COMPETENCY FRAME WORK FOR ARTIFICIAL INTELLIGENCE (AI) BASED PSYCHOMETRIC ASSESSMENTS & INTERVENTIONS IN HEALTH CARE AND EDUCATION

Abstract

Purpose: The proposed chapter aims to provide a bird's eye view of cluster of prominent skill sets required for AI application in the field of psychometric assessments and allied interventions in context of recent advances in health and education.

Approach: Secondary data review and expert interviews were used as key approach for data collection and discussion. Data analysis was conducted using thematic approach.

Findings: Competency framework broadly classified into four types of competencies that have enabled researchers and practitioners make significant AI related breakthroughs. The four competencies, namely **scientific thinking skills, design thinking skills, a psychometrician's competency and AI-self efficacy** are elaborated through recent published multidisciplinary scientific findings. The scientific thinking skills are derived from the core Turingian philosophy which refer to scientific traits viz. curiosity, skepticism and empiricism necessary to envision AI in solving psychosocial problems. The design thinking skills emphasize on the importance of combination of both cognitive and affective traits like empathy, ideation and interdisciplinary collaboration which are perquisites of AI prototyping and testing phases. The psychomterician's competency section discusses published case studies highlighting how certain softwares on account of their strong psychometric properties and NLP analysis have managed to

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predict and provide diagnostic based solutions for various physical and mental health conditions like breast cancer, Covid-19, anxiety, and suