smart cities aimed to better manage urbanization, energy consumption, the environment, and citizens' economic and

living conditions, as well as improve people's ability to use and embrace current information and communication technologies (ICT). In the smart cities concept, ICT is playing a vital role in policy design, decision, implementation, and ultimate productive services” (Ullah et al. 2020, p. 313).

The primary objective of this review is to explore the role of artificial intelligence (AI), machine learning (ML), and deep reinforcement learning (DRL) in the evolution of smart cities. “The preceding techniques are efficiently used to design optimal policy regarding various smart city-oriented complex problems. In this survey, researchers present in-depth details of the applications of the prior techniques in intelligent transportation systems (ITSs), cyber-security, energy-efficient utilization of smart grids (SGs), effective use of unmanned aerial vehicles (UAVs) to assure the best services of 5G and beyond 5G (B5G) communications, and smart health care system in a smart city. Finally, they presented various research challenges and future research directions where the aforementioned techniques can play an outstanding role to realize the concept of a smart city” (Ullah et al. 2020, p. 313).

Arel and Karnowski stated that:

Mimicking the efficiency and robustness by which the human brain represents information has been a core challenge in artificial intelligence research for decades. Human exposed to myriad of sensory data received every second of the day and are somehow able to capture critical aspects of this data in a way that allows for its future use in a concise manner. The main difficulty that arises, particularly in the context of pattern classification applications, is that the learning complexity grows exponentially with linear increase in the dimensionality of the data. He coined this phenomenon ‘the curse of dimensionality’. The mainstream approach of overcoming ‘the curse’ has been to pre-process the data in a manner that would reduce its dimensionality to that which can be effectively processed, for example by a classification engine. This dimensionality reduction scheme referred to as feature extraction (Arel et al. 2010, p.13).

As a result, Arel et al. stated,

the intelligence behind many pattern recognition systems has shifted to the human-engineered feature extraction process, which at times can be challenging and highly application-dependent. Moreover, if incomplete or erroneous features extracted, the classification process is inherently limited in performance. Recent neuroscience findings have provided insight into the principles governing information representation in the mammalian brain, leading to new ideas for designing systems that represent information. One of the key findings has been that the neocortex, which is associated with many cognitive abilities, does not explicitly pre-process sensory signals, but rather allows them to propagate through a complex hierarchy of modules that, over time, learn to represent observations based on the regularities they exhibit. This discovery motivated the emergence of the subfield of deep machine learning, which focuses on computational models for information representation that exhibit similar characteristics to that of the neocortex (Arel et al. 2010, p.13).

Aziz and Dowling explained in their research, Artificial intelligence and the machine learning techniques that form the core of AI, are transforming, and will revolutionize the financial risk management approach. Everything to do with understanding and controlling risk is up for grabs through the growth of AI-driven solutions: from deciding how much a bank should lend to a customer, to providing warning signals to financial market traders about position risk, to detecting customer and insider fraud, and improving compliance and reducing model risk. In this chapter, current machine learning, AI techniques and current applications of those techniques are being detailed. Furthermore, to envisage the future role for fully AI solutions as the natural next step after the widespread adoption of

machine learning in helping the organization to manage risk (Aziz & Dowling 2019, p. 34).

Researchers Aziz and Dowling explained in detail that:

A first step is defining what AI and machine learning mean, and this is not necessarily a straightforward distinction. In a glib sense, the public relations and fundraising functions of start-ups tend to use the more attractive AI term when they most often mean machine learning, but even in research, there is a reasonably fluid distinction. AI is most commonly viewed as intelligence demonstrated by machines, with intelligence being defined with reference to what we view intelligence as in humans. As it matters to risk management, they are normally particularly interested in artificial super intelligence; that is machines can demonstrate a risk management specific intelligence higher than human intelligence in this field. To compare the two terms in a more technical manner, they mentioned machine learning is a core technique of AI involving learning from data, but that AI often involves additional techniques and requirements (Aziz & Dowling 2019, p. 35).

The researchers added that:

A full AI solution would be automated in terms of data identification, data testing, and making decisions based on the data testing. In practice, AI might involve additional techniques in addition to machine learning, such as including hard-coded and logic rules. Machine learning on the other hand normally involves manual data identification and testing by the data scientist and human decisions as to how to apply the outputted information. Given the lack of technological and organizational readiness for pure AI, and the reality that most claimed AI is in fact machine learning, in this section they outlined

the core machine learning techniques applied to risk management. Furthermore, discussion more towards AI as the logical next step to follow from the widespread usage of machine learning techniques. Machine learning falls into two broad categories of supervised and unsupervised machine learning. In supervised learning, you have input data that you wish to test to determine an output. This is similar to how in traditional statistics terms you have a range of independent variables that you test to determine relationship with the dependent variable. In unsupervised learning, you only have input data and wish to learn more about the structure of the data. Regression machine learning is the closest group of techniques to that usually applied in traditional determination of the causal relationship between variables. In simple terms, a traditional linear regression equation for a credit lending risk assessment as perhaps the dependent variable being the risk of loan non-repayment, which was explained by a range of independent variables that influence the risk of loan non-repayment. These independent variables might, for example, include financial measures such average non-repayment rates, whether the person is full-time employed, whether they have a good credit history, and whether they own property (Aziz & Dowling 2019, p.36).

Ma & Sun explained that:

Artificial intelligence agents driven by machine learning algorithms are rapidly transforming the business world, generating heightened interest from researchers. In their paper, researchers review and call for marketing research to leverage machine-learning methods. They provide an overview of common machine learning tasks and methods, and compare them with statistical and econometric methods that marketing researchers traditionally use. They argue that machine-learning methods can process large-scale and unstructured data, and have flexible model structures that yield strong



predictive performance. Meanwhile, such methods may lack model transparency and interpretability. They discuss salient AI-driven industry trends and practices, and review the still nascent academic marketing literature, which uses machine-learning methods. More importantly, they presented a unified conceptual framework and a multi-faceted research agenda” (Ma & Sun, 2020, p. 481).

Additionally, they focused on the “five key aspects of empirical marketing research: method, data, usage, issue, and theory. They proposed a number of research priorities, including extending machine-learning methods and using them as core components in marketing research. Using the methods to extract insights from large-scale unstructured, tracking, and network data, using them in transparent fashions for descriptive, causal, and prescriptive analyzes, using them to map out customer purchase journeys and develop decision-support capabilities, and connecting the methods to human insights and marketing theories. Opportunities abound for machine-learning methods in marketing, and we hope our multi-faceted research agenda will inspire more work in this exciting area (Ma & Sun 2020, p. 481).

### **2.1.2 Natural Language Processing**

Human language is complex and subjective. The standard form of communication with machines uses keyboard. This process is different from human’s interaction, for example, a very simple reason in human communication, red in red hair is different from red in apple. This is a fundamental problem to represent symbols/words and leads to a big hindrance to the progress of Natural Language Processing. Current Natural Language Processing can identify spoken words and even translate them. Yet, in AI, it is primitive in terms of fully understanding human conversation. Sun and his team of research scholars stated, “the prevalence of social media on the Internet, opinion mining has become an essential approach to analysing so many data. Various applications appear in a wide range of industrial domains. Meanwhile, opinions have

diverse expressions that bring along research challenges. Both of the practical demands and research challenges make opinion mining an active research area in recent years. In this paper, they presented a review of Natural Language Processing (NLP) techniques for opinion mining” (Sun, Luo & Chen, 2017, p. 10). First, in this research an introduction was given in general NLP techniques, which are required for text pre-processing. Furthermore, investigation was done in the approaches of opinion mining for different levels and situations and comparative opinion mining and deep learning approaches was introduced for opinion mining. Lastly, challenges and open problems related to opinion mining were stated (Sun, Luo & Chen, 2017).

Zhang along with co-researchers stated that:

Workplace safety is a major concern in many countries. Among various industries, construction sector is identified as the most hazardous work place. Construction accidents not only cause human sufferings but also result in huge financial loss. To prevent reoccurrence of similar accidents in the future and make scientific risk control plans, analysis of accidents is essential. In construction industry, fatality and catastrophe investigation summary reports are available for the past accidents. Text mining and natural language process (NLP) techniques are applied to analyze the construction accident reports. To be more specific, five baseline models, support vector machine (SVM), linear regression (LR), K-nearest neighbour (KNN), decision tree (DT), Naive Bayes (NB) and an ensemble model are proposed to classify the causes of the accidents. Besides, Sequential Quadratic Programming (SQP) algorithm is utilized to optimize weight of each classifier involved in the ensemble model. Experiment results show that the optimized ensemble model outperforms rest models considered in this study in terms of average weighted F1 score. The result also shows that the proposed approach is more robust to cases of low support. Moreover, an unsupervised chunking approach is proposed to extract common objects which cause the accidents based on grammar rules identified in the reports. As harmful objects are one of the major factors leading to construction accidents, identifying such objects is extremely helpful to mitigate potential

risks. Certain limitations of the proposed methods are discussed and suggestions and future improvements are provided (Zhang et al. 2019, p. 238).

### **2.1.3 Human-Machine Interaction**

Nowadays, many people are required to interact with a computer, which is different from interacting with a human. This needed a push towards human centered interfaces, emphasizing to remove mechanical feeling inputs from computers/machines and adapting them to behave more like a human. This urges insistently for video input and a technique to track facial expressions, emotional hints to track human actions and recognize action needed. This leads machines for a crucial step to understand the complete picture and not only respond to basic verbal commands. AI has already been accelerated and its reflection in higher education is seen through the usage of technology supported by IBM supercomputer, Watson. This technology is based on algorithms that are suitable to complete repetitive and predicable tasks. This is an example of the impact of AI on administrative work in higher education institutions. Adoption of this technology is changing the quality of services, saving time and improving the structure of workforce. However, some AI solutions are dependent on programming and some have integral capacity to understand patterns and make predictions. AI branch of Google could beat the world's best player Go which is a very complex board game and AlphaGo software developed by DeepMind are the examples. Thus, 'machine learning' is a subfield of AI that uses software to identify patterns, to make estimations/predictions and to apply a new pattern to the situation, which was not part of in the initial design (Gibney, 2017).

The term AI is including efforts to understand human intelligence by recreating a mind within a computer, as well as efforts to design technologies that accomplish tasks that are linked with some level of human intelligence (Broussard, 2018; Frankish and Ramsey, 2014).

The concept of AI used in this article is based on the latter definition, with an emphasis on the pragmatic goals of AI and the technology designed to do certain activities in the communication process that were previously performed by people. Conversational agents, social robots, and automated-writing software are all examples of communicative AI. The advancements in the AI subfields of Natural Language Processing (NLP) and

Natural Language Generation (NLG) have largely driven the development of these technologies (NLG). NLP and NLG have the interwoven aims of processing human communication well enough for machines to understand communications delivered in human language rather than machine language, and producing messages in human language at their most fundamental level (Allen, 2003).

“AI technologies of communication are designed as something with which people exchange messages, a departure from the historical role of media developed as the means through which people communicate with one another” (Gunkel, 2012).

It is true that talking technologies existed before AI, such as car navigation systems; however, interaction with these devices was restricted to using a narrow range of rote commands. Technology did not adapt to user, context, or message. Interactions with AI-enabled devices and programs are dynamic rather than static, contingent upon the messages being exchanged within a particular moment and context or upon the data being fed into the program. Some AI technologies also are responsive to individual users, learning about their human communication partner and adjusting interactions accordingly. Some scholars go as far as to argue that emerging technologies, such as robots, not only surpass the interactive capabilities of previous devices but may eventually push past the boundaries of human communication in their integration of multiple modalities of communication (Peter & Kühne, 2018, p. 73).

In the area of design and function, the technologies used in AI and positioned at a complex level are playing as an effective communication partner.

“In the field of AI, research in human–computer interaction (HCI) has revealed that when technologies directly exchange messages with people, particularly when integrated with human social cues, the devices and programs are understood as different social actors, according to the researchers (Nass, Steuer, & Tauber, 1994). People use their understanding of human

interaction to make sense of and direct their interactions with the media (Reeves & Nass, 1998). Despite the fact that people are aware that a human created the computer, researchers have discovered that people address their communications to the gadget rather than the programmer (Sundar and Nass, 2000). Even though most individuals are aware that a human designed the computer, studies have observed that people communicate with the device rather than the programmer (Edwards Edwards, Spence, Harris, & Gambino, 2016). People who interact with a digital assistant consider themselves to be exchanging communications with a machine (Guzman, 2019). Communicative AI technologies designed and used as communicators and interpreted by people.

Guzman and Lewis stated in their research “elements of technology design, such as voice, elicit human-like responses toward devices” (Nass & Brave, 2005), “as do anthropomorphic cues, including gender” (Eyssel and Hegel, 2012). For example, “gender has been an important heuristic in guiding the design of AI agents and people’s interactions with them” (Suchman, 2009), “and the degree to which a technology’s gender aligns with cultural expectations within a given context influences people’s perceptions of their computerized partner and interactions with it” (see Nass and Brave, 2005). “A pertinent area of ongoing research includes the study of how people interpret the human and machine-like traits and characteristics of communicative technologies. This may include consideration for verbal and nonverbal attributes (i.e. human/machine, male/female, young/old, embodied/disembodied, mobile/stationary) that inform how to conceptualize the assistant as a communicative subject and, in turn, act toward it. Social responses to human-like cues within technology should not be misinterpreted as evidence that people think of a particular technology as human or behave exactly the same toward a human and device in all aspects of communication” (Guzman, & Lewis, 2020). As Nass and Moon (2000) explain, “people exhibit social behaviours toward technology because they are drawing on knowledge of communication that was first built around human interaction. In some instances, machine characteristics may be more influential in shaping people’s perceptions of technology as a message source” (Sundar, 2008). “Scholars have also found differences in people’s communicative behaviour between people and technology, including AI (e.g. Mou and Xu, 2017) and robots” (Shechtman and Horowitz, 2003). In these instances, “people treated both technology and humans as communicators but as different types of communicators. Therefore, ongoing research should not only be focused on

assessing the similarities between humans and machines in their function as communicators, but should also take into account the differences, so that scholars can develop an understanding of technology as a unique type of communicator” (Guzman & Lewis, 2020, p 77).

Guzman and Lewis indicated, Existing research regarding people’s perceptions of social cues with technology provides scholars with a starting point in the study of communicative AI. However, as we have discussed, the design of emerging AI is more sophisticated than the technologies that were the focus of earlier studies. Given that communicative AI has only recently become more available, much has yet to be learned regarding how people conceptualize and interact with these more advanced technologies within the context of their daily lives. Two key elements of communication theory are space and time (e.g. Innis, 2008), and future research could focus on how these elements factor into the function of AI as communicator and how people perceive it as such. For example, it is now possible to conduct longitudinal studies of how and the degree to which people’s conceptualizations of programs and devices as communicators change over time and across different contexts. Additional questions include to what degree and to what effect people’s interactions with early AI influence their understanding of future generations of AI technology (Guzman, & Lewis, 2020, p 77).

Guzman and Lewis explained the rationale aspects of AI as communicator, it is through communication that people form relationships with one another and that society ultimately forms (Mead, 1967). People’s interactions, thus, are not isolated processes; rather, they unfold within social contexts through which each communicator makes sense of the attributes and traits of the other in relation to the self (Goffman, 1959). All are true of human communication, but what about people’s interactions with AI? In the previous section, we focused on the ways in which a technology functions as a

communicator, including the fundamentals of the type of interaction taking place and the communicative attributes programmed into the technology. Here, we build upon and add to these initial questions by focusing on what we call the relational aspects of AI as communicator: how people understand AI in relation to themselves and themselves in relation to AI (Guzman & Lewis, 2020, p.77).

Furthermore, Guzman and Lewis stated, the purpose of designing technology within an overt social role is to provide people with a mental guide for how they could and should communicate with it (Suchman, 2009). From an HMC perspective, the study of the social positioning of technology includes how a person interprets what a particular technology is in relation to themselves, the factors contributing to such interpretations, and how such conceptualizations inform their interactions. As with the example of the robot journalist, people may also assign social roles to particular technologies designed without overt social cues. Therefore, in addition to studying how people act toward technology designed to enact a particular role, which has been the predominant form of research so far, communication scholars should also take into consideration other aspects of how the role of a technology is shaped, such as through public discourse (e.g. Carlson, 2015). It is also important to note that the study of social roles and relationships are also sites for the investigation of power dynamics between people and technology (e.g. Guzman, 2017) (Guzman & Lewis, 2020, p.78).

In this context, Guzman and Lewis further detailed, AI technologies also raise questions regarding how people view themselves in light of their interactions with these devices (Turkle, 1984). Although technology has long been integral to the formation of self, what intrigues scholars about people's interactions with AI and related technologies is that it

is a human-like entity, instead of a human being, now at the other end of the interaction (e.g. Turkle, 1984; Zhao, 2006). As articulated by Papacharissi (2018), the exploration of the networked self in the age of AI includes not only the ways in which individuals make sense of themselves in their communication with a particular technology but also the ways in which people leverage these technologies to reimagine who they are. Like Spence's (2019) argument that HMC should not be approached as lesser than human-human communication, Papacharissi (2018) advocates for moving beyond the usual tropes regarding technology and the self by interrogating the assumptions surrounding these technologies and how they are studied. And so, here we reiterate the charge we gave to scholars regarding the functional aspects of communicative AI: the study of AI and the self will require researchers to be cognizant of how the anthropocentric conceptualization of communication has informed and shaped the study of the self and take into consideration the ways in which it may need to be rethought in a human-AI context (Guzman & Lewis, 2020, p 78).

#### **2.1.4 Ethics**

The ethics of artificial intelligence is considered as the ethics of technology. This is specific to artificially intelligent systems and divided into a concern with the ethical and moral behaviour of researchers as they make, design, use and treat artificially designed systems. The main debates, first on ethical issues that arise with AI systems as objects, i.e. tools made and used by humans; here, the main sections are privacy, manipulation, opacity, bias, autonomy & responsibility and the singularity. Looking into AI systems as subject, when ethics is for the AI systems themselves in machine ethics and artificial moral agency (Muller, 2020).

In recent years, there is a significant coverage in ethics, artificial intelligence and robotics. Very often, the print and digital media talks about the issues which are under discussion, about the future technology, and about the ethical matters as though people in the field already know and how to achieve that. Furthermore, media coverage focuses on risk, prediction of impact on



the job market and security (Brundage et al. 2018). The result of such discussions is to; identify the technical problems and a process to achieve a desired outcome. In the current scenario, the industry focuses on image and public relation wherein as a label the word 'ethical' is not prioritized more than the term 'green'. In the field of AI ethics, there is a little challenge to do the right things. This leads to job-loss, robbery, and crime when considering the usage of AI and are considered as 'not a problem in ethics'. The big question is, whether these are acceptable and permissible under specific circumstances (Muller, 2020).

Machine ethics means ethics that a machine must follow, which means 'ethical machines'. In this context, ethics must be for machines as a subject but not for the human use of different AI machines as objects. However, it is often very challenging whether this should cover all aspects of AI ethics or a part of it (Floridi et al. 2018). At times, it appears that the uncertain inference is at work here. That is in case of robots operate in ethically significant ways, and then we need a machine ethics. Some of the debate in machine ethics is predicated on the idea that robots can act as ethical agents, who are responsible for their acts and are autonomous moral agents. Moreover, it is unclear whether there is a consistent concept of 'machine ethics,' because weaker/low versions of robotics are in a danger of maintaining 'having an ethics'. This concept would not normally be considered sufficient because these machines are without 'reflection' or even 'action'. Henceforth, stronger concepts that move toward artificial moral agents. So, it is clear ethical issues and the concept of moral agency in artificial systems/machines is a moral necessity (Muller, 2020).

If one considers machine ethics to be about moral agents in some meaningful way, then these agents can be referred to as 'artificial moral agents', with rights and responsibilities. However, the debate over artificial objects or entities leads to a number of challenges with common concepts in ethical assumptions, and it can be quite helpful to comprehend these concepts in isolation from the human scenario (Müller, 2021). The question is, Will the robots be held responsible, liable, or accountable for their conduct if they act. Should the distribution of risk, rather than talks about accountability, take precedence? Several authors use the term 'artificial moral agent' in a less demanding sense, drawing from the term 'agent' in software engineering, in which case questions of responsibility and rights are avoided (Muller, 2020). In a research done by James Moor in 2006, he distinguished machine agents in four types: ethical impact agents, implicit ethical agents, explicit ethical agents and full ethical agents. He further

stated examples for each type. Roboo jokeys as ethical impact agents, safe autopilot as implicit ethical agents, using formal methods to estimate utility as explicit ethical agents and full ethical agents were stated as machines that can take an explicit ethical judgement and carry the competency to justify them. He stated, adults are considered as a full ethical agent. Moor proposed a number of ways to achieve explicit and full ethical agents in his programming such as operational morality. This is done by developing the ethics in functional morality and lastly, full-blown morality was incorporated with full intelligence and sentience (Moor, 2011). The concept of a 'moral patient' appears in some of these discussions. Ethical agents have obligations, but ethical patients have rights, because harm to them matters. Some living things, such as animals that may feel pain but cannot make rational decisions, appear to be patients without being agents. On the other hand, in a Kantian framework, it is often assumed that all agents will be patients as well. Strawson stated in 1998, being a person is often associated with free-will and complete consciousness, and being a person is considered to be what makes an entity a responsible agent, someone who can have duties and be the subject of ethical concerns (Muller, 2020)

Traditionally, responsibility distribution already exists. For example, a car producer is responsible for the car's technical safety; while driving, a driver is responsible to take all safety measures; a mechanic is accountable for appropriate maintenance of the machine and the government is responsible for the road's technical conditions etc. In general, "The effects of decisions or actions based on AI are often the result of countless interactions among many actors, including designers, developers, users, software, and hardware with distributed agency comes distributed responsibility." (Floridi & Taddeo 2018, p. 751). The way in which this distribution occurs is not a problem unique to AI. According to certain authors, it should be seriously studied if modern robots can be given rights (Danaher 2020; Gunkel 2018). In one of the researches done on robot's right by Coeckelbergh stated that position appeared to be based mostly on criticisms and the empirical observation that robots and other non-humans were occasionally treated as though they had rights. In this discussion, a so-called 'relational turn' has been proposed. Which means, if robots are treated as if they have rights, then we might be well advised not to search whether they really do have such rights (Coeckelbergh, 2010). This brings forward two questions such as, how far such anti-realism may go? and the next question is if robots have rights, then is it a human-centred approach? (Muller, 2020).

In one of the draft reports, “The National Artificial Intelligence Research and Development Strategic Plan” in 2016 stated that, “it is a completely separate issue whether robots and other AI systems can be given a legal status, as they are legal persons or legal entities in the sense similar to a human being.” The report also added that, “businesses and other organizations hold a legal entity by having specific legal rights and duties.” Accordingly, The European Parliament has considered allocating a legal status to robots in order to deal with civil liability but not with criminal liability (Parliament, 2016). Based on this report, there is a possibility to assign only certain rights and duties to robots. This is a longstanding argument and discussion to decide whether such legal rights can be given to artificial objects. Furthermore, in environmental ethics the discussion continues if the legal rights can be given to natural objects such as trees! (Stone 1972). Some authors have urged for a suspension of artificial phenomenology among the community of artificial consciousness because producing such consciousness would probably include ethical responsibility to sentiments, such as not harming it or ending its existence by turning it off (Bentley, Brundage, Häggström, & Metzinger, 2018). Future developments in artificial intelligence and robotics have prompted basic challenges about what researchers and developers should do with these systems, what they should do, and what threats they might pose in the long run. As these artificial machines/robots can challenge human status and become a dominant species on the globe. Henceforth, considering the challenges that have been presented, it is always needed to maintain a high level of social and ethical consciousness while using technology and developing artificial machines. Considering the previous issues, advancements must be closely watched while giving social status to machines/robots. Thus, machine ethics is a vital concern and must be carefully interpreted.

Henceforth, ethics of artificial intelligence and robotics has been given significant importance in recent years as we see advancements in this field. This supports the kind of growth in the subject area. The focus is to understand the notion of artificial intelligence as any kind of artificial computational machine that gives or reacts based on some intelligent behaviour which means a kind of complex behaviour that functions based on some codes, algorithms etc. to achieve a goal.

## 2.2 AI in Education

Artificial intelligence is already applied in the field of education mainly in the areas such as tools that help to develop student skills, testing systems etc. Technology is adapted at a global level in the field of education for transforming the way conventional teaching-learning approach change to online and self-learning/independent learning by the learner. The field of artificial intelligence is one of the techniques to customize the experiences of different learners, instructors/tutors.

For decades, a big hype is noticed in and became omnipresent in our daily lives. Technology advancements are evident in the form of intelligent sensors, automatic parking features in cars, smartphones etc. Therefore, AI is playing a vital role in our daily life.

Here are few of the tools suggested in TeachThought (2018) which define educational experience of the future:

1. Automation of grading system using AI: in colleges, grading is one of the tedious tasks which often takes ample time of faculty. AI cannot actually replace human grading, but it can get very closer. Advancements in technology is actually helping in testing methods such as multiple choice, fill-in-the blanks testing and further automated grading of student writing may not be far behind. With advancement in technology, essay writing software is still at infant stage but will surely improve in coming years. These advancements will allow teachers to focus more on in-class activities with more student interactive sessions than grading.
2. Adoption of Educational Software based on student needs: growing number of adaptive learning programs led as one of the key ways in AI with high impact on education. These advanced technology oriented systems are supporting to respond to student needs, putting greater emphasis on certain topics, repetition of certain topics for the benefit of students and in general helps students to work on their own and at their convenient pace. This type of custom-tailored education is a machine-assisted solution which helps students in different levels and to work together in a classroom.
3. AI points areas of improvement needed in course: AI also helps to solve the problem of, teachers not being able to identify the gaps in their lectures and educational materials, which leads to a state of confusion in the student's mind. "Coursera", a massive open online course provider is already putting this into practice. This system helps to identify if a group of

students submit incorrect answers to any home assignment. Adopting this, alerts teacher and leaves a customized message to other future students. Basically, this type of system will help the teacher to fill in the gaps in explanation that can occur in courses. Furthermore, it also gives a feedback to students, which helps them to understand a concept and how it is to be solved the next time around.

4. Additional support from AI tutors: While in current time, still it is obvious that human tutors offer better than machines. Yet, the future could be seen that more students being tutored by tutors that exist in the virtual world. Few of these programs are already available in basic mathematics, writing and other subjects. These are helping to teach fundamentals, but so far they aren't at the level of high-order thinking and creativity. Yet the possibility of AI to rule out this situation is very much possible in the near future. In the past few decades with the rapid growth in technological advancements, it is very evident that advanced tutoring systems may not be in a pipe dream.
5. AI driven programs to give feedback to students and tutors: AI not only helps to craft design a course as per educator and student needs but it also helps in offering feedback to students and tutors. Mainly educational institutions offering online courses are adopting such technology into their system. This is useful to monitor students and alert tutors to inform and issue student performance. Such kind of systems is not only helping to offer feedback, but also to choose majors which are hard to succeed in.
6. As an alerting tool to interact with information: Google adapts results based on user location, Amazon suggest users based on previous purchase, Siri adapts to use needs and commands and furthermore, all web ads are towards user interest/shopping preferences. Such intelligent systems are playing a big role in how a user is interacting in his/her professional and personal life. This could change how to find information in academia as well. With the advancements in AI over a decade, students performing research and looking for facts might get a vast and different experience in the near future.
7. AI could change role of a teacher: Role of a teacher can never be replaced with a machine; however, role and how a system can entail might change due to new technology advancements in the form of computing systems. As AI can take over the tasks of grading, can support students improve learning, and can even substitute for real-time tutoring. Yet, AI systems could be programmed to provide expert advice, can serve students to get potential answers for the queries in their courses. In general, it can shift role of a tutor to that of a

facilitator. Technology is already driving some of these changes especially in online tutoring or in flipped classroom teaching.

8. AI can make trial-and-error learning less intimidating: Trial-and-error is critical part of learning process, but for many students such a thing is paralyzing their thinking. In such cases, an intelligent computer system, which is designed to support students to learn, will be less discouraging and a way to deal with trial and error. AI can offer students an opportunity to experiment and learn in an environment that is relatively free of judgment. In fact, for such students AI is a perfect platform and a format supporting this way of learning, for a simple reason that AI systems usually learn by a trial-and-error method.
9. Data powered by AI can change how schools find, teach, and support students: Intelligent data collection powered by computer systems changed the way that educational institutions interact with students. Such systems are helping students to choose their courses and tailor student needs as per the educational goals. In higher education, data mining systems are already playing a vital and integral role. However, AI has a wide scope to alter higher education systems further. In many higher education institutions, such initiative is already underway to ease the transition from high school to college. Such advancements may also end up with college selection process on Netflix, Amazon with a system recommending an appropriate higher education institution and program, considering student interests.
10. AI may change who teaches students, where students learn, and how students acquire skills: while it may take a few more decades for major changes, the reality is AI has the potential for a radical change in education. Adoption of AI and different kinds of software students can learn from any part of the world and at any time. AI powered educational programs are helping students to gain basic skills but these programs yet need a hype by the developers to use them in higher education learning and to provide students with a wide range of services (TeachThoughtStaff, 2018). This approach enables the learner to choose an alternative sense of making paths with proper guidance. Furthermore, it improves learning resources and better navigational choices in multi-dimensional space.

Student interaction with AI related resources or applications that are available on semantic web are much useful in current higher education system. The instructors to interact with students using varied teaching-learning resources use these web applications as an explanatory approach. Advanced e-learning systems and web applications are used as a source

of information in guiding knowledge and skills in the formal education system. Application of semantic web helps students and teaching faculty to explore multiple paths and gather more subject relevant information. For instance, this helps to specific topics, user friendly and flexibility from the user point of view. However, because it is based on some technology, often brittle, sole reasoning and known concepts. Thus, while adapting such technology in higher education system, linking the learner requirements will help to overcome this instability (Dzbor, Motta & Domingue, 2007). This leads to another AI application, student support, which is a growing use in higher education institutions. The higher education sector started to use machine learning to guide students by using applications that help them automatically register, recommend courses based on the curriculum and in career guidance. Previously student advisors and career guidance office gave such services. These advanced AI systems/tools also help to make recommendations based on how students with similar data profiles interact and communicate. Lastly, higher education institutions can apply artificial intelligence in instruction. This is done through creating systems that respond to individual users' pace and progress. This educational software is called Personalized Learning Platforms that help to assess students' progress, automatically delivers parts of a course, helps students to review course content and also helps with additional resources.

### **2.2.1 Applications of AI for Learning**

Fahimirad and Kotamjani stated in a research carried out by them that, “Higher education is fundamentally associated with advances in innovative technologies and high computational capacities of the intelligent machines. Hence, the developments in the field of artificial intelligence provides new opportunities and challenges for teaching and learning in the context of higher education; moreover, artificial intelligence has the potential to make effective changes in the core design of institutions in higher education. There is no ultimate definition regarding the concept of artificial intelligence among philosophers since Aristotle” (Fahimirad & Kotamjani, 2018, p. 107).

Late in 1950s, extensive research was done in the field of artificial intelligence to investigate advancements and solutions in the field. This led to a first solution by Turing that states, "when a system is considered intelligent" (Russell & Norvig, 2010). "He suggested the simulated game to test the capacity of a human listener to distinguish between a dialogue with a machine and another human; if the system fails to detect this difference, we would admit having artificial intelligence (AI)" (Fahimirad & Kotamjani, 2018, p. 107). John McCarthy coined the most comprehensive definition of artificial intelligence in 1956: "AI is the basis of the assumption that every aspect of learning or any other feature of intelligence can be described precisely the property of machine or program; the intelligence that the system demonstrates." (Popenici & Kerr, 2017).

Fast and vast advances are seen in the field of artificial intelligence and this leads to a higher impact on the nature of services offered in the higher education system. For example, Artificial intelligence is currently progressing at an accelerated pace, and this has an impact on the profound nature of services within higher education. For instance, a university in Australia named Deakin University applied IBM's supercomputer Watson as an advanced artificial intelligence system to offer advising to students (Moles & Wishart, 2016). This invention has a substantial impact on the quality of services provided, as well as the workforce and dynamic time inside the university. As a result, it is important to note that "machine learning" is a rapidly expanding research area in the science of artificial intelligence. Some artificial intelligence solutions are heavily reliant on programming while others have built-in capabilities for making predictions and learning patterns. As a result, the term "machine learning" is defined as a type of artificial intelligence (Schölkopf, 2015). "Machine learning is software that make predictions,



identify patterns, and apply those recently discovered patterns to circumstances that were not covered by their primary design” (Fahimirad & Kotamjani, 2018, p. 107).

Based on the advances in AI, innovative educational technologies have revolutionized the teaching approaches and learning process. Recently in teaching-learning AI approaches are started to deal with new technologies. This led to higher education sector to examine the consequences of innovative technologies. Furthermore, it addressed the challenges in integrating artificial intelligence in educational institutions.

### **2.3 AI in Higher Education**

The higher education system is directly associated with new technology and intelligent machines. Henceforth, developments in this field of artificial intelligence pave a pathway to new opportunities. However, challenges are possible to adapt it in teaching-learning which plays a core value in making effective changes in the design of institutions in higher education. Extensive research is performed in this area to understand and identify current applications in the educational system. Additionally, artificial intelligence has the potential to improve topics within different courses and classes can be tailored considering students’ profiles. In a research performed by Fahimirad and Kotamjani they stated tools that will shape the application of AI in future. They expounded as below:

#### **“Artificial Intelligence Can Automate Grading in Educational Context”**

“Grading homework and tests usually takes a significant amount of time. This time could be used to work on professional development, interact with students and prepare for class. As AI might not truly replace human grading, it’s about to replace human grading. AI automated grading is able to grade nearly fill-in-the-blank and all kinds of multiple choice testing. However, essay-grading software is still in its early stages yet and it will be improved over the coming years”.

#### **“Students Could Receive Supplementary Support From AI Tutors”**

“It is obvious that human tutors can teach some subjects that machines are not able to teach; however, students will be tutored by Artificial intelligence machines. Currently, there are some tutoring programs which are based on artificial intelligence to help students through writing, basic mathematics, and other subjects. These AI programs can instruct students only basics subjects; however, these machines aren't perfect to teach high-order thinking and creativity to students. With the rapid advancement of technology, advanced tutoring systems might not be an unattainable dream”.

#### **“AI programs Can Give Students and Lecturers a Constructive Feedback”**

“AI has the potential to provide feedback to lecturers and students about the success of the course. Some schools employ AI systems to track and monitor students' progress and to notify professors if there is an issue with students' performance. Moreover, these AI systems provide students with the appropriate support and provide professors with feedback to improve the instruction in the related subject matter”.

#### **“AI Can Alter the Role of Teachers”**

“AI able to take charge of various tasks such as grading, giving constructive feedback on students' performance. Furthermore, they even might be a substitute for teaching. They could be programmed to provide knowledge, to ask questions and find information for very basic course materials. However, in several cases of application of AI in education, AI has shifted the role of the teacher to a facilitator. Teachers can integrate AI lessons as supplementary materials to assist weak students and provide hands-on experiences in the form of human interaction for students”.

#### **“AI Makes the Process of Trial-and-Error Learning Less Daunting”**

“AI systems have been designed to assist students in the process of learning, in this context, trial and error process is much less intimidating to students. Since AI systems

provide students with fairly judgment-free environment of learning, moreover, as AI tutors can suggest solutions to students' performance. Indeed, AI is considered as an optimum system for learning, because AI itself frequently learn through a trial-and-error method".

Finally, Fahimirad and Kotamjani stated, AI systems may change the way students learn, and assist them to develop basic skills. In fact, recently artificial intelligence is about to change fundamentally the process of learning in educational contexts. AI programs are substituting particular types of classroom instruction by providing support for students to learn from anywhere in the world at any time. In addition, in future, AI system might replace lecturers in some subjects. Currently, some educational programs are equipped with AI, scaffolding students to learn basic skills. However, as AI program developers are advancing, AI will more likely provide students with extensive range of services. AI systems provide this level of insight to not only save time, but also can provide teachers with more details which may not be obvious or possible for teachers to identify them. Classroom AI systems have a high capability to analyze multiple sources of data and compare those data to known patterns. They can recognize the source for problems and also give guidance to lecturers to achieve more consistent outcomes across various classes (Fahimirad & Kotamjani, 2018, pp. 110-111).

As a positive consequence of implementing the above AI solutions, a massive change and a revolution can be expected in the education sector. This change will support the education sector to track curriculum, teaching-learning process, tutoring, grading and feedback sessions using advanced AI systems. Henceforth, the effective automatic teaching/learning process will lead to achievement of learning outcomes. Lastly, high tech systems will also lead to students having a great potential to adapt advanced learning ways.

### **2.3.1 Developments of AI in the context of Higher Education**

In the research done by Fahimirad and Kotamjani they stated that Artificial intelligence (AI) is defined as a system, tools or machines that are widely used in educational institutions at the global level. Smart phones, internet, different applications and search engines are some of advanced technologies used. Such a kind of technology is developed using artificial intelligence and a complicated set of software mainly in iPhone's Siri (Shulman & Bostrom, 2012). Although this kind of technology/Siri can be classified as low-complexity AI, it has been classified as an artificial intelligence project in the United States since 2001. This application was first used in the iPhone operating system in 2007. Google has been able to deploy AI in its search engines. Furthermore, AI is incorporated in all new cars' engines, brakes, and navigation systems. Some well-known corporations like Volvo, Google, and Mercedes-Benz, have made self-driving technology a top priority for research (Beam & Kohane, 2016). In 2015, this technology was put to the test for the first time in Australia. Self-driving technology are prominently used in the mining industry. Furthermore, self-driving trucks are used in Australia for a variety of purposes (Hillier, 2015).

Students are currently at the core of learning and teaching issues in higher education. Human-AI contact is seen as a type of solution or partnership that can help people with disabilities all around the world. As a result, these technologies may encourage people to use AI in higher education. It can encourage students and teachers to become more involved in the learning process. Furthermore, this also motivates both learners and instructors to get more engaged in the teaching-learning process (Kelley & Knowles, 2016). "Based on (Programas de las Naciones Unidas para el Desarrollo, 2015), complex-computing systems that use the machine learning algorithms are able to help individuals with different kinds of abilities. Moreover, to some degree, they are involved in some human-like processes, and they can do some complicated tasks in the world of teaching and learning. Thus, a new era for higher education is opened for institutions" (Fahimirad & Kotamjani, 2018, p. 108).

This type of human-machine interaction is a game-changer in terms of assisting humans in learning and remembering knowledge. However, the question of how long it takes for this form of interface (AI) to raise the degree of memory and cognition in humans remains unanswered. According to MIT researchers, there will be some changes in the way technology is used in

education, particularly after 2007, when the first iPhone models hit the market. Not only is the iPhone a new technology that allows us to access and use information that was previously unavailable, but it also represents a significant cultural shift that has an impact on people's social life (Liebowitz, 2001). "However, if the emphasis of "cyborgs" shifts from science fiction to the computer application for both teachers and learners, 'cross-breeds' or cyborgs of human and machines can be manifested in the world of education in near future" (Fahimirad & Kotamjani, 2018, p. 108).

The impact of artificial intelligence on the economy can be seen, which has piqued the interest of many observers. Google made the greatest investment (\$400 million) in the acquisition of Deep Mind technology in the European Union in 2014. DeepMind Technologies, which is now known as Google DeepMind, is a London-based artificial intelligence business that can be utilized in machine learning. Surprisingly, Google made another Artificial Intelligence investment in the German Research Centre (Lanctot et al., 2017). Artificial intelligence is a field in which some of the world's most powerful companies, like Apple, Google, Microsoft, and Facebook, compete and invest heavily in new applications and research. According to a Google research from December 2015, a new computer model known as the D-Wave 2X is capable of doing complicated AI tasks (Caplar, Tacchella, & Birrer, 2017). This computer model is far quicker than modern computers. According to Google experts, it represents a huge step forward in the field of AI. "We think it will aid researchers in developing more efficient and accurate models for everything from speech recognition to online search and protein folding," says the team (ElSayed, Thomas, Marriott, Piantadosi, & Smith, 2015).

Investing in AI has the potential to alter academic settings. Perhaps the financial difficulties faced by students in higher education are compelling reasons to explore AI solutions. The connection of a machine and a human brain is possible, as shown in the previous examples, and this issue presents a challenge for teachers to explore for new dimensions, functions, and pedagogies in a variety of contexts for students to learn. For example, the brain-computer interface has piqued the interest of researchers all over the world. Professionals in the field of computer have developed several ways for managing software with a brain-computer interface by combining analysis methods and brain signals with some approaches in modern computing systems (Kena et al., 2015). The brain-computer interface is capable of capturing and decoding

brain activity. Furthermore, it can facilitate communication among persons who have motor function difficulties (Pandarinath et al., 2017). The rapid advancement of technology, which allows us to apply AI functions, has improved our talents and capacities. “Innovation in education is not just about putting more technology in more classrooms; it is about transforming teaching methodologies so that students gain the skills they need to flourish in competitive global economies,” Schleicher explained (Schleicher, 2012).

Fahimirad and Kotamjani stated in educational system, the educational goals can be better achieved and managed by artificial intelligence (AI). By using AI instructors can analyze students in a class and recognize who is a slow learner to understand the topics. If a student has some weaknesses in some areas or he/she fails to understand few topics, consequently AI analysis would showcase this report to lecturer or parents then appropriate action can be taken by a lecturer to scaffold learning” (Fahimirad & Kotamjani, 2018, p. 109). Moreover, “Artificial Intelligence has the potential to draw attention to which topics of courses need to be improved, since lecturers might not always be cognizant of gaps in their educational materials which can lead to students’ confusion. Classes can be tailored according to students’ profile and students’ interests can be stimulated by exposing them to various content and courses” (Fahimirad & Kotamjani, 2018, p. 110). Besides, “AI can assist lecturers in terms of homework. For an instance, Coursera which acts as an enormous open online course provider, evaluates students’ responses to a problem. As Coursera found that a large number of students submitted the incorrect answer to a homework, the teacher is alerted through the system and the system gives prospective students a message to offer clues to the right answer. This AI system contributes to provide explanation of courses, and to ensure that all students are building the same conceptual basis (Fahimirad & Kotamjani, 2018, p. 110).

Furthermore, Fahimirad and Kotamjani stated, lecturers with the ability to employ technology for their teaching strategy can gain the advantages of automatic data created from students' engagement. Since these digital information systems are prone to store and process huge amounts of information quickly in a short time. Apart from these specialized algorithms, these systems could identify the level of students' engagement and make sense of their behavioural patterns that appear in a teacher's class and could inform these results to the teacher. The application of this technology assist lecturers to manage their classes appropriately and they can spend less time on paperwork and spend more time on obtaining invaluable insights from AI tools to deliver higher quality research-informed teaching (Fahimirad & Kotamjani, 2018, p. 108). This research focuses and explains only a few tools that will shape the application of AI in educational situations in the future have been discussed in this study.

### **2.3.2 Impact of AI in Higher Education**

Fahimirad and Kotamjani indicated, "since artificial intelligence solutions have potentiality to transform university administrative services, teaching and learning may experience a totally a various range of challenges" (Fahimirad & Kotamjani, 2018, p. 113). For Perez (2016), AI systems are capable of automating tasks. However, it is impossible to believe that they will be able to complete the more difficult duties associated with higher education (Soto et al., 2012). Fahimirad and Kotamjani stated some examples of how AI can be used to improve teaching and learning in the educational system. However, there are significant restrictions to the use of technology; AI cannot be a substitute for teachers. Computing algorithms now have an impact on every element of people's lives, from credit ratings to employability. To date, higher education has been at the center of this massive transformation, and it has the potential to create both benefits and hazards. From a scholarly standpoint, this crucial problem requires attention and analysis. As a result, we should look for solutions in the field of education, and technological growth will be a common solution (Bengio et al., 2013). The use of technology in higher education is appropriate when it improves research, teaching, and learning possibilities and capabilities.

The goals of this study are consistent with the goals of previous research in this area, such as the "National Artificial Intelligence Research and Development Strategic Plan". According to the report, AI increased human capabilities and the barriers between people and artificial intelligence were being dismantled (National Research Council, 2012).

Indeed, the advancement of machine learning and AI in higher education has created both opportunities and challenges. However, it is critical to remember that education is a human-centered effort rather than a technological answer. Despite rapid advancements in AI, relying only on technology is incorrect. As a result, it is critical to concentrate on the idea that human beings must perceive difficulties and hazards for themselves. They should also inquire about privacy and control when it comes to the demand of encouraging creativity. Furthermore, they should leave room in the learning and teaching process for serendipity routes (Council, 2011).

Fahimirad and Kotamjani explained that, the motive for AI is like a panacea in higher learning and leaves those who are in the path under the wheels of reality. However, an important issue in education is maintaining academic scepticism. Generally speaking, we need to consider this aim to nurture responsible citizens and educated minds” (Fahimirad & Kotamjani, 2018, p. 114). They further stated, “enhancing human thinking and increasing the teaching and learning process is the main aim of technology in education. With the increasing application of AI, it is essential for academic institutions to be informed of whether controlling over algorithms is not monopolized by tech-lords” (Fahimirad & Kotamjani, 2018, p. 114). For Pasquale (2015), decision making must be automatically based on human reflections (Secundo, Vecchio & Passiante, 2015). Fahimirad and Kotamjani concluded, “the quick advancements of AI can be doubled by universities when they try to look for some economic solutions to stabilize the budgets. In education, there is an ability to change a number of teaching assistants and administrative staff. Thus, exploring the impacts of these factors on learning is very



essential. These impacts will be profound especially in contexts that there are demands for initiative and creativity for graduates (Fahimirad & Kotamjani, 2018, p. 114).

### **2.3.3 COVID19: Emergency Remote Learning in Higher Education**

In a research carried out by Ho, Cheong and Weldon, they stated that “despite the wide adoption of emergency remote learning (ERL) in higher education during the COVID-19 pandemic, there is insufficient understanding of influencing factors predicting student satisfaction for this novel learning environment in crisis (Ho, Cheong, & Weldon, 2021 p. 1). Ho et al. further explained in their research, “to date, the COVID-19 (2019–2020) outbreak has had widespread repercussions to the lifestyle and working mode for most people. Countries and cities continue to be locked down to promote social distancing and prevent excessive gatherings, controlling the further spread of COVID-19” (Di Renzo et al. 2020). “Due to the unpredictable length of this pandemic, most education institutes have adopted emergency remote learning (ERL) via online learning platforms, to replace most, if not all, face-to-face theoretical and practical lessons. Even programs traditionally taught in person have rapidly shifted to online learning, to fulfil education obligations and avoid delaying students from graduating, pursuing further education, and obtaining employment. This use of fully remote online teaching and learning to continue the education that had been enforced, led to issues with lesson delivery and planned pedagogical methods. Therefore, unlike traditional online learning, the objective of ERL is to provide quick, temporary, and reliable access to teaching support. Limited studies have addressed student satisfaction during ERL, due to the emergency of the pandemic” (Aristovnik, Keržič, Ravšelj, Tomažević & Umek, 2020; Shim & Lee 2020; Almusharraf, & Khahro 2020; Alqurshi, 2020; Shahzad, Hassan, Aremu, Hussain & Lodhi, 2021 and Fatani, 2020). In this research the objective was to analyze student satisfaction level during the emergency remote teaching-learning process.

With advancements in technology and use of AI in developing E-learning, a considerable diversity is noticed in the statistical and research methods used (Jung & Won, 2018). “The simplest, straightforward, and easy to interpret modelling methods may be multiple regression, which has been widely adopted in previous literature examining important factors influencing student satisfaction” (Al-Adwan & Smedley 2013). “More recently the use of artificial intelligence-related data mining techniques, such as machine learning, for predicting students’ performance

in higher education has been extensively used” (Saa, Al-Emran & Shaalan, 2019). Therefore, in the research carried out by Ho et al. “next objective is to compare the performance of machine learning and traditional multiple regression models. Meanwhile, focus is given to combine the use of machine learning algorithms and multiple regression to provide additional insights into the application of novel artificial intelligence techniques for future similar studies” (Ho, Cheong & Weldon, 2021).

Ho et. al stated, “numerous studies regarding online learning across higher education have been conducted, that have enhanced both the understanding and practical implications of adopting different modes of online learning, such as blended, asynchronous, and synchronous learning” (Jung & Won, 2018). Student satisfaction is one of the important indicators to determine the better performance and effectiveness of e-learning in higher education. In the e-learning systems success model, it was proposed that student satisfaction is one of the key components to determine e-learning success. Henceforth, understanding the key factors that influence student satisfaction will help to improve online teaching-learning and designing courses (Hidalgo, 2019).

### **2.3.3.1 Current Theories for Satisfaction in E-learning**

Students' happiness with E-learning has been identified and influenced by a number of elements. DeLone and McLean devised an early E-learning study model in 2003 that was primarily centered on the quality of information, technologies, and services that determined user satisfaction (DeLone, W. H., & McLean, E. R. 2003). During the COVID-19 epidemic, this model was used to compare E-learning achievement between male and female students in Malaysian universities. The user satisfaction approach is another important method for establishing a theoretical framework in E-learning research. Yamoah (2020) used a 7-point Likert-scale to measure satisfaction with E-learning in developing nations' higher education like Ghana (Imam et al., 2019). Domains of course design, delivery, interaction, and delivery environment were among the question items in their study. Despite the fact that the study period coincided with the epidemic, that study did not focus on ERL. Other technological acceptability and E-learning quality models have been established, with an emphasis on usefulness and ease of use, in addition to the aforementioned models (Al-Fraihat, Joy & Sinclair, 2020), (Abdullah & Ward, 2016). Al-Fraihat et al. (2020) developed a multidimensional conceptual model to evaluate the EESS model more

holistically due to the distinct characteristics, strengths, and limits of each study model (Al-Fraihat, Joy & Sinclair, 2020).

In 2020, Shim and Lee conducted a thematic analysis of the universities' experiences with ERL during the COVID-19 epidemic in South Korea without using the aforementioned models (Shim & Lee, 2020). Alqurshi (2020) employed a custom-made questionnaire with 5-point Likert-scale items to analyze student satisfaction in different Saudi Arabian schools, concentrating on virtual classrooms, course completion learning outcomes, and alternative assessments (Alqurshi, 2020). While the deployment of ERL during the COVID-19 pandemic was abrupt, these previously mentioned theoretical models were built to evaluate pre-planned E-learning. Apparently, the direct use of E-learning research models may not adequately reflect the underlying factors affecting the success and satisfaction of ERL. As a result, EDUCAUSE recently designed a custom survey kit for schools to quickly use in order to collect input from higher education stakeholders (Ho, Cheong, & Weldon, 2021). "Therefore, the subsequent literature review has been primarily based on the items and constructs proposed in the EDUCAUSE survey kit, while taking reference from the components of the multidimensional EESS model (Ho, Cheong, & Weldon, 2021, p.3).

### **2.3.3.2 Readiness and Accessibility**

The first section of the EDUCAUSE survey kit (2020) focuses on technological concerns and challenges encountered during the shift to online learning (Ho, Cheong, & Weldon, 2021). "Questions included the level of discomfort and familiarity of instructors and students while using technological applications, the adequacy of digital replacements for face-to-face collaboration tools (e.g., whiteboards), and accessibility to a reliable internet connection, communication software, and specialized software and tools" (Ho, Cheong, & Weldon, 2021, p.4). According to Al-Fraihat et al., (2020), the original DeLone and McLean model assumed a direct relationship between system quality and student happiness (2003) (DeLone, & McLean, 2003), (Al-Fraihat, Joy, & Sinclair, 2020). Similarly, another research reveals that when it comes to E-learning, greater system quality has a beneficial impact on student satisfaction (Cidral, Oliveira, Di Felice, & Aparicio, 2018). "In the EESS model, the technical system quality has several subset items including ease of use and learning, user requirements, and the systems features, availability, reliability, fulfilment, security, and personalization" (Ho, Cheong, & Weldon, 2021, p.4). Al-Fraihat et al. (2020) identified various barriers to E-learning adoption in poor and developed countries

(Al-Fraihat, Joy & Sinclair, 2020). For example, “resources, accessibility, and infrastructure are more important for developing countries while information quality and usefulness of the system are more important in developed regions. However, low-income families may also exist in developed countries, and students from relatively poor living environments may face similar problems as those living in the developing countries, although the technological infrastructure of higher education institutes is better developed (Ho, Cheong, & Weldon, 2021, p.4).

Self-efficacy, defined as an individual's belief in his/her own ability to complete a task, challenge, or successfully engage with instructional technology, was also found to be linked to student satisfaction (Wang & Degol, 2014). Recently, Prescott stated, self-efficacy, defined as an individual's belief in his/her own ability to complete a task, challenge, or successfully engage with instructional technology, was also found to be linked to student satisfaction (Prifti, R. 2020). Similarly, Geng et al. (2019) stated, technology readiness was demonstrated to have a favourable impact on learning motivation during blended learning in higher education (Geng, Kris, Law & Ben, 2019). Interestingly, a recent research carried out by Alqurashi (2018) implies that university students had become more competent and confident in using technology when performing online learning. Alqurashi (2018). He also reported inconsistent findings about the impact of students' self-efficacy for using technology on student happiness (Alqurashi, 2019). However, when performing ERL in Poland during the COVID-19 epidemic, Rizun et al. (2020) confirmed that self-efficacy levels did alter students' acceptance in terms of perceived ease of use and usefulness. Because the circumstances in well-planned and structured E-learning differ from those in ERL, it's critical to evaluate essential constructs like accessibility and students' preparation, including self-efficacy, in order to define ERL effectiveness (Rizun & Strzelecki, 2020).

### **2.3.3.3 Instructor, Assessment, and Learning**

Learning and education-related topics are in the focus of the EDUCAUSE survey kit. Personal preferences for face-to-face learning, evaluation criteria, students' attention to remote classes and activities, instructor availability and response, and whether the original lectures were properly transferred to a remote format are among the focused questions. As two-way communication between the instructor and students, Alqurashi (2019) demonstrated the necessity of effective learner-instructor engagement.

Furthermore, this research uses multiple regression to show that the learner-content interaction is the most important predictor of student satisfaction, which backs up the findings of Kuo and team (Kuo, Walker, Schroder & Belland, 2014). “By providing user-friendly and accessible course materials, assists in the motivation of students’ learning and understanding, in turn leading to increased student satisfaction. Meanwhile, the authors recommended students should pay more attention to the feedback and responses from the course instructors, such as asking and answering questions, receiving feedback, and performing online discussions.” (Ho, Cheong, & Weldon, 2021, p.5).

Muzammil and team of research scholars in 2020 used a structural equation model to establish comparable findings in Indonesian higher education (Muzammil, Sutawijaya & Harsasi, 2020). They discovered that student-tutor interaction had a major impact on student engagement, whereas student satisfaction was heavily influenced by engagement. Pham et al. (2019), who found that the instructor’s capacity to give quality E-learning provisions influenced the satisfaction and loyalty of Vietnamese college students, further proved this. Students’ perceptions of E-learning instructor quality were gathered through a series of questions centered on the instructors’ knowledge, responsiveness, consistency in delivering good lectures, organization, class preparation, encouragement for interactive participation, and whether the instructors have the students’ best long-term interests in mind. Carpenter and his core searchers recently emphasized the topic of students’ “illusional learning,” in which well-rehearsed lectures delivered by enthusiastic and engaging instructors might inflate students’ subjective impressions and evaluations of learning (Carpenter, Witherby & Tauber, 2020). “Since the evaluation of teaching effectiveness and quality of teachers from the students’ point of view may have a strong bias, when designing a questionnaire concerning the instructor and E-learning for students, the focus should be placed on the familiarity in E-learning technology, responsiveness, and availability rather than teaching quality, performance and usefulness.” (Ho, Cheong, & Weldon, 2021, p.5)

Ho, Cheong, and Weldon stated:

with the accelerated use of ERL under the strong pressure induced by the COVID-19 pandemic, there is an urgent need to investigate the perception from students' perspectives in such a novel education strategy. Firstly, find accurate models between machine learning algorithms and multiple linear regression, and subsequently predict student satisfaction on ERL with the selected model as well as identify relevant important features/predictors. It provided insights into both the statistical methods and relevant predictors in determining the student satisfaction on ERL in higher education. The use of feature selection pre-processing techniques such as RF-RFE and the verification of model accuracy with testing dataset should be considered as necessary routine procedures to safeguard the selected model against inflated performance. With the more accurate predictive model and precise important features used for further analysis, the empirical results of this study provided insights to both teaching faculties, managerial staff, and administrative personnel for what should be focused on to maximize the learning experience and teaching performance using ERL during the crisis for higher education (Ho, Cheong, & Weldon, 2021, p.22).

The research done by Ho, Cheong and Weldon concluded, the findings from this study indicate that higher education institutes should put a high emphasis on facilitating and improving the efforts made by instructors, modulation of assessment methods to better accommodate the workload, appropriateness, and fairness for all the sudden changes using ERL during a crisis, preparing contingency plan and other alternative learning activities or resources to supplement the inadequacy, or learning deficits in ERL. Moreover, it is important to rule out the underlying reasons why face-to-face learning is more preferable for students from the different program such that course providers and

teachers can provide specific and tailor-made courses, learning activities, contents, and implementation methods to enhance the learning experience and maximize the students' satisfaction (Ho, Cheong & Weldon 2021, p 23).

Up to date, spread of Covid19 at the global level is still affecting on the lifestyle and working mode for most of the industries. Countries continue undertaking the lockdown and social distancing. This has an impact on the education sector and most of higher education institutions at the global level opted for a sudden shift from conventional education to emergency online education/remote learning mode. The educational institutions to replace face-to-face theoretical and practical sessions adapted different platforms. However, online education is not something completely new to the sector. Furthermore, the immediate measures, which were taken by the education sector showed that the majority of students were competent in technology and did not have any obvious issues in accessing learning devices or using new platforms. As from the instructors' perspective, many efforts were put in adjustment to assessment methods.

#### **2.4 Model for Corporate and Educational Governance (CEG)**

An effective governance system is very important in the higher education system because it provides a clear framework for stakeholders. Such a system will pave a pathway to have right leadership and to pursue its objectives. The main principle of corporate governance is to define the relationship between shareholders and management. This helps higher education institutions to maintain its relationships and also to ensure sustainability by adhering with specific principles, policies & regulations. These principles are the basis for a well-run of higher education institute by following certain steps such as transparency, accountability, well-informed decision making, adherence to purpose and dedication to its stakeholders. Thus, the work of corporate governance is ongoing and a significant process.

Corporate governance plays an important role in profiting and non-profiting private sector, where relationships of owners, management, directors of the institution and employees of the organization are taken into consideration. It's a management application system which helps in planning, directing, reviewing, organizing and encouraging best practices. A good corporate governance system pushes an organization to apply better corporate objectives; this

will support the organization in preserving its resources, to maintain the community recognition and acceptance create greater value and ways to create more capital investment, leading to long-term success of the corporation (OECD, 2003).

“In education, CEG can be defined as the processes that guarantee the efficient and effective use of resources to enable the organization to achieve its overall goal of transmitting established knowledge to new generations along with the power to make this knowledge evolve” (Gomede, Gaffo, Brigano, De Barros & Mendes, 2018, p 3).

Table 2.1: Educational governance drivers and Stakeholders.

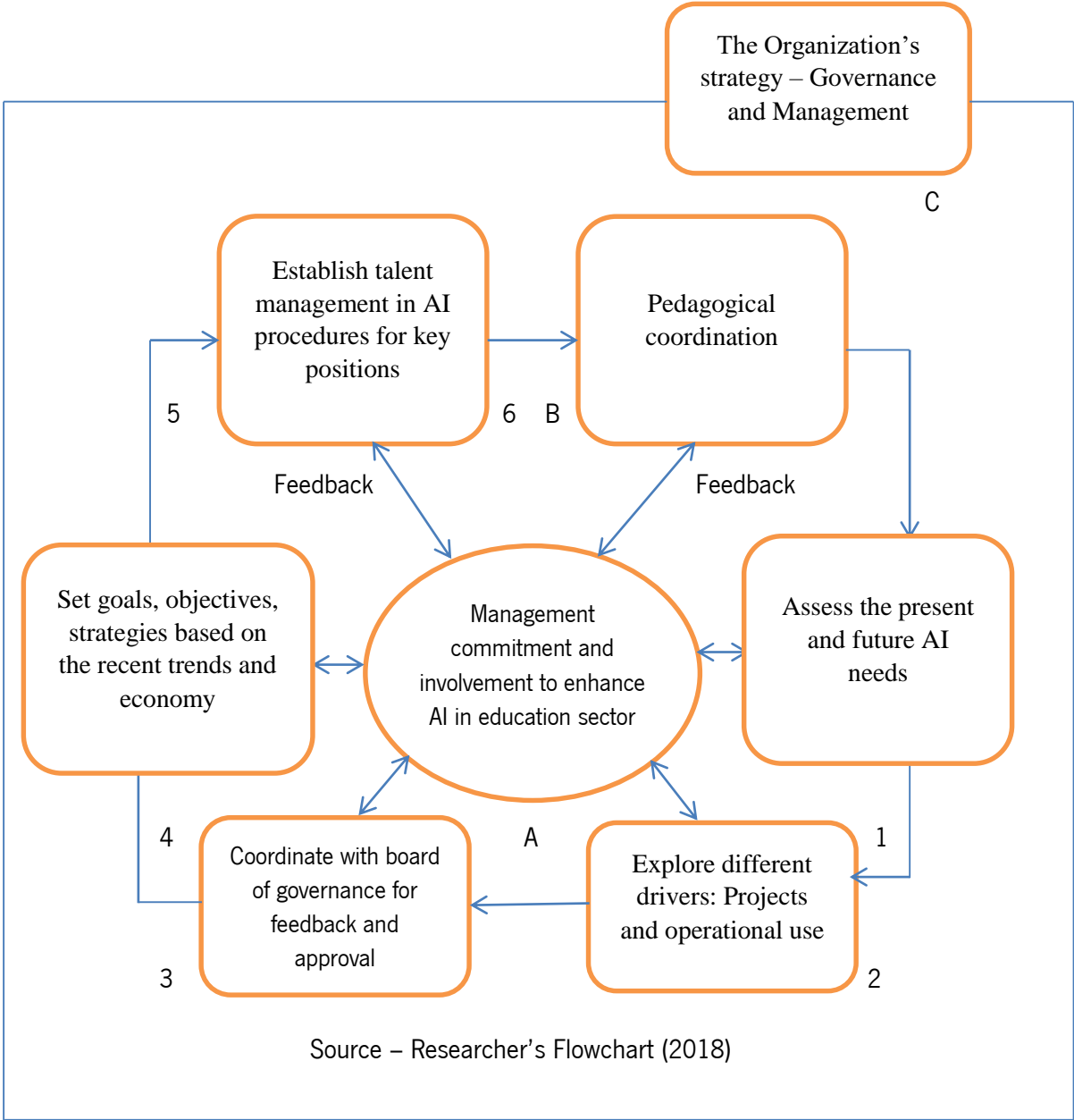
<b>Stakeholders</b>	<b>Drivers</b>	<b>Needs</b>
Ministry	Policies, by-laws, approval process, timeline	Providing high quality education with adoption of recent trends
Management	Institution strategic & operational plans, procedures, policies, budgeting, technology trends and training needs.	Knowledgeable graduate to the society, capability to perform individually and in groups and time management
Faculty	Training, teaching methodologies, communication methods, and technological trends	Creating a motivating learning environment, providing needed information and focus on further improvements needed
Students	Engagement, learning needs, activities initiations	Involvement in the process for better learning
Parents	Communication, child training and economics	Enhanced skills and knowledge in younger generation, capability to achieve their goals and successful careers

Source: adapted from Gomede et al., 2018

Table 2.1 elucidates stakeholders (direct and indirect), drivers influencing their needs and their needs in education. Figure 2.1 below, exhibits relationships between educational providers, management of the organizations and their drivers which reinforce the system.



Figure 2.1: Conceptual framework model of corporate governance in AI in education sector



Source – Researcher's Flowchart (2018)

The first component (A) of the framework represents the need for a commitment and involvement of the top organizational management in implementation of AI. This component is considered as the heart of any planning and management effort that is why it is placed at the centre of the model. Top management has to play a vital role in such matters, and should support managers who promote AI growth, devise and foster planning, and create a position or a unit that will administer all IT matters (Gandossy & Verma, 2006). To underline the significance of the

management role, the component A is connected to the six practices comprising the component B with six management practices. The aim of these practices is to identify enhancements in an existing situation, skills and competencies needed. This practice needs to depict the need of an organization to create explicit procedures for assessing a current situation and future advancement by adopting AI. Eventually, organizations need to get an approval from board of governance before implementing any change. This leads to develop objectives, goals of the organization and further, to develop a pool of talents who will support the organization in implementing AI procedures. However, the sixth step is very important to get a pedagogical coordination and feedback from the users to evaluate and gauge the value of AI in overall growth and success.

The proposed conceptual framework model supports the need of the doctoral research in understanding HEIs management commitment and connections between different parameters as indicated in figure 2.1. It enables to justify the opted research design in soliciting opinions from varied stakeholders and analysing their viewpoints. In concluding this section, it is important to note that the proposed model (Figure 2.1) is fairly considered by incorporating elements of all stakeholders in Higher Education Institutions. This model/framework focuses mainly on two notions; the role of leadership that is placed at the core of the model and the integration of artificial intelligence/advanced systems into the organizational culture. Besides, this framework attempts to merge the leadership role and talent management aspects, the two major contributors in growth of higher education institutions. In addition, this model incorporates the need to execute prudent research and replacement/adaption of advanced systems to support growth in the higher education system.

## **2.5 Synthesis**

To summarize, there is extensive literature that addresses the need of advancements in technology to support the educational sector. Yet, the management in academia needs to be more selective in choosing the technology because this literature review for academia has twofold implications: Firstly, it is vital for higher education institutions to improve the current system, which is based on some strategies and practices. As the risks are high to implement, new technology, it is very important for all higher education institutions to establish a systemic training for students and staff to cope with the new shift in education. Secondly, literature provides hype

to increase research activities on the topic of AI. Since there is much more to be explored and to innovate in the field of AI, different forms of research is ongoing such as explorative, evaluative, explanatory and action research.

In addition, this research explores the concept of the growth and use of artificial intelligence in the teaching-learning process in higher education. An extensive study is done to investigate educational implications based on emerging technologies, teaching approaches and the way students learn. With the current global COVID19 crises, these technological advancements were widely adapted. Meanwhile, higher education institutions started to explore more systems that are advanced in order to smooth the transition from conventional teaching to remote learning. However, still there is wider scope in this field and at the global level; the future nature of higher education will be based on artificial intelligence. Unpredictable challenges could be mandatory adoption of new systems due to current COVID19, technical issues behind it, lack of training due to time constraint ... etc. To overcome these, the higher education sector will benefit with well-established IT team members, tutorial videos on HEIs websites ... etc.

## **CHAPTER 3 - RESEARCH METHODOLOGY**

This chapter describes the research design, participants, data collection instruments, variables, materials, as well as data collection and analysis procedures employed. To better understand the research problem and adequately examine the research questions, this study has employed a mixed methods design. Participants for this study were fulltime academic staff, fulltime administrative staff of the studied HEIs and subject experts from the industry. The researcher collected data through a survey and semi-structured interviews. Data was analyzed using both quantitative and qualitative methods.

### **3.1 Research Questions**

In order to have a broader picture of AI and its effect upon higher education, this study will address four primary questions:

1. What's the possible role of using AI tools/systems in HEIs teaching, learning and educational management activity?
2. Are HEIs adequately prepared to implement AI in their teaching, learning and educational management processes?
3. What are the concerns in the minds of students, teaching faculty and other HEIs staff towards the adoption of AI?
4. From students' and HEIs staff' perspectives', what are the challenges HEIs face in implementing AI technologies for academic and administrative purposes?

### **3.2 Research Design**

As mentioned earlier, this study employed a mixed methods approach. This approach is relatively new as it dates back to the 1950s (Fraenkel & Wallen, 2008). According to Creswell (2009), Campbell and Fiske (1959) first used this approach in the field of psychology; and, several years later, some researchers used it as a technique for triangulating data sources. In recent years, the mixed methods approach has become a distinct methodology of research (Creswell 2009; Fraenkel & Wallen, 2008).

Mixed methods research combines qualitative and quantitative techniques in collecting and analysing data. The application of both qualitative and quantitative methods in a single study increases the overall strength of the study more than using either of the two methods alone

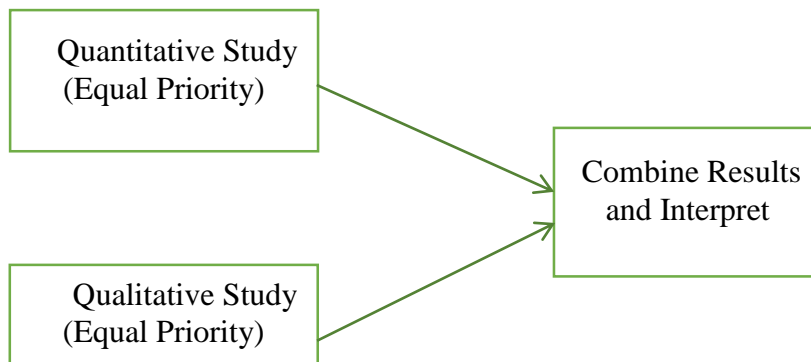
(Creswell, 2009; Fraenkel & Wallen, 2008). Moreover, utilization of this approach broadens the understanding of the issue being studied, which partly explains why there has recently been an increasing interest in the mixed methods research inquiry (Creswell, 2009).

The mixed methods approach consists of three main design categories: the exploratory design, explanatory design, and the triangulation design (Fraenkel & Wallen, 2008). These are further divided into six different strategies (Creswell, 2009):

- 1) sequential explanatory design.
- 2) sequential exploratory design.
- 3) sequential transformative design.
- 4) concurrent triangulation design.
- 5) concurrent embedded design.
- 6) concurrent transformative design.

This study utilised the concurrent triangulation design as explained below.

Figure 3.1: Triangulation mixed methods design



Source: Fraenkel & Wallen (2008, p. 561).

### 3.3 The Concurrent Triangulation Design

The concurrent triangulation design belongs to the triangulation design category. As Figure 3.1 shows, this design entails concurrent data collection, followed by data analysis and integration of interpreted results (Creswell, 2009; Fraenkel & Wallen, 2008). Since in this study both the quantitative and the qualitative methods were given the same priority and were used

concurrently, the design can be expressed by the procedural notation: QUANT + QUAL (Creswell, 2009). In this design, although data were collected simultaneously, analysis was conducted separately and the final results integrated into the last chapter, Chapter 5, where the mixing was effected through the integration and discussion of the two sets of results stemming from the two research method components (Creswell & Clark, 2017).

### **3.4 Brief Description of the Two Research Components**

Quantitative component: The quantitative component entailed application of the survey method to collect participants' views about AI implementation efforts at 15 different HEIs. The purpose of the survey method was to understand and describe the opinions of a large group of people about the given topic according to different variables (Fraenkel & Wallen, 2008). Hence, the survey method was suitable in this study because opinions of participants were needed to identify areas of strength and weakness in the implementation of Artificial Intelligence at the subject HEIs. Weighted average statistical method was used to gain understanding and to compare the opinions of different groups of participants regarding Artificial Intelligence practices in HEIs. Also, qualitative analysis was used to analyze open-ended survey questions for supplementing some multiple-choice survey questions. Because of the nature of the research questions being addressed, quantitative findings are reported within the survey results in Chapter 4.

Qualitative component: For the qualitative component, the data source utilised was interview transcripts. The present study investigated a specific topic of Artificial Intelligence implementation efforts within fifteen HEIs in the Sultanate of Oman, using different interviewees; it employed multiple sources of data (Creswell, 2003; Miles & Huberman, 1994; Stake, 1995).

Regarding the interview method, data were collected from thirteen purposefully selected participants through semi-structured interviews. The purpose of interviewing participants was to discover topic-specific information, feelings, and experiences they have accumulated (Fraenkel & Wallen, 2008). The sample of participants included faculty from IT, administration staff from IT and subject experts/companies dealing with AI. In order to enhance comparability of views among interviewees, the same semi-structured interview guide with open-ended questions was employed. This means that the researcher decided in advance the outline, sequence, and

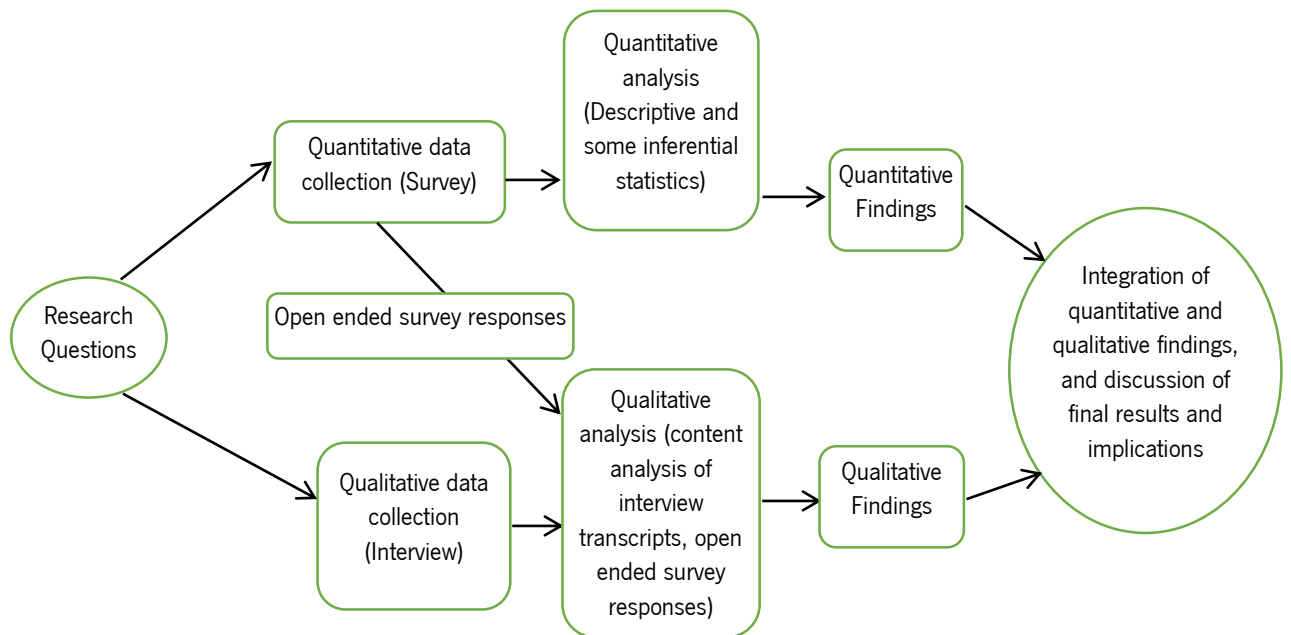
wording of the questions to be used in the course of interview (Fraenkel & Wallen, 2008). There were several benefits of employing an interview guide. First, the researcher could ask questions designed to elicit responses related to specific factors or variables that are of high interest to the researcher; and second, this strategy allowed comparing and contrasting data from different kinds of interview informants (Fraenkel & Wallen, 2008). Also, the interview guide increased data richness around a priori variables or themes, made the interview discourse systematic, enhanced the focus of both the interviewer and respondents, simplified data analysis; and, actually it can allow review and replication of data collection (Fraenkel & Wallen, 2008).

### **3.5 Justification for Concurrent Triangulation Design for this Study**

The concurrent triangulation strategy design was beneficial for this study. One of the benefits is that the approach enabled the researcher to triangulate the data. Triangulation is a process of comparing data from various sources for “confirmation, disconfirmation, cross-validation, or corroboration” (Creswell, 2009, p. 213). Also, multiplicity of data collection and analysis methods tend to complement each other’s strengths and offset each other’s weaknesses (Creswell, 2009; Fraenkel & Wallen, 2008); which in turn heightens the validity of the results and increases the rigor of the study. Another point is that since data collection took place simultaneously, less time was used in this design than the time that would be needed in sequential approaches. In addition, this concurrent triangulation approach was considered adequate for an evaluative study like this one.

Lastly, one can argue that, since quantitative methods are philosophically inclined towards positivism and the qualitative methods point to postmodernism (Fraenkel & Wallen, 2008), it is the mixed methods approach, which is associated more with pragmatism, that can suitably enable the researcher to have a better understanding of the AI issues. Figure 3.2 presents graphically the research flow diagram for the whole study.

Figure 3.2: Research Flow diagram: Concurrent triangulation mixed methods



Source – Researcher’s diagram (2018)

To sum up, although this approach entails more work and time than a quantitative or qualitative approach alone, the associated benefits of obtaining the enriched, well-validated, and substantiated data as well as enhancing the research rigor overshadowed the extra effort. In fact, within the mixed methods framework, the concurrent triangulation strategy demands less time than that required by sequential strategies (Creswell, 2009).

### 3.5.1 Assumptions

This study was premised on two major assumptions. First, the researcher assumed that every participant would understand the meaning of the questions and would respond honestly and timely to most survey and interview questions. Another assumption was that participants would be interested in the topic to elicit an adequate response rate and adequate information.

### 3.6 Scope of the Study (Participants)

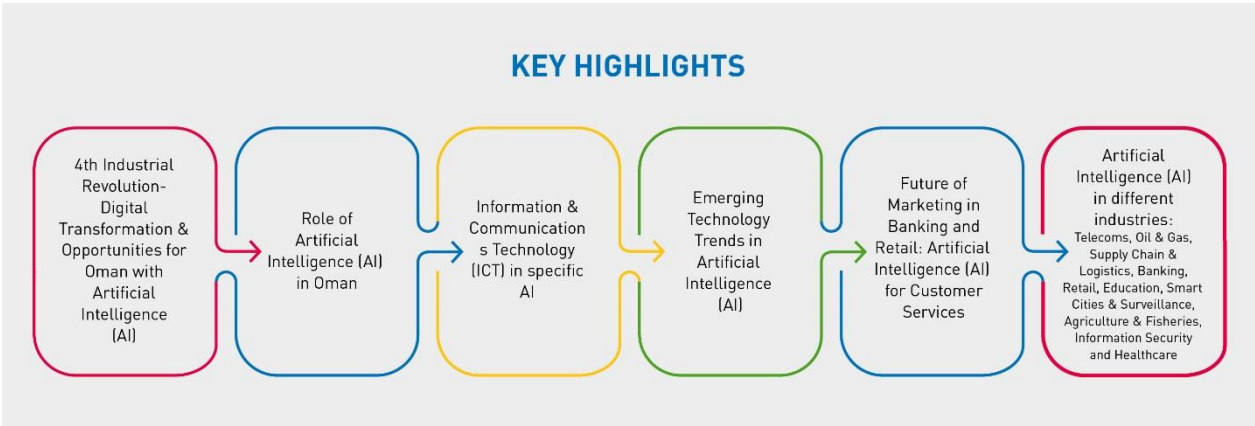
This study covers an investigation of Higher Education Institutions (HEIs) in Oman and their stakeholders’ attitude towards the adoption of AI. Stakeholders include students, academic staff, administrative staff and higher management. Mainly fifteen HEIs were researched.



### **3.7 Brief Description of HEIs**

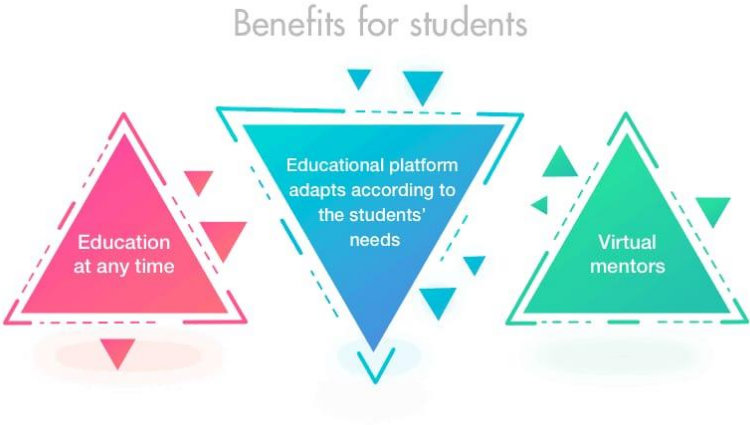
According to Al Lamki (2002) during the renaissance of the last 30 years, the Sultanate of Oman has established a relatively large and diverse system of general (pre-tertiary) education. The rapid and dynamic expansion of general education has produced an ever-increasing demand for higher education unmatched by supply. This discrepancy has yielded a large number of secondary school graduates competing for limited numbers of higher (post-secondary) public education places in the Sultanate of Oman. There is only one governmental University - SQU and recent trend is to merge colleges into universities. Prior to 2020/2021 academic year, the second public university was launched as an umbrella to many public colleges. GUtech University offers BSc in AI, which proves nation is supporting such academic programs for future development of the country. A number of different ministries and government authorities manages the current system. There is no tradition of charging fees and tuition in the public system of higher education. Privatization of higher education in the Sultanate of Oman is a relatively recent market orientation phenomenon. Therefore, there is no established mechanism for student loans. In his first speech, His Majesty Haitham Bin Tareq, Sultan of Oman mentioned, "We recognize the importance of Small Medium Enterprises, Entrepreneurs, use of technology; especially with Artificial Intelligence AI, which help to empower the youth and create opportunities for them" (Alsaid, 2020). COMEX AI International Conference on AI was the biggest event in the Sultanate to exhibit the National Vision of AI adaptation in industries and many sectors including education. Oman launched The National Artificial Intelligence and Education Forum (Future Foresight and Pioneering Applications) in October 2020, it focused on fields of education where AI solutions can be implemented (Oman News Agency, 2020).

Figure 3.3: COMEX AI - INTERNATIONAL CONFERENCE ON AI



Note. The figure illustrates key highlights stated by COMEX AI International Conference on AI. The focus was “We recognize the importance of Small Medium Enterprises, Entrepreneurs, use of technology; especially with Artificial Intelligence AI, which help to empower the youth and create opportunities for them”. Copyright 2021 by Arabian Research Bureau – OITE?ARB Group.

Figure 3.4: Benefits for the student



Note. The figure illustrates how AI can improve the process of education and what benefits gain students, who use the system. Copyright 2021 by Daria R. Cleve road.

Figure 3.5: Benefits for schools and teachers



Note. The figure illustrates advantages of usage Artificial Intelligence in schools not only for students, but also for the teachers and schools as well. Copyright 2021 by Daria R. Cleve road.

Figure 3.6: Education platforms based on AI technology



Note. The figure illustrates best Machine Learning Applications in education. Copyright 2021 by Daria R. Cleve road.

Figure 3.7: Skills of the languages key competence and some associated AI capabilities



Note. The figure illustrates Skills of the languages key competence and some associated AI capabilities. Copyright 2018 by Tuomi, Ilkka. Luxembourg: Publications Office of the European Union.

**3.8 Survey Participants**

Since this study utilized a mixed methods approach, two types of participants were involved. For the quantitative component, a target population was ninety. This population was comprised of 54% Faculty Members, 16% Department Heads and 30% other staff. Utilization of this sample size was prompted by a desire to achieve a good number of respondents. Indeed, this strategy, together with follow-up efforts, resulted in a satisfactory number of respondents, based on number of HEIs in Oman an effort was put by getting approval for this topic from MoHERI and accordingly total number of HEIs in Oman are 56 (28 private and 28 public) from which 15 were involved in seeking opinion.

**3.9 Interview Participants**

Regarding the interview method, the researcher employed a purposeful, criterion sampling method (Creswell, 2017). The study involved thirteen purposefully selected

participants. These were selected because of their responsibilities in matters pertaining to AI and its growth.

The purpose of this study was to understand the status and issues of AI and management efforts of HEIs in Sultanate of Oman. Although the findings can be informative to HEIs, practitioners, researchers, and scholars in academia at large, they may not be used for generalization to other populations, institutions, or the entirety of the higher education system in the nation or region. Moreover, not all kinds of the subject HEIs employee groups were involved in this study. Staff members and all part-time workers were excluded from this study. The study rather focused on fulltime faculty, faculty administrators, fulltime professional administrative staff, and fulltime administrative leaders. This means that the opinions provided in this study do not represent all categories of employees at HEIs. Despite all these delimitations, the findings of this study present a starting point for further detailed study on the subject matter at the HEIs and at other academic institutions in the Sultanate of Oman in general.

### **3.10 Instrumentation, Interview Protocols, and Documents**

#### **3.10.1 The Quantitative Component**

Survey instrument - The quantitative component employed a survey instrument known as, A Questionnaire for Assessing Oman Higher Education Institutions dealing with Artificial Intelligence. The researcher based on his proposed conceptual framework illustrated in Figure 3.1 and literature review created this questionnaire. The questionnaire comprises two sections: Section A: Demographics and Section B: Challenges of introduced emerging AI technologies, action to overcome challenges, perceptions, adaptability and impact of the planning and adoption of AI, specific measures to be followed in dealing with AI and specific budget for improving AI and lastly are two open ended questions.

Every survey section was vital. Section A allowed the researcher to examine the characteristics of the survey participants. For instance, this section helped to depict participants' occupational roles, number of years of service at the HEI, their colleges/administrative units, their highest education levels, gender, ethnicity, and age. Moreover, this section generated data portraying the anticipated number of retirements to occur in the near future. Most importantly, the data from this section generated four categorical variables required for answering research question number three. Section B enabled the researcher to understand perceptions of

participants regarding AI, practices observable in their respective colleges or administrative units, status of AI efforts at the studied HEI, factors associated with AI efforts at the HEI. The survey used in this study is attached as Appendix A.

### **3.10.2 Variables and Measurements:**

Since this was an evaluative study, many variables or factors were examined. For the first research question, the overall factor evaluated was the status of AI efforts at the HEI. To understand this factor, overall performance of HEI, importance of a systematic AI program, urgency for establishing or improving AI program, and AI approach preference. A Likert scale (1-5), with 1 representing Not Applicable and 5 standing for highest score with Strongly Agree, was used to measure participants' opinions concerning the above-mentioned four variables. Respondents were given a chance to ask any question for clarifying their doubts before they started answering the designed set of questions.

### **3.11 The Qualitative Component**

The interview protocol: An interview method was employed to collect qualitative data. The interview protocol with semi-structured questions guided the data collection process from each of the fourteen participants.

Data collection process was done using emails and personal interviews. In both cases a systematic protocol was maintained by informing the interviewees that the data collected will be used for research purposes only and personal details will be kept confidential.

### **3.12 Trustworthiness and consistency:**

The trustworthiness and consistency of the qualitative data was enhanced through several methods. These included checking the accuracy of data through rechecking of transcripts, using member checking method to determine the accuracy of transcripts and emergent findings (Creswell, 2009; Fraenkel & Wallen, 2008). Regarding member checking, all interview transcripts were presented to participants for verification. Since the study employed three methods of data collection, the findings' trustworthiness was also enhanced through a triangulation technique in the process of data analysis, integration, and interpretation (Creswell, 2007; Creswell, 2009; Fraenkel & Wallen, 2008). In fact, several views given by interview participants validated each other; and, the findings from the documents reviewed and from open-ended survey responses confirmed most of the interview findings.

### **3.13 Procedures for collecting data**

The Scientific Council of the Institute of Education of the University of Minho approved the proposal of this study on July 18<sup>th</sup> 2018. In the same month, the instrument was reviewed by the supervisor to enhance its content validity. As required by the concurrent triangulation research design, qualitative and quantitative data were collected independently but during the same timeframe (Creswell & Clark, 2007). The survey instrument was administered to 90 participants via email. The researcher sent email to all institutions requesting their input. Other participants received a personalized e-mail addressed directly to him/her without knowing other participants. The first group of e-mails was sent in July 2019. This was followed by reminders that took place in September and November 2019. The consent statement constituted a part of the e-mail to the participants. By completing the survey, respondents signified their consent to take part in the study. Online data collection continued until the closing date in December 2019.

Parallel to data collection through the survey, the researcher conducted interviews during the same time frame. Some of the interviews were 15-30 minutes long in duration; and were conducted in respondents' own offices/telephone calls. Interviewees consented to be interviewed as required by the informed consent form. An interview protocol with a set of semi-structured questions (see Appendix B) was used to guide the interview processes, some feedback collected via email and one was voice recorded.

### **3.14 Data Analysis Procedures**

Given the purpose of this study as outlined in chapter 1, the researcher sought to answer the following four research questions:

#### **Question 1**

What's the role of using AI tools/systems in HEIs to protect student data, while maintaining privacy and confidentiality of sensitive student information?

Purpose: With this question, the researcher aimed to collect information on specific measures to be followed in dealing with AI.

#### **Question 2**

Do HEIs have a specific budget to implement AI in administrative and teaching-learning process?

Purpose: With this question, the researcher aimed to collect information on actions to overcome challenges and specific budget for improving AI.

### **Question 3**

Are there any threats of job automation in employees' minds, and their impact on teaching faculty?

Purpose: With this question, the researcher aimed to collect information on perceptions, adaptability and impact of the planning and adoption of AI.

### **Question 4**

From students' and employees' perspectives', what are the challenges HEIs face in implementing AI technologies for administrative and academic purposes?

Purpose: With this question, the researcher aimed to collect information on challenges of introduced emerging AI technologies.

Data analysis was conducted on the basis of these four research questions. The process of analysing qualitative and quantitative data occurred between June and September 2020. Since this study employed the concurrent triangulation design, two stages of data analysis were necessary (Creswell & Clark, 2007). The first stage involved separate QUAN and QUAL analyzes; and, the second stage entailed merging the two data sets and discussing (Creswell & Clark, 2017).

#### **3.14.1 Data screening for Quantitative Data Analysis**

Data screening is an important task before conducting statistical analysis because it aims at enhancing data accuracy through identification of missing data, outliers, and the fit of statistical assumptions like normality and linearity (Mertler & Vannatta, 2005). Data from ninety cases were exported from the Monkey Survey software. Before conducting the analysis, data were screened. Data screening led to elimination of no cases.

#### **3.14.2 Qualitative Data Analysis**

All interviews were transcribed in April 2020. Qualitative data analysis occurred in July 2020. Qualitative content analysis was applicable for the research questions. The aim of the



content analysis approach was to generate open-ended survey questions and to relate these to the relevant research questions. Different content analysis steps and techniques were used to analyze qualitative data from interview and open-ended survey questions. Steps entailed data preparation or organization, data exploration, data analysis, and display of results (Creswell & Clarks, 2017).

### **3.14.3 Integration of Quantitative and Qualitative Findings**

The concurrent triangulation mixed method tradition requires the mixing of the QUAN and QUAL findings (Creswell & Clark, 2017). The mixing was effected by merging two data sets and discussing them together (Creswell & Clark, 2017). For that purpose, the researcher integrated and discussed together the summaries of QUAN or survey and QUAL findings in Chapter 4. This mixing or integration enhanced the interpretation and richness of the study results; at the same time, it strengthened the cross-validation of the findings through the inherent triangulation property embedded within the triangulation mixed methods approach.

## CHAPTER 4 - RESULTS AND FINDINGS

This chapter represents the findings and results gathered from the Omani higher education institutions. The presentation of data collected from the HEIs with reference to the questionnaire based on the conceptual framework, the sample size was ninety respondents. A weighted average statistical tool was used to analyze the research data. As mentioned before, the main purpose of this study was to find out the state of Artificial Intelligence within the Omani HEIs and to understand the adoption of AI and management efforts for effective and timely implementation of such system in education. This chapter of the study presents both quantitative and qualitative data analysis.

### 4.1 Quantitative Findings

#### 4.1.1 Response Rate

To measure the response rate, the finalized questionnaire was distributed among faculty and staff members from 15 HEIs in Oman. As summarized in the total respondents from the quantitative survey were ninety.

- 54% Faculty Members, 16% Department Heads, 30% other staff
- 50% Doctorate, 38% Master, 10% Bachelor
- 27% Female, 73% Male

#### 4.1.2 Research Questions Feedback:

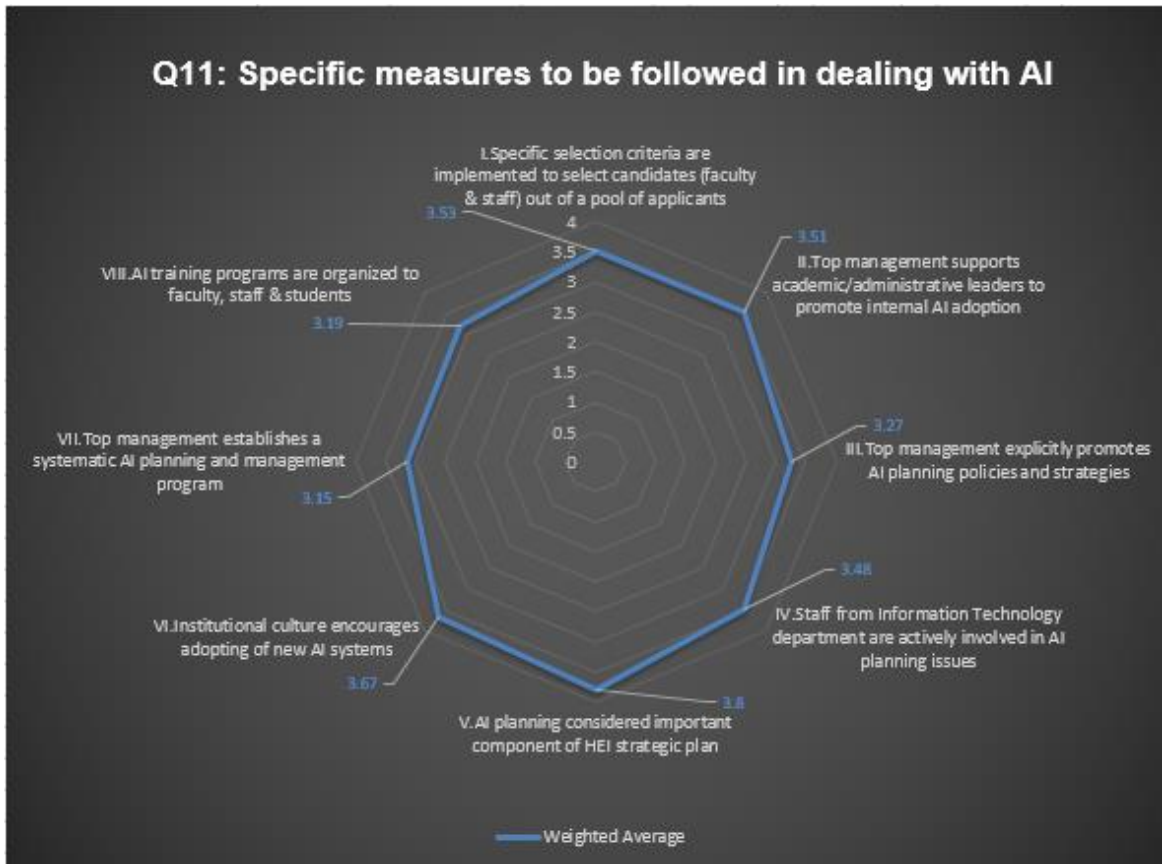
What's the possible role of using AI tools/systems in HEIs teaching, learning and educational management activity?

Table 4.1: Question # 11: Specific measures to be followed in dealing with AI, answers RQ#1:

	5 (Strongly Agree)		4 (Agree)		3 (Disagree)		2 (Strongly Disagree)		1 NA		Total	Weighted Average
I. Specific selection criteria are implemented to select candidates (faculty & staff) out of a pool of applicants.	22.47%	20	43.82%	39	12.36%	11	6.74%	6	14.61%	13	89	3.53
II. Top management supports academic/administrative	16.67%	15	45.56%	41	18.89%	17	10.00%	9	8.89%	8	90	3.51

leaders to promote internal AI adoption.												
III. Top management explicitly promotes AI planning policies and strategies.	13.33%	12	42.22%	38	17.78%	16	11.11%	10	15.56%	14	90	3.27
IV. Staff from Information Technology department are actively involved in AI planning issues.	16.67%	15	46.67%	42	16.67%	15	7.78%	7	12.22%	11	90	3.48
V. AI planning considered important component of HEI strategic plan.	31.46%	28	41.57%	37	12.36%	11	4.49%	4	10.11%	9	89	3.8
VI. Institutional culture encourages adopting of new AI systems.	21.11%	19	47.78%	43	15.56%	14	7.78%	7	7.78%	7	90	3.67
VII. Top management establishes a systematic AI planning and management program.	12.36%	11	33.71%	30	26.97%	24	10.11%	9	16.85%	15	89	3.15
VIII. AI training programs are organized to faculty, staff & students.	13.33%	12	35.56%	32	24.44%	22	10.00%	9	16.67%	15	90	3.19

The Table 4.1 shows descriptive statistics. The majority considered AI planning as important component of HEI strategic plan with highest W.A, while minority confirmed lack of systematic AI management program with lowest W.A.



5. Are HEIs adequately prepared to implement AI in their teaching, learning and educational management processes?

Table 4.2: Question # 9: Actions to overcome challenges, partially answers RQ#2:

	5 (Strongly Agree)		4 (Agree)		3 (Disagree)		2 (Strongly Disagree)		1NA		Total	Weighted Average
	%	Count	%	Count	%	Count	%	Count	%	Count		
I. There are systems to assess future requirements of emerging AI in higher education.	8.99%	8	34.83%	31	30.34%	27	10.11%	9	15.73%	14	89	3.11
II. There are efforts exist to internally identify talent from existing	12.36%	11	33.71%	30	28.09%	25	10.11%	9	15.73%	14	89	3.17

staff for future AI utilization.													
III. There is available AI planning chart exists that guides the new AI process for each field of program/major offered.	7.78%	7	27.78%	25	31.11%	28	14.44%	13	18.89%	17	90	2.91	
IV. Employees are involved in discussing/reviewing applied AI frameworks.	10.11%	9	28.09%	25	30.34%	27	14.61%	13	16.85%	15	89	3	
V. Students are involved in discussing/reviewing applied AI frameworks.	6.67%	6	27.78%	25	33.33%	30	13.33%	12	18.89%	17	90	2.9	
VI. There is a deliberate effort to identify a pool of talent with high AI potential for different designations.	8.89%	8	33.33%	30	32.22%	29	11.11%	10	14.44%	13	90	3.11	
VII. Employee/s participation is highly encouraged in AI development programs based on their job requirements.	10.11%	9	44.94%	40	20.22%	18	11.24%	10	13.48%	12	89	3.27	

VIII. Enhancing the potential of local citizens in AI, rather than depending on other expatriate talent.	9.20%	8	42.53%	37	18.39%	16	10.34%	9	19.54%	17	87	3.11
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In the above Table 4.2, the majority considered employee/s participation is highly encouraged in AI development programs based on their job requirements with highest W.A, and a minority agreed that students are involved in discussing/reviewing applied AI frameworks with lowest W.A.

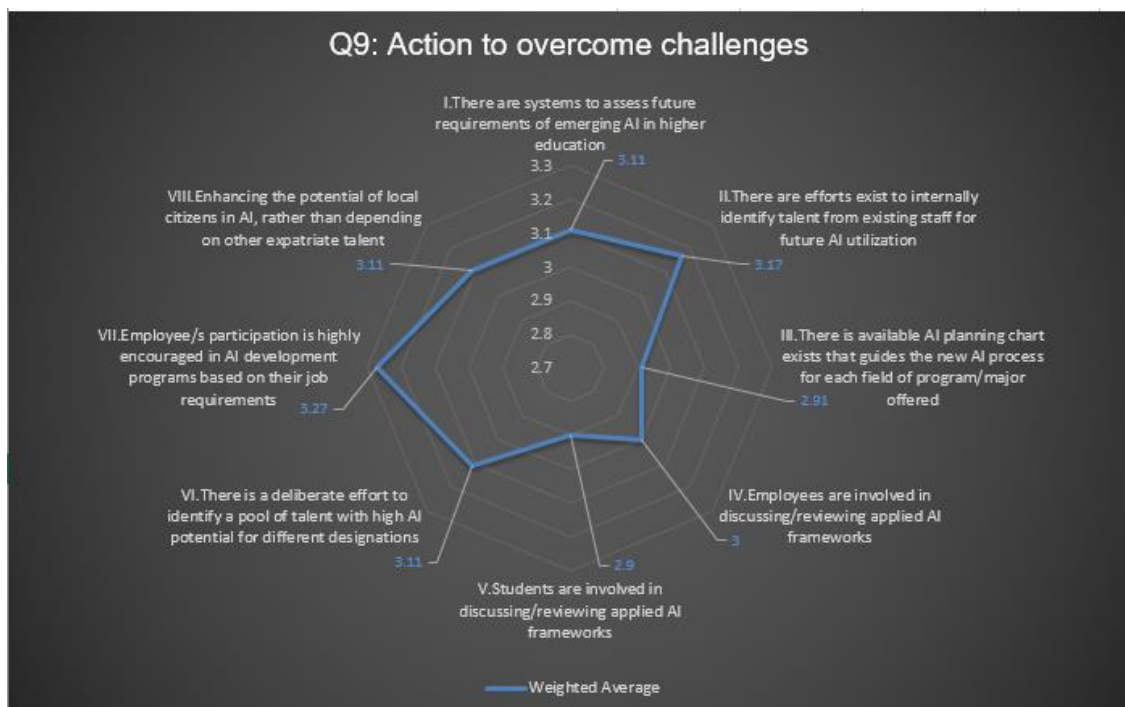
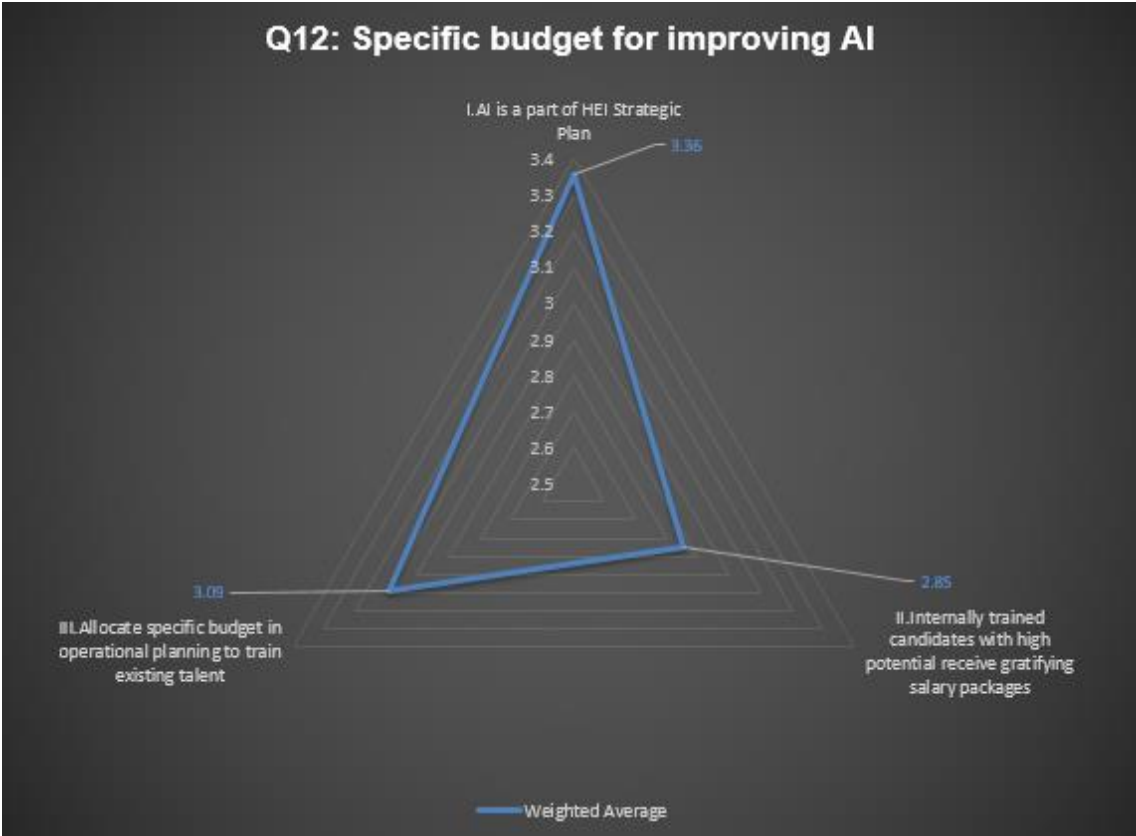


Table 4.3: Question # 12: Specific budget for improving AI, partially answers RQ#2:

	5 (Strongly Agree)		4 (Agree)		3 (Disagree)		2 (Strongly Disagree)		1 NA		Total	Weighted Average
	%	Count	%	Count	%	Count	%	Count	%	Count		
I. AI is a part of HEI Strategic Plan	13.64%	12	45.45%	40	18.18%	16	9.09%	8	13.64%	12	88	3.36
II. Internally trained candidates with high potential receive gratifying salary packages.	4.49%	4	34.83%	31	25.84%	23	11.24%	10	23.60%	21	89	2.85
III. Allocate specific budget in operational planning to train existing talent.	2.27%	2	44.32%	39	30.68%	27	5.68%	5	17.05%	15	88	3.09

Here in Table 4.3 the majority once again agreed that a specific budget for improving AI comes true when AI is a part of HEI Strategic Plan, with highest W.A, and the minority agreed that internally trained candidates with high potential receive gratifying salary packages, with lowest average.



6. What are the concerns in the minds of teaching faculty and other HEIs staff towards the adoption of AI?

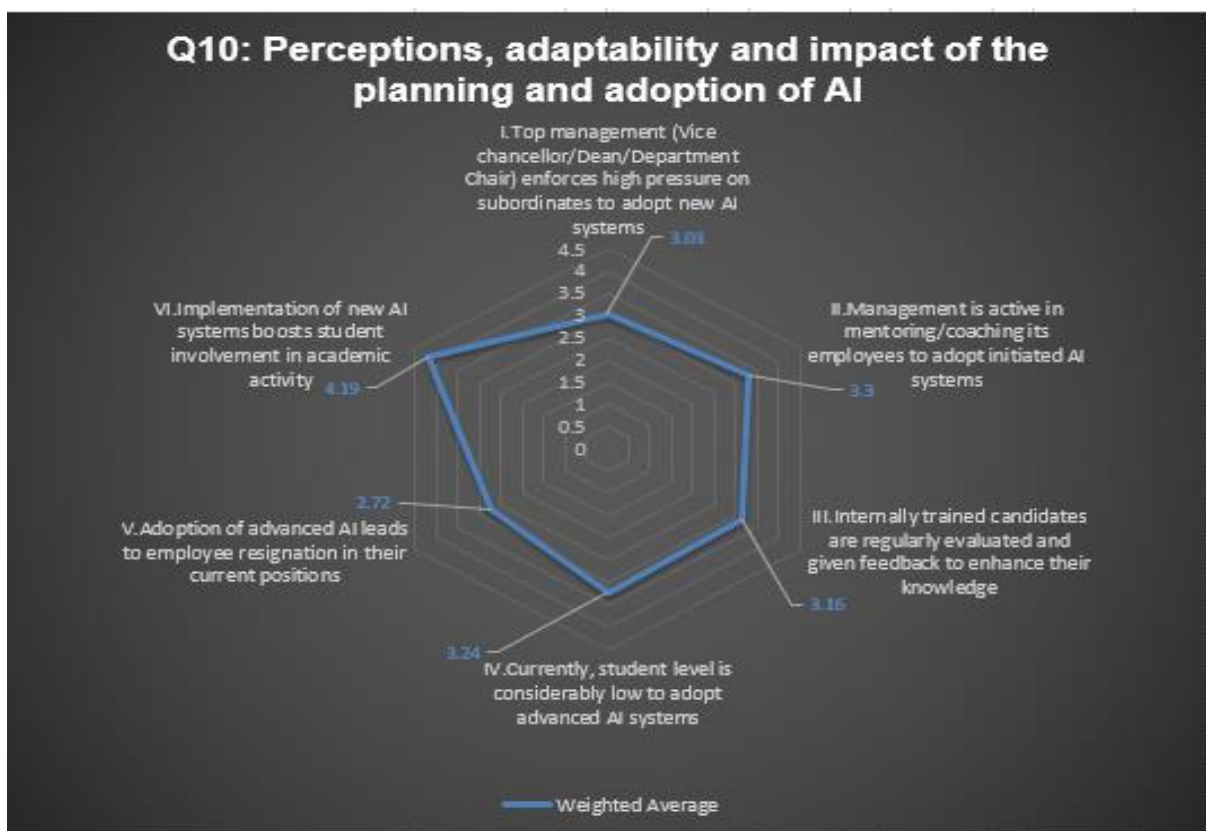
Table 4.4: Question # 10: Perceptions, adaptability and impact of the planning and adoption of AI, answers RQ#3:

	5 (Strongly Agree)		4 (Agree)		3 (Disagree)		2 (Strongly Disagree)		1 NA		Total	Weighted Average
I. Top management (Vice chancellor/Dean/D epartment Chair) enforces high pressure on subordinates to adopt new AI systems.	6.67%	6	35.56%	32	27.78%	25	14.44%	13	15.56%	14	90	3.03
II. Management is active in mentoring/coaching its employees to adopt initiated AI systems.	13.48%	12	41.57%	37	20.22%	18	11.24%	10	13.48%	12	89	3.3
III. Internally trained candidates are regularly evaluated and given feedback to enhance their knowledge.	10.00%	9	38.89%	35	24.44%	22	10.00%	9	16.67%	15	90	3.16
IV. Currently, student level is considerably low to adopt advanced AI systems.	13.33%	12	30.00%	27	31.11%	28	18.89%	17	6.67%	6	90	3.24
V. Adoption of advanced AI leads to employee resignation in their current positions.	3.41%	3	13.64%	12	45.45%	40	26.14%	23	11.36%	10	88	2.72



VI. Implementation of new AI systems boosts student involvement in academic activity.	38.64%	34	47.73%	42	10.23%	9	1.14%	1	2.27%	2	88	4.19
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The above Table 4.4 shows the majority agreed that implementation of new AI systems boosts student involvement in academic activity, with highest W.A, in contrast with the minority who agreed that adoption of advanced AI leads to employee resignation in their current positions with lowest W.A.



Other factors respondents raised that may affect the adoption of AI practices in HEI:

- Lack of motivations and incentives, requirement of training, budget, employees' mindset, awareness, and rewards/incentives.
- Faculties could be expert in other areas of specialization, then adapting AI could be a big challenge for them and fear of losing of one's job.
- Complete dependence on technology involves risks.
- The existence of overall policy to set the guidelines from the Ministry of Higher Education, there are other psychological factors that should be discussed to enhance our understanding of the challenges, are HEIs in Oman ready to adopt 4th industrial revolution?

- Offering AI programs at HEIs.
- Human culture and daily practice, a need for simplified procedures.
- Interaction with specialized organizations.
- Progress in students learning process.
- Identification of areas where AI usage beyond academics should be identified.
- More research on AI.
- Top Management should believe in the AI importance.
- Update schools' curricula and students from secondary schools not well-prepared.

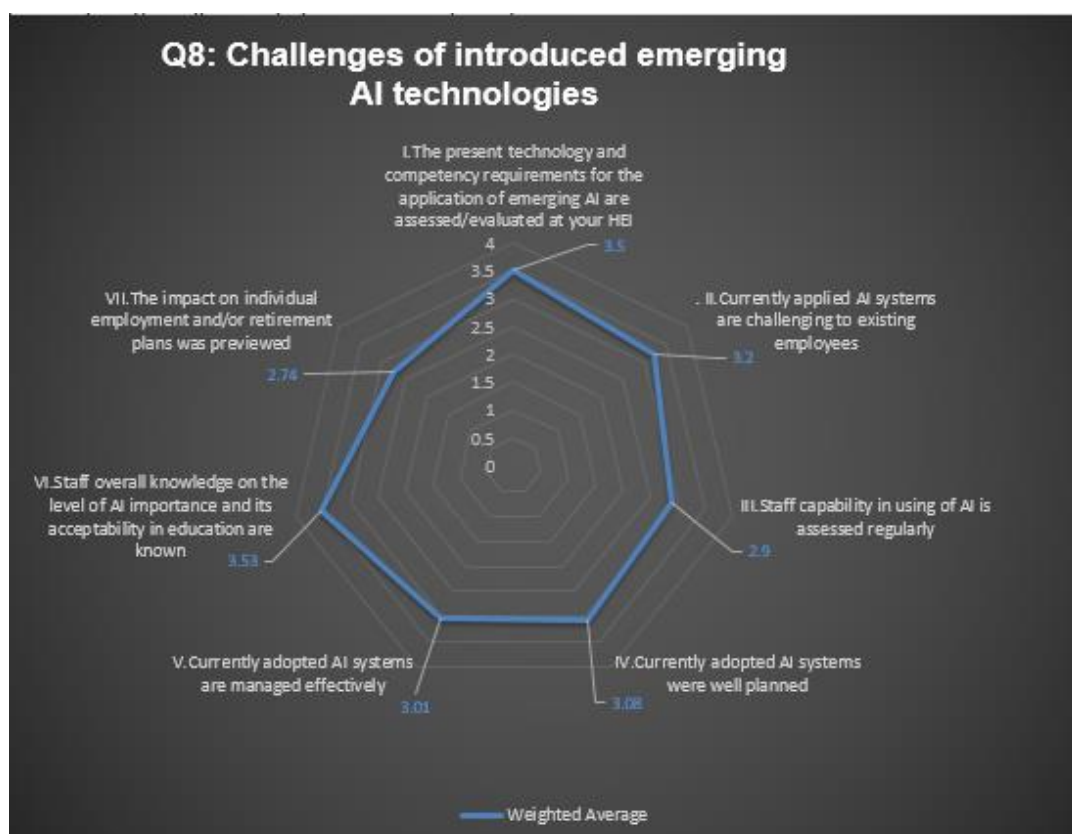
7. From HEIs staff perspectives, what are the challenges HEIs face in implementing AI technologies for academic and administrative purposes?

Table 4.5: Question # 8: Challenges of introduced emerging AI technologies, answers RQ#4:

	5 (Strongly Agree)		4 (Agree)		3 (Disagree)		2 (Strongly Disagree)		1NA		Total	Weighted Average
I. The present technology and competency requirements for the application of emerging AI are assessed/evaluated at your HEI.	15.56%	14	46.67%	42	20.00%	18	7.78%	7	10.00%	9	90	3.5
II. Currently applied AI systems are challenging to existing employees.	12.22%	11	34.44%	31	31.11%	28	5.56%	5	16.67%	15	90	3.2
III. Staff capability in using of AI is assessed regularly.	7.78%	7	30.00%	27	30.00%	27	8.89%	8	23.33%	21	90	2.9
IV. Currently adopted AI systems were well planned.	8.89%	8	36.67%	33	25.56%	23	11.11%	10	17.78%	16	90	3.08
V. Currently adopted AI systems are managed effectively.	8.89%	8	34.44%	31	27.78%	25	6.67%	6	22.22%	20	90	3.01

VI. Staff overall knowledge on the level of AI importance and its acceptability in education are known.	15.56%	14	44.44%	40	23.33%	21	11.11%	10	5.56%	5	90	3.53
VII. The impact on individual employment and/or retirement plans was previewed.	7.78%	7	26.67%	24	26.67%	24	10.00%	9	28.89%	26	90	2.74

The above Table 4.5 shows the majority agreed that staff overall knowledge on the level of AI importance on its acceptability in education are known, with highest W.A, where the minority agreed that the impact on individual employment and/or retirement plans was previewed with lowest W.A.



Suggestions from respondents to implement AI planning practices in HEI:

- Workshops, regular trainings with hands on experience

- Start with an awareness program, followed by training selected staff to focus on AI and introduce AI in pilot areas
- MOHERI should provide proper AI solutions (Programs/Apps) to implement in the HEI
- The key necessity is the applicability of AI to measure the rate of success followed by delivery of an academic program. How much of the quality education has been delivered followed by how much of the quality education has been achieved? Simultaneously, very much need to address and improve the core factors hindering the faculty members to deliver high quality of education such as weak level of incoming students.
- Equip secondary schools with AI Labs which force HE Institutes to prepare for HE Levels in AI
- Incorporation in curriculum and syllabus
- Check what your HEI is in need and then implement it. Copying other HEIs doesn't help.

## **4.2 Qualitative findings**

### **Interview Questions**

As a next approach, a qualitative research method was applied in order to understand attitudes while seeking opinion from different participants. This was done by conducting interviews with different stakeholders by using structured questions. The main idea is to capture changing attitudes within a target group, to get more details which can be challenging to explain something that numbers (weighted average) alone are unable to reveal, a more flexible research approach etc. For this reason, Administrative staff from IT, Academic staff from IT, Web Developer, Subject experts/companies dealing within the local market, Oman Education Council member, Company working on VR, AR and AI were considered.

#### **4.2.1 Admin Staff from IT**

- 1.** Do you implement any machine learning systems (supervised & unsupervised) in your HEI? If yes, what and how are they beneficial to students?
- 2.** May I know your HEI uses any automatic programming in administrative work? If yes, please mention and brief its uses.
- 3.** If you were given authority to change/initiate one AI technique/system at your HEI, what would it be, and how would you go about implementing that change to enrich AI knowledge?

**IT Unit Manager @ SCD:** It was found that there is a possibility to apply AI in different services for faculty, staff and students, as follows:

*“1. Turnitin tool is a good example on advanced AI solutions and ML, it checks plagiarism in writing, makes codes for assignment, provides real feedback to students and automates grading for instructors in their courses when they apply these activities within this tool, it applies authenticity for students, effectiveness for faculty and therefore better education outcomes.*

*2. Yes, HR module and Inventory module “IMS” for students and departments, departments apply their needs of materials, then Inventory Management System will evaluate the usage of these required materials, also within the Human Resource the module of appraisal system is there but not activated, where there might be automatic programing within that part of the module.*

*3. Analytics of the academic student records using the big data available in SIS, to initiate personalized learning environment to suite the level of performance and progress for each student and this is the core of AI, to propose learning path according to data collected individually about the student which might be different from other students, and the suggested personalized learning guidelines and resources rely on the student’s interests, knowledge and the weaknesses to help the student to enhance the learning experience, it continues after graduation even for long life learning.”*

(Interviewee1)

Based on the structured questions used to interview an administrative expert it is analyzed that, in academic work Turunitin tool which is based on advanced AI solutions and ML is helping to access plagiarism, HR modules and inventory modules are useful in administrative work. Overall, his opinion very clearly emphasizes that AI systems are very much effective in tackling academic and administrative work.

**Web developer @ SCD:** From the interviewee, it was found that it could be beneficial for students to advise and to help in generating/proposing timetables according to available data for each student.

*“1. Not at the moment.*

*2. Not at the moment.*

3. *"In the current HEI, I would implement a Machine learning technique based on Supervised. A student advisory chat bot, whereas the student would make full transaction and get guide on course plan and other function which would allow student get close and easy access".*

*"Students would benefit from AI using Machine Learning Techniques at my current HEI, with systems such as Student Advisory bots. Whereas students can complete full transactions such as change courses through best routes and plan to reduce timing required and many other benefits".*

*"On the other hand, implementing those types of AI would require a lot of research and understanding. However, the best starting point would be the existing data".*

*"Whereas a MLT AI would require to understand what question would be asked and in which why would be the response such as keywords or predefined sentence"*

*"Mainly, I would build a mobile application with a chat mechanical, from which gives the student full freedom of type his own sentences and the machine grasps on understanding those kind of words and evaluates based on it. Such as, should I change my registered courses? the AI would evaluate the course registered by the student and checks his plan. At the same time understand his/her performance throughout the education (student Life Cycle) and based on that the AI would either recommend courses and change courses or stick to the current".*

*"Finally, it would help in analysing student time table and develop scenarios to choose based on course selection and other inputs such as days off, or working hours".*

(Interviewee2)

The interviewee here focused on automation of most services offered to students from admission process till graduation, he assured the ability of using AI in course registration, plan guidance and offering mobile application as a portal to get most of required data to build on AI solutions.

**IT staff member from one of the HEIs:** From the interviewee, it was found that they have not plan to implement AI.

*“1. No*

*2. No*

*3. implementing an automatic time table generation system and enrich the AI knowledge by implementing artificial neural network expert system.”*

(Interviewee3)

This shows that some HEIs have no plan to launch AI solutions, and this might be because of lack of knowledge, skilled staff or even the IT infrastructure required to host big data.

#### **4.2.2 Academic Staff from IT**

- 1.** What is your awareness about programming languages in AI? Are they incorporated into the curriculum at your HEI? If yes, at which level? E.g.: Python, Java, C/C++, JS, R, Lisp, Prolog ... etc.
- 2.** Can you state your experience with online learning platforms?
- 3.** What role should HEI take to incorporate programs related to AI in Sultanate of Oman?

From the interviewee, it was found that including ML and DL in initial stage of all IT studies should be mandatory to have a concrete base of knowledge to build on.

*1. “We use Python for AI-related courses, we have beginner, intermediate and advanced levels”.*

*2. “Moodle is our official virtual learning platform, we run 100% through Moodle, where students can enhance their learning by integrated technologies. Learning resources, group work, assignment, workshops, quizzes, peer moderation, web-video lectures, and instructor communications are part of services that we deliver through Moodle”.*

*3. “They should take the initiative to train and prepare the next wave of the task force that is capable of contributing to the 4th industrial revolution, where AI is the main driving force. Deep learning and machine learning should be fundamental courses in any computer science department in Oman”.*

(Interviewee1)

From the interviewee, it was found that HEIs should enhance and support researches in the field.

*1. “Java and C++”*

*2. “Excellent in Moodle, blackboard, schoology and edmodo”*

*3. “Leading role in terms of training, research and development”*

(Interviewee2)

From the interviewee, it was found that data science courses could be amended to enrich the offered programs at SQU and other HEIs.

*"1. Yes, we teach at Sultan Qaboos University Python, Java, and C++ in introductory programming courses and they are used in higher level courses (including AI). Also Lisp, Prolog and other languages are used in AI and other advanced courses"*

*"2. I have used Moodle for providing course materials to students and for submission of assignments and exams. Some courses in our department. have used Moodle for online exams. Most teachers will use Moodle for online teaching and online exams this special semester."*

*"3. AI and data science should be incorporated as courses in existing programs, as new specializations/tracks in existing programs, as minors and/or as completely separate programs."*

(Interviewee3)

From the interviewee, it was found that he suggested getting input from stakeholder prior planning or implementation.

*"1. AI included at basic level as of now and will be focused on improving during the coming curriculum revision."*

*'2. N/A"*

*"3. committee may be formed to review the content and provide recommendations"*

(Interviewee4)

From the interviewee, it was found that it might be difficult to apply AI if the institution doesn't offer IT specializations, but he focuses on the importance of adopting AI in e-learning modules and even in administrative work.

1. *"Based on my specialization (Personalized Mobile Learning) I am aware that we can utilize many programming languages in AI applications, but in my HEI we don't have a Computer / Technology related field of study, so programming languages are not included in the students' study planes, hopefully they will be included in the near future to address Oman 2040 vision in relation to adoption of AI in daily life.*

2. *"As said earlier as a specialized person in Personalized Mobile Learning, I had to deal with many online or e-learning platforms, but unfortunately most of the popular online platforms don't adapt AI or if they do they don't utilize it as it supposed to. I had many research that proves that adopting and utilizing AI in the online/e-learning process is very crucial in enhancing the quality of students' learning, by considering the personalized learning."*



3. *"It is now known as a fact the AI will shape our future or at least the technology future, so each HEI should consider this as an important in their future planes. They need to prepare their students and employees for this future by including courses that incorporate AI in their study plans and by adaption this technology (AI) in their administrative and educational processes. Furthermore, they need to encourage and motivate the use of AI in the institutions"*

(Interviewee5)

From the interviewee, it was found that the HEI should realize its role and do positive impact regarding spreading the awareness of AI importance in the educational environment.

1. *"Our college use Prolog language at the second level.*
2. *Our college used "Google Classroom" and from this semester the college use "Microsoft Teams".*
3. *The HEI should be taken its role in disseminating the AI systems."*

(Interviewee6)

From the interviewee, it was found that HEIs can plan to adapt AI in any field of study and not limited to IT specializations.

1. *"I am aware of most of the AI programming and development techniques, only one course is taught in the college which includes Prolog programming"*
2. *"I am using similar systems in my teaching specifically (Microsoft platform) in which I am using it for:*
  - 1- *Dissemination of handouts*
  - 2- *Distribute assignments, mark them and return the marks and comments back to the students*
  - 3- *Online discussion"*
3. *"AI is not a new topic, it was started before more than 4 decades, but its progress was slow and mostly theoretical because it needs very powerful computation machines. Recently, the advances in technology, had made it quite possible to implement AI algorithm and utilize these techniques in various applications. This gives motivation to HEI's to incorporate AI in their curricula not only in the specializations linked to AI such as CS and IT, but also, in other specializations to make them aware of the possible applications of AI."*

(Interviewee7)

From the interviewee, it was found that HEIs should start the awareness complain with freshman students to assure the full knowledge of AI from the most beginning, this might change their minds to go in AI tracks and pathways.

1. *“As a business management lecturer I have a little knowledge about programming language, usually we are using graphical user interface. I guess the higher college of technology IT department is using C/C++”*

2. *“The online guided teaching was extensively utilized in the current semester, usually the online resources were partially used in the overall course delivery. The e. learning portal is using various platforms such as Moodle, Google-classroom & MS Teams, from my personal perspective I found that MS Teams is more stable and user friendly it accommodates large files sizes, interactive with the students, online secure assessment etc.”*

3. *“I think the awareness is the initial stage to spread knowledge about artificial intelligence then go for pure mathematicians’ selection, then the concepts of robotics could be considered as a future gate to economic diversification as most transformational industries in Oman is characterized by expatriate semi-skilled workers. Further HEIs can support orientation courses about AI to encourage learners to build awareness about AI and foster its future development in GCC generally and Sultanate of Oman in particular”*

(Interviewee8)

#### **4.2.3 Subject Experts/Companies dealing within the local market**

1. Can you share your viewpoint about encouraging educational innovation applying AI that you are aware of? Why is it innovative? What value will it bring to the education sector in Oman aligned with Oman Vision 2040?
2. What programs (do you have for/are you aware of) administrative processes that can be incorporated in HEIs in Oman?
3. Professionally, where do you see Oman could be in 10 years in adopting AI systems in different sectors?

**Oman Education Council member:** Based on the open ended questions, the interviewee explained a standard process for implementation of artificial intelligence and to strength for Colleges and universities in Oman.

1. *“There is a great potential in leveraging emerging technologies, including AI in improving knowledge attainment. Vision 2040 emphasizes on the goal of a competent and competitive workforce and this is directly related to integrating the emerging technologies capabilities of students in particular, and in the education ecosystem as a whole. A number of H.E.Is started specialized Master's degrees related to data science, such as Muscat College”.*
2. *“Reinforcement Learning could be used in longitudinal study to accentuate the competitive advantage of learners”.*
3. *“Within 10 years the Sultanate could develop specialized AI talents, in areas relevant to economic diversification such logistics, manufacturing, and energy. In addition to Sustainable Development Goals SDGs related sectors such as education, health and agriculture”.*

(Interviewee1)

**Company working on VR, AR and AI:** From the interviewee’s response, it can be claimed that colleges and universities in Oman and transition services are assisting in the use of artificial intelligence.

*“We are in the midst of technology outburst witnessing a rapid change in how we interact and access information, surrounded by intelligent devices influencing our next generation to think, act and behave in a whole different way. AI has already touched many aspects of our life. Education is definitely one of them”.*

*“AI in education is more than science fiction. AI in education generally focuses on identifying what a student does and doesn't know through diagnostic testing and then developing personalized curricula based on each student's specific needs. One study found that 34 hours on Duolingo's app are equivalent to a full university semester of language education. But educational AI and the broader category of educational technology (EdTech) go well beyond language learning. According to Derek Li, founder of Chinese EdTech unicorn Squirrel AI, “In three hours we understand students more than the three years spent by the best teachers”*

*“One of the highly effective and innovative platforms built on AI is ALEKS (**A**ssessment and **L**earning in **K**nowledge **S**pace), is a popular online learning platform with courses spanning K-12 through higher education. Students start with an ALEKS Assessment to gauge their current knowledge on a range of subjects. Based on their responses, ALEKS claims to gain a precise picture of the student’s level of understanding. When the student enters Learning Mode, the system then uses their assessment to adjust its curriculum to fill in their knowledge gaps”.*

*“Once a student gives consistently correct answers, they move on to the next topic and ALEKS updates their map of the student’s knowledge state. Additionally, ALEKS periodically reevaluate the student on prior topics to ensure long term memory retention.*

*ALEKS is definitely a highly recommended tool that should be introduced to education systems in Oman. There are many such platforms are immersing every other day to challenge the existing education system to revive itself for the betterment of the student and for the whole country”.*

*“Oman is still at a very infant stage with technology adoption. With HM’s visionary leadership, for 2040 Oman has already taken few initiatives to achieve the vision and AI is definitely can be the force behind”.*

(Interviewee2)

**Dell CEO – GCC:** from the interviewee, it was found that IT companies as partners with governmental and private HEIs and the education sector in general can build up AI solutions, and he proposed to add DL and ML studies to study plans.

*“AI will be crucial to ensure companies are competitive and relevant in the marketplace. I expect private and public sectors in Oman and the Gulf region to adopt ML/DL in many of their workloads. Education institutes will have to add ML/DL in their curriculum to attract and equip the students with the right talent... to this end, they have to have the right professors with the right knowledge in these areas.”*

(Interviewee3)

## **CHAPTER 5 - FINAL CONSIDERATIONS**

In this final chapter, I'm going to present a little discussion on the impact of AI in the Higher Education sector, and I will present the conclusion considerations of my research: (Impact of AI in HE, addressing research, conclusion about research method, findings, limitations, contributions and implications of the study and finally recommendations for further study).

In the chapter a brief unfolding on the research analysis and literature in general are stated. Throughout the research, focus was in analysing HEIs effort and viewpoint in AI tools/systems, implementation of AI systems, strategic planning, budget allocation for improving, faculty & staff readiness, student challenges, training programs for adapting new systems etc. Additionally, to get a personal viewpoint, I interviewed admin staff from IT, web developers, academic staff from IT, subject experts/companies dealing within the Oman market, Oman education council member, and companies working on VR, AR and AI. Qualitative and quantitative results in comparison with the literature and presented as reflections that state the impact of AI in HE, rules that might change the future of education and overall recommendations that can be adapted by higher education leaders.

To manage and improve effectiveness of implementation of artificial intelligence in higher education institutions, Strategic Planning is a way of helping to enhance efficiency, cohesiveness, flexibility, and competitiveness of any system.

### **5.1 Impact of Artificial Intelligence in Higher Education**

Over a decade, many researchers explained the effects of artificial intelligence on the education system. Focus was given mainly in curriculum artificial intelligence having a major on the curricula in higher education. This was because the power of artificial intelligence contribution to provide high speed and accuracy. However, this requires training the students to enhance their skills in technical discipline. Furthermore, certain subject areas like finance, medicine, accounting etc. might be badly hit due to fast growth in this domain. On the other hand, this will also cause increasing in education cost. In general, the most important effects that higher education will experience is replacement with the digital language. To understand and apply this digital language, students must deal with ten rules which might change the future of education:

- i) Possibility to automate basic activities in education, such as grading.
- ii) Advanced artificial intelligence, technology applications and programs system can help to tailor educational programs based on the students' needs.

- iii) High technology AI system can enable students to obtain extra support automatically. This new feature will work to empower educational institutions to serve students to the maximum level.
- iv) Academic programs that are dependent on advanced AI technology will help academicians and students to have an opportunity to provide useful comments/feedback which helps in sharing experiences and learning better.
- v) Well integrated and developed AI systems will change the way to search information and to interact with it. Over the past few decades, there has been a radical transition in AI systems and its uses. Further, these intelligent systems play a vital role in the way professionals, academicians and students interact with personal and professional lives. This newer and advanced integrated technology will help future students with significantly different experiences in performing research and finding facts.
- vi) Highly integrated and advanced AI systems also help to indicate the areas that need improvement in courses. This helps to identify the gaps and improve curriculum. This course of action will help to ensure that all enrolled students develop the same conceptual foundations. AI technology assists students to get instant feedback and understand the concept better. Furthermore, it guides them on how to use it in the future.
- vii) The next and important rule is that AI systems will help to reduce the fear of learning by trial and error methods. This helps students to learn better from a relatively rule-free environment and independent learning.
- viii) The data encryption will help nations and higher education institutions to adapt to an AI system which might change the customary practices/methods through helping students to opt for the institution they are willing to enroll in.
- ix) The emergence of smart devices especially with technology advancement, AI systems might change the instructors'/teachers' role.
- x) Lastly, AI systems will change the teaching-learning location and the way basic knowledge is gained. These advanced systems will allow students and instructors to grasp the opportunity to choose the opted places for learning and improve their knowledge and skills.

On the whole, the researcher recommends that higher education leaders to adopt the following steps:

- i) Organize academic conferences/workshops/symposiums on all AI related issues.
- ii) Create cooperation with specialized companies in the field of AI within the region.
- iii) Stay abreast with the challenges arising from the new applications of AI to the jobs, responsibilities and roles of academics in the higher education sector.
- iv) Increase awareness among specialities' requirements by applying AI in higher education.

To conclude, the researcher strongly recommends academic researchers to perform more studies about the future of AI in all levels of higher education and AI transformations.

## **5.2 Addressing Research**

**Question 1** - What is the role of using AI tools/systems in HEIs to protect student data, while maintaining privacy and confidentiality of sensitive student information?

Top management must plan and support academic and administrative leaders to adapt AI systems by considering it as an important strategy in HEIs Strategic Plan. Furthermore, they should make it as an institutional culture and train its employees. 4.2.2 details more specific indicators and ratings against them. It is identified that a minority confirmed lack of systematic AI management program with low weighted average.

**Question 2** - Do HEIs have a specific budget to implement AI in administrative and teaching-learning process?

Table 4.3 details this section. The majority of participants agreed that a specific budget for improving AI comes true when AI is a part of HEI's Strategic Plan, with highest weighted average. On the other hand, the minority agreed that internally trained candidates with high potential receive gratifying salary packages, with lowest average.

**Question 3** - Are there any threats of job automation in employees' minds, and their impact on teaching faculty?

Research question 3 was addressed by considering indicators as detailed in table 4.4. In this section, top management enforcement (Vice chancellor/Dean/Department Chair) have to adopt new AI systems, make management active in mentoring/coaching its employees, evaluate internally trained candidates and student level. The effect of adoption of advanced AI leads to

employee resignation whereas new AI systems boost student involvement in academic activity. Based on the survey analysis, the majority agreed that the implementation of new AI systems boosts student involvement in academic activity, with highest weighted average. However, it is noticed the minority in the survey expressed their viewpoints that adoption of advanced AI leads to employee resignation in their current positions.

**Question 4** - From students' and employees' perspectives', what are the challenges HEIs face in implementing AI technologies for administrative and academic purposes?

HEIs employees depicted a good knowledge on the level of AI importance and its acceptability in education with highest weighted average. On the other hand, a minority agreed that the impact on individual employment and/or retirement plans was previewed with lowest weighted average.

### **5.3 Conclusion about research methods**

Creswell (2003) indicates that quantitative methods are appropriate when identifying those factors that might influence a specific outcome or when testing a particular theory, while qualitative studies are appropriate when the researcher is exploring and isn't necessarily able to quantify the existing variables. Specific factors have already been identified during the literature review, as key variables in the implementation of continuous improvement in higher education. Triangulation is often used to indicate that more than two methods are used in a study with a view to double (or triple) check results. This is also called "cross examination" triangulation, which is a powerful technique that facilitates validation of data through cross verification from more than two sources. In particular, it refers to the application and the combination of several research methodologies in the study of the same phenomenon. A multiphase sample was utilized, as there were many private and public HEIs, and for the purpose of validity and reliability, data were collected from both of the HEIs types.



## 5.4 Findings

Table 5.1: Findings

	<b>Adaption</b>	<b>Planning</b>	<b>Implement</b>	<b>improvement</b>
<b>Action</b>	Requirement of training	Policy to set the guidelines	Offering AI programs at HEIs	Interaction with specialized organizations
<b>Concern</b>	Lack of motivations and incentives/ Fear of losing of one's job/ Ethical AI	Psychological factors	Complete dependence on technology involves risks	Update schools' curricula
<b>Challenges</b>	Budget/ Employees' mindset/ Adopting AI by faculties of other specializations	Are HEIs in Oman ready for the Industrial Revolution 4?	Areas where AI usage beyond academics should be identified	Top management should believe in the AI importance
<b>Efficiency</b>	Rewards/Incentives	Equip secondary schools with AI Labs which force HEIs to prepare for HE levels in AI	Human culture and daily practice	More research on AI
<b>Effectiveness</b>	Awareness	Workshops/ regular trainings with hands on experience	Need for simplified procedures	Progress in students learning process

Source – Researcher's data (2021)

## 5.5 Limitations

Due to time constraint, the samples were confined to ninety valid respondents representing fifteen HEIs. Hence, the generalizability of the findings may be questioned.

Furthermore, since the study employed the questionnaire method, bias may also occur. Inaccuracy of staff members assessing their own awareness, commitment level, and their managers' personalities may affect the results of the study. The main fieldwork problem stemmed from the difficulties in getting the officials to agree to interview, especially during the transitional period to launch Oman Vision 2040.

Limitations constitute potential weaknesses that may threaten the internal validity of the study (Creswell, 2009, Maxwell, 2005). This study employed a concurrent triangulation mixed method; therefore, two types of limitations were foreseen, those related to quantitative and qualitative methods respectively. Regarding the quantitative component, the study employed a survey instrument for data collection, limitation of this method normally centers on the construction and interpretation of the survey questions, especially the possibility of questions' ambiguity (Creswell, 2009). Although the survey instrument was subjected to different scrutiny procedures, there were some participants who might have not understood some of the AI terminology because AI is a relatively new field in higher education.

In addition, this study utilized the newly proposed conceptual framework created by the researcher based on different readings included in the literature review to generate a survey instrument. Concerning the qualitative component, this study utilized semi-structured interviews. The common limitations of the interview method are related to researcher's biases and reactivity. While bias denotes a researcher's subjectivity in the form of individual beliefs and perceptual lens, reactivity entails the influence of the researcher on the participants or the setting of the study (Maxwell, 2005). It is virtually impossible to completely eliminate researcher's bias or reactivity; but what is important is to be aware of them and avoid being misled (Maxwell, 2005).

The final limitation is that the timing of this study might have affected the opinions of participants. This study took place when the Sultanate of Oman was undergoing serious budgetary limitations and top leadership transition. Thus, the researcher believes that many respondents were bold enough to express their views because of the realities they were facing at the time. However, it is also possible that some participants overreacted due to some frustrations at the time of the study.

Despite these limitations, the trustworthiness and consistency of the qualitative findings are deemed enhanced through the application of several strategies such as:

- 1) verifying the accuracy of transcripts.
- 2) respondent validation through member checking.
- 3) peer review of the content analysis.
- 4) triangulation of data from different sources.
- 5) peer debriefing of the final report to enhance the accuracy of researcher's account (Maxwell, 2005, Creswell, 2009).

## **5.6 Contributions and Implications of the Study**

As there is a considerable field of knowledge and a broad body of literature about this topic, one way to make a contribution to knowledge is to propose a framework for reviewing that knowledge. Sometimes, such a framework will also highlight an area in which, despite an abundance of knowledge, there is a relatively small amount on that aspect of the topic. The researcher feels that educational reforms in the HEIs will help in the process of programs delivery, staff development, prosperity, and eventually development in the country. The Omani government, on the other hand, predicts that worldwide education will be run by the private sector, so in other words, the society has to build its own HEIs and the government's role will only be a supervisory and controlling body. The current study assumed that governmental policies play an important role in providing the institutions with the organizational ideals to which they relate. To sum up, this thesis may contribute in the following forms:

First, the current situation was characterized by the fact that HEIs were related more towards strategic plans and policies. In several cases in this study, there were examples that institutions selected elements of the plans that fit their own development needs or processes. These elements were picked not only for increasing internal legitimacy, but also to release public funding. Consequently, the plans should be framed in a language that stimulates creative interpretations or that is relevant for adaptors. One could argue that since the plans were framed in a familiar way, close to what many institutions perceived as the core of their academic activity, so institutional translation and adaptation would become easier.

Second, as chapters one and four have shown, 'Artificial Intelligence' could be conceived as an independent institution. Artificial Intelligence was not only on the agenda of the Ministry of Higher Education in Oman, but it was also the ever-present topic internationally, in the business world, in researches, ... etc. To link strategic plans of HEIs to this common trend, one may have to reinforce the pressure for instigating change.

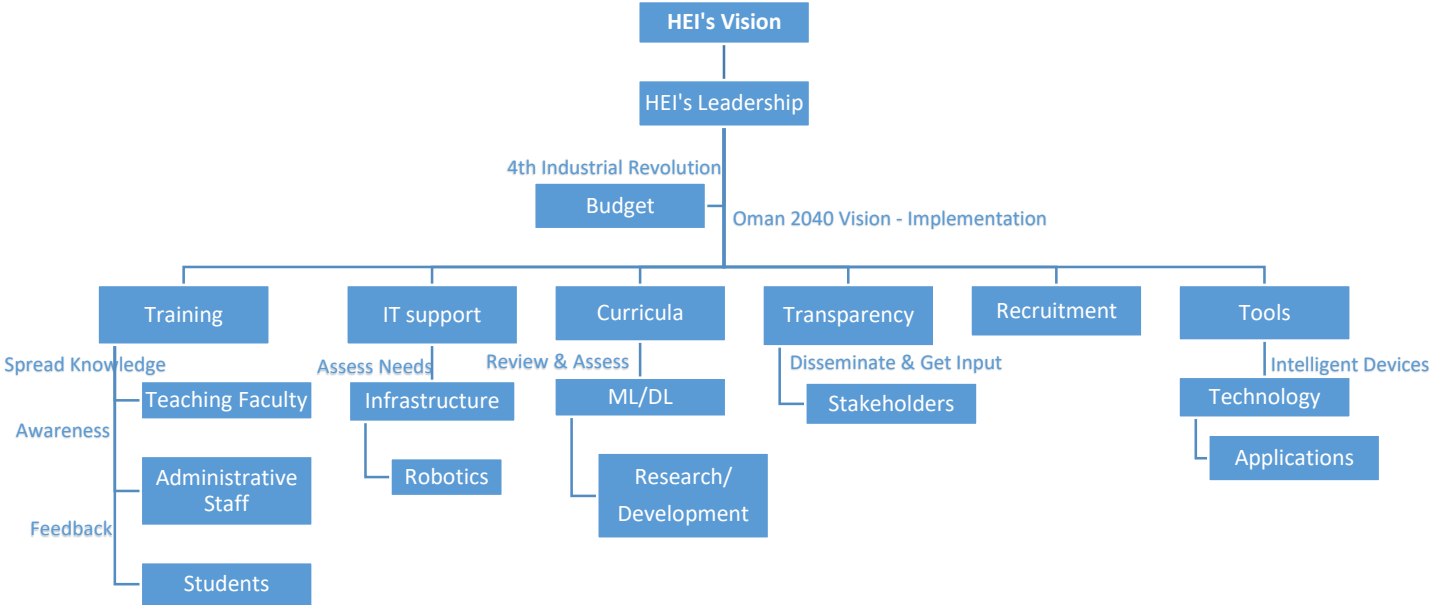
Finally, the main contribution of this research could be considered as a pioneer full study that addressed the issue of Artificial Intelligence in Oman, particularly the higher education revolution. The study offered an evaluative perspective on an important national development programme and could be conducted in a country level by sampling Omani's HEIs.

## **5.7 Recommendations for further study**

Recommendations should follow the same logical flow as the findings and interpretations. Recommendations are suggestions for actions, how leaders can apply the results of the study, for whom, when, and where. Research limitations clearly stated that there is vast literature pertaining to Artificial Intelligence in HEIs. There are a lot of research centers at global level, but the research related to application of artificial intelligence in education management was less compared to other areas of research. The researcher, in this junction, suggests that government funds should be increased to enhance the know-how in education. Another area of research, which is directly related to this area is to study on how to retain qualified staff members in HEIs.

The success of institutions depends on their management strategy on how to identify, classify, analyze, and to react to the effective approach. This study revealed that adoption of Artificial Intelligence would leave an excellent impact on the goals of the institutions and would create value in enhancing the economic value even though the implementation of Artificial Intelligence might bring a wide range of changes in an organization. In conclusion, the proposed conceptual model represented the critical success factors of implementation of Artificial Intelligence in HEIs.

Figure 5.1: Oman HEIs Dealing with AI – Concept Map



Source – Researcher’s diagram (2020)

Furthermore, the researcher suggests that sub studies could be initiated based on structural estimation for each and every area of artificial intelligence in the arena of HEIs in Oman. This would be more specific in the fields of business studies, social sciences, medicine, engineering etc. The results could be addressed according to specialization, which could in return enhance the delivery of such types of programs by adopting artificial intelligence in Oman.

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## Appendices

### Appendix A: Research Questionnaire – Bilingual Survey Questions

Dear Participant,

I would like to express my gratitude in advance for your attention and little time to take part in this unique study of mine by giving your information and valuable opinions in Section A & B. The objective of this study is to understand adoption of Artificial Intelligence (AI) in Oman Higher Education Institutions (HEIs) and management efforts for effective and timely implementation of such system in education. This questionnaire is anonymous and all responses will be confidential.

In the higher education sector, advancements in AI will support the system. Yet, traditional forms of education will always have its place. However, with the advancements in technology and its implementation in education, it is clear that new types of online education and usage of AI are becoming more and more important (AIDahdouh & Osório, 2016).

Artificial Intelligence (AI): "A study to move forward on an estimation that the feature of intelligence can be described saying an intelligent machine can be made to mimic it" (Russell & Norvig, 2010). "Can Machines Think?" Researcher requests to take this definition into consideration while answering the questionnaire.

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أعزائي المشاركين،  
أود التعبير مسبقاً عن شكري لاعطائي قليلاً من وقتكم وانتباهكم للمشاركة في هذه الدراسة الفريدة من نوعها من خلال إعطاء معلوماتك وأرائك القيمة في القسمين "A" و "B". الهدف من هذه الدراسة هو فهم تبني الذكاء الاصطناعي (AI) في مؤسسات التعليم العالي في سلطنة عمان (Oman HEIs) وجهود الإدارات في التطبيق الفعال وفي الوقت المناسب لمثل هذا النظام في التعليم. هذا الاستبيان لا يحتوي أسماء المشاركين وستكون جميع الردود سرية.  
في قطاع التعليم العالي، تدعم التطورات الحاصلة في مجال الذكاء الاصطناعي النظام التعليمي. لكن الأشكال التقليدية للتعليم سيبقى لها مكان دائماً. ومع ذلك، وبالتقدم التكنولوجي وتطبيقه في التعليم، فإنه من الواضح أن الأنواع الجديدة من التعليم عبر الإنترنت واستخدام الذكاء الاصطناعي أصبحت أكثر أهمية (AIDahdouh & Osório, 2016).  
الذكاء الاصطناعي (AI): "دراسة للمضي قدماً في تقدير أن ميزة الذكاء يمكن وصفها بالقول إنه يمكن صنع آلة ذكية لتقليد هذه الميزة" (Russell & Norvig, 2010). "هل تستطيع الآلات أن تفكر؟" يطلب الباحث أخذ هذا التعريف في الاعتبار عند الإجابة على الاستبيان.

**Section A: Demographics** التركيبة الجغرافية

<b>1</b>	<b>Indicate HEI under which you work</b> اختيار اسم مؤسسة التعليم العالي التي تعمل بها	
	1. A`Sharqiyah University	
	2. Al Buraimi University College	
	3. Al-Musanna College of Technology	
	4. Al-Zahra College for Women	
	5. Arab Open University Oman Branch	
	6. Armed Forces Medical Services School	
	7. Bayan College	
	8. Caledonian College of Engineering	
	9. College of Banking & Financial Studies	
	10. Dhofar University	
	11. German University of Technology in Oman	
	12. Global College of Engineering and Technology	
	13. Gulf College	
	14. Higher College of Technology	
	15. Higher Institute of Health Specialties	
	16. Ibra College of Technology	
	17. Ibri College of Applied Sciences	
	18. Ibri College of Technology	
	19. Institute of Topographic Sciences	
	20. International College of Engineering and Management	
	21. International Maritime College of Oman	
	22. Majan University College	
	23. Mazoon College	
	24. Middle East College	
	25. Military Technological College	
	26. Ministry of Health Educational Institutes	
	27. Modern College of Business and Science	
	28. Muscat College	
	29. Muscat University	
	30. National Defense College	
	31. National University of Science and Technology	
	32. Nizwa College of Applied Sciences	
	33. Nizwa College of Technology	
	34. Nizwa University	
	35. Oman College of Health Sciences	
	36. Oman College of Management and Technology	
	37. Oman Dental College	

	38. Oman Medical College	
	39. Oman Tourism College	
	40. Royal Air Force Technical College	
	41. Rustaq College of Applied Sciences	
	42. Salalah College of Applied Sciences	
	43. Salalah College of Technology	
	44. Scientific College of Design	
	45. Shinas College of Technology	
	46. Sohar College of Applied Sciences	
	47. Sohar University	
	48. Sultan Qaboos Academy for Police Sciences	
	49. Sultan Qaboos Military College	
	50. Sultan Qaboos Naval Academy	
	51. Sultan Qaboos University	
	52. Sur College of Applied Sciences	
	53. Sur University College	
	54. The Command and Staff College	
	55. University of Buraimi	
	56. Waljat College of Applied Sciences	
<b>2</b>	<b>Indicate your position at your HEI: المسمى الوظيفي</b>	
	Dean العميد	
	Deputy Dean for Student Affairs نائب العميد لشؤون الطلبة	
	Deputy Dean for Academic Affairs نائب العميد للشؤون الأكاديمية	
	Vice Chancellor نائب الرئيس	
	Director مدير	
	Assistant Director مساعد مدير	
	Department Chair/Head رئيس قسم أكاديمي	
	Coordinator منسق	
	Faculty member عضو هيئة تدريسية	
	Manager مدير	
	Head of administrative section رئيس قسم إداري	
	Administrative staff member عضو هيئة إدارية	
	Other: please indicate: مسمى آخر: أرجو ذكره	
<b>3</b>	<b>Identify your highest degree earned تحديد أعلى درجة علمية حصلت عليها</b>	
	High school	
	Certificate level	
	Diploma level	
	Higher Diploma level	
	Bachelor	
	Masters	



	Doctorate	
	Other: please indicate:	
<b>4</b>	<b>First degree specialization:</b> التخصص في الدرجة العلمية الأولى	

<b>5</b>	<b>Current academic/research field/area if different from #4</b> مجال العمل الحالي إذا اختلف عن رقم 4 التخصص المذكور في رقم 4	
<b>6</b>	<b>Gender</b>	
	Female	
	Male	
<b>7</b>	<b>Your age</b>	
	Under 26	
	26-35	
	36-45	
	46-55	
	56-65	
	Above 65	

<b>Section B: Data Collection</b>					
<b>Rating Scale</b> مقياس التقييم	<b>5</b> <b>(Strongly Agree)</b> أوافق بشدة	<b>4</b> <b>(Agree)</b> أوافق	<b>3</b> <b>(Disagree)</b> لا أوافق	<b>2</b> <b>(Strongly Disagree)</b> لا أوافق بشدة	<b>1</b> <b>NA</b> لا ينطبق
<b>8</b>	<b>Challenges of introduced emerging AI technologies</b> تحديات إدخال تقنيات الذكاء الاصطناعي الجديدة				
<b>i.</b>	The present technology and competency requirements for the application of emerging AI are assessed/evaluated at your HEI. يتم تقييم متطلبات التكنولوجيا والكفاءة الحالية اللازمة لتطبيق الذكاء الاصطناعي في مؤسسة التعليم العالي التي تعمل بها.				
<b>ii.</b>	Currently applied AI systems are challenging to existing employees. أنظمة الذكاء الاصطناعي المطبقة حالياً تمثل تحدياً للموظفين الحاليين.				
<b>iii.</b>	Staff capability in using of AI is assessed regularly. يتم تقييم قدرة الموظفين على استخدام الذكاء الاصطناعي بانتظام.				
<b>iv.</b>	Currently adopted AI systems were well planned.				

	تم التخطيط بشكل جيد لأنظمة الذكاء الاصطناعي المعتمدة حالياً.					
<b>v.</b>	Currently adopted AI systems are managed effectively. تتم إدارة أنظمة الذكاء الاصطناعي المعتمدة حالياً على نحو فعال.					
<b>vi.</b>	Staff overall knowledge on the level of AI importance and its acceptability in education are known. يعي الموظفون بشكل عام أهمية الذكاء الاصطناعي في التعليم بشكل واضح.					
<b>vii.</b>	The impact on individual employment and/or retirement plans was previewed. تم تحديد التأثير على التوظيف الفردي و / أو خطط التقاعد.					
<b>9</b>	<b>Action to overcome challenges</b> العمل على التغلب على التحديات					
<b>i.</b>	There are systems to assess future requirements of emerging AI in higher education. توجد أنظمة لتقييم المتطلبات المستقبلية للذكاء الاصطناعي في التعليم العالي.					
<b>ii.</b>	There are efforts exist to internally identify talent from existing staff for future AI utilization. توجد جهود لتحديد المواهب داخلياً من الموظفين الحاليين لاستخدام الذكاء الاصطناعي في المستقبل.					
<b>iii.</b>	There is available AI planning chart exists that guides the new AI process for each field of program/major offered. يوجد مخطط تخطيطي للذكاء الاصطناعي والذي يوضح عملية الذكاء الاصطناعي الجديدة لكل مجال من مجالات البرنامج / التخصص المقدم.					
<b>iv.</b>	Employees are involved in discussing/reviewing applied AI frameworks. يشارك الموظفون في مناقشة / مراجعة أطر عمل الذكاء الاصطناعي المطبقة.					
<b>v.</b>	Students are involved in discussing/reviewing applied AI frameworks. يشارك الطلاب في مناقشة / مراجعة أطر عمل الذكاء الاصطناعي المطبقة.					

<b>vi.</b>	There is a deliberate effort to identify a pool of talent with high AI potential for different designations. هناك جهد واضح لتحديد مجموعة من المواهب ذات إمكانات عالية في الذكاء الاصطناعي في المسميات الوظيفية المختلفة.					
<b>vii.</b>	Employee/s participation is highly encouraged in AI development programs based on their job requirements. يتم تشجيع مشاركة الموظف / الموظفين بشدة في برامج تطوير الذكاء الاصطناعي بناءً على متطلبات وظيفتهم.					
<b>viii.</b>	Enhancing the potential of local citizens in AI, rather than depending on other expatriate talent. يتم تعزيز إمكانات المواطنين المحليين في الذكاء الاصطناعي، بدلاً من الاعتماد على المواهب الأجنبية الأخرى.					
<b>10</b>	<b>Perceptions, adaptability and impact of the planning and adoption of AI</b> التصورات والقدرة على التكيف وتأثير التخطيط واعتماد الذكاء الاصطناعي					
<b>i.</b>	Top management (Vice chancellor/Dean/Department Chair) enforces high pressure on subordinates to adopt new AI systems. الإدارة العليا (نائب رئيس المؤسسة/ العميد / رئيس القسم) تفرض ضغطاً كبيراً على المرؤوسين لاعتماد أنظمة جديدة للذكاء الاصطناعي.					
<b>ii.</b>	Management is active in mentoring/coaching its employees to adopt initiated AI systems. الإدارة نشطة في توجيه / تدريب موظفيها على اعتماد أنظمة الذكاء الاصطناعي التي بادرت بتطبيقها.					
<b>iii.</b>	Internally trained candidates are regularly evaluated and given feedback to enhance their knowledge. يتم تقييم المرشحين الذين يتم تدريبهم داخلياً بشكل منتظم وإعطاء ملاحظات لتحسين معارفهم.					

<b>iv.</b>	Currently, student level is considerably low to adopt advanced AI systems. حاليا ، مستوى الطالب منخفض بدرجة كبيرة بحيث لا يمكنه تبني أنظمة الذكاء الاصطناعي المتقدمة.					
<b>v.</b>	Adoption of advanced AI leads to employee resignation in their current positions. اعتماد الذكاء الاصطناعي المتقدم يؤدي إلى استقالة الموظف من وظائفهم الحالية.					
<b>vi.</b>	Implementation of new AI systems boosts student involvement in academic activity. تنفيذ نظم الذكاء الاصطناعي الجديدة يعزز مشاركة الطلاب في النشاط الأكاديمي.					
<b>11</b>	<b>Specific measures to be followed in dealing with AI</b> التدابير المحددة الواجب اتباعها في التعامل مع الذكاء الاصطناعي					
<b>i.</b>	Specific selection criteria are implemented to select candidates (faculty & staff) out of a pool of applicants. يتم تطبيق معايير اختيار محددة لاختيار المرشحين (أعضاء هيئة التدريس والموظفين) من بين مجموعة من المتقدمين.					
<b>ii.</b>	Top management supports academic/administrative leaders to promote internal AI adoption. تدعم الإدارة العليا القادة الأكاديميين / الإداريين لتعزيز تبني الذكاء الاصطناعي الداخلي.					
<b>iii.</b>	Top management explicitly promotes AI planning policies and strategies. الإدارة العليا تروج صراحة لسياسات واستراتيجيات التخطيط للذكاء الاصطناعي.					
<b>iv.</b>	Staff from Information Technology department are actively involved in AI planning issues. يشارك موظفو قسم تكنولوجيا المعلومات بشكل فعال في قضايا تخطيط الذكاء الاصطناعي.					
<b>v.</b>	AI planning considered important component of HEI strategic plan.					

	يعتبر تخطيط الذكاء الاصطناعي مكوناً مهماً في الخطة الاستراتيجية لمؤسسة التعليم العالي.					
vi.	Institutional culture encourages adopting of new AI systems. تشجع الثقافة المؤسسية تبني أنظمة الذكاء الاصطناعي الجديدة.					
vii.	Top management establishes a systematic AI planning and management program. تقوم الإدارة العليا بإنشاء برنامج منهجي لتخطيط وإدارة الذكاء الاصطناعي.					
viii.	AI training programs are organized to faculty, staff & students. يتم تنظيم برامج تدريبية للذكاء الاصطناعي لأعضاء هيئة التدريس والموظفين والطلاب.					
12	<b>Specific budget for improving AI</b> ميزانية محددة لتحسين الذكاء الاصطناعي					
i.	AI is a part of HEI Strategic Plan يعتبر الذكاء الاصطناعي جزءاً من الخطة الاستراتيجية لمؤسسة التعليم العالي.					
ii.	Internally trained candidates with high potential receive gratifying salary packages. يتلقى المرشحون المُدرَّبون داخلياً الذين يملكون إمكانيات عالية رواتب مرضية.					
iii.	Allocate specific budget in operational planning to train existing talent. يتم تخصيص ميزانية محددة في التخطيط التشغيلي لتدريب المواهب الحالية.					

**13. Mention other factors that you believe may affect the adoption of AI practices in HEI.**

اذكر عوامل أخرى تعتقد بأنها تؤثر على تبني ممارسات الذكاء الاصطناعي في المؤسسة.

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**14. Kindly feel free to give your suggestions to implement AI planning practices in HEI.**

يرجى تقديم اقتراحاتك لتطبيق ممارسات تخطيط الذكاء الاصطناعي في المؤسسة.

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**Thank you for your cooperation**

شكراً لتعاونكم

## **Appendix B: Interview Questions**

### **Admin Staff from IT**

1. Do you implement any machine learning systems (supervised & unsupervised) in your HEI? If yes, what and how are they beneficial to students?
2. May I know your HEI uses any automatic programming in administrative work? If yes, please mention and brief its uses.
3. If you are given authority to change/initiate one AI technique/system at your HEI, what would it be, and how would you go about implementing that change to enrich AI knowledge?

### **Academic Staff from IT**

1. What is your awareness about programming languages in AI? Are they incorporated into the curriculum at your HEI? If yes, at which level? E.g.: Python, Java, C/C++, JS, R, Lisp, Prolog ... etc.
2. Can you state your experience with online learning platforms?
3. What role should HEI take to incorporate programs related to AI in the Sultanate of Oman?

### **Subject Experts/Companies dealing within the local market**

1. Can you share your viewpoint about encouraging educational innovation applying AI that you are aware of? Why is it innovative? What value will it bring to the education sector in Oman aligned with Oman Vision 2040?
2. What programs do you have for/are aware of administrative processes that can be incorporated in HEIs in Oman?
3. Professionally, where do you see Oman could be in 10 years in adopting AI systems in different sectors?

### **Objectives are to:**

1. get input from HEIs management regarding their plans for adapting AI-related systems in administration work,
2. seek academicians' opinion related to AI subjects covered in the current curriculum or planning to initiate and
3. know-how professionals in the market are ready to supply and support AI technology into admin and academic areas.

**Overall, interview sessions will help to discuss in person with administrative staff, academicians and professional companies in the local market to know what kind of AI systems are existing or can be initiated both at administrative and academic ends.**

## Appendix C: MoHERI's Approval Letter

The following letter was attached to the email sent by the researcher to all participants of the research survey, MoHERI already emailed it to all HEIs in Oman.

Sultanate of Oman  
Ministry of Higher Education  
Directorate General of  
Private Universities & Colleges



سلطنة عُمان  
وزارة التعليم العالي  
الديرة العامة للجامعات والكلية الخاصة

التاريخ: ١١ / ٧ / ٢٠١٩ م

الرقم: ١٠٥ / ٢٠١٩ / ٢٨٠ - ص/ح

تعميم رقم (٢٠١٩/١٠٣)

المحترمين  
المحترمين

الأفاضل / رؤساء الجامعات الخاصة  
الأفاضل / عمداء الكليات الخاصة  
السلام عليكم ورحمة الله وبركاته....،،،

### الموضوع: تسهيل مهمة باحث

نود إفادتكم بأن الفاضل / عماد عادل - نائب العميد لشؤون الطلبة بالكلية العلمية للتصميم يقوم حالياً بإعداد إستبيان وذلك كجزء من بحثه في الدكتوراه بعنوان (Dealing With AI Oman HEIs) والذي يهدف للوقوف على التحديات والفرص لتطبيق الذكاء الاصطناعي في مؤسسات التعليم العالي في سلطنة عمان .

علية.. نرجو التكرم مشكورين بالإعاز لمن يلزم نحو تسهيل مهمة الباحث ومساعدته في الحصول على المعلومات والبيانات المتعلقة بدراسته وحسب ما ترونه مناسباً،

شاكرين لكم اهتمامكم وتعاونكم.

وتفضلوا بقبول فائق التقدير والاحترام...،،،



جوخة بنت عبدالله الشكيلية  
المديرة العامة للجامعات والكليات الخاصة

نسخة إلى:  
- رئيس مكتب معالي الدكتورة الوزيرة  
- مدير مكتب سعادة الدكتور الوكيل



نحو تعليم عال ذي جودة عالية يلبي متطلبات التنمية المستدامة  
سلطنة عُمان ص.ب: ٨٢ روي - الرمز البريدي ١١٢ - هاتف ٢٤٣٤٠٣٦٨ / فاكس ٢٤٣٤٠٣٦٦  
Sultanate of Oman, P.O.Box: 82 Ruwi, PC 112, Tel: 24340368 / Fax 24340366 www.mohe.gov.om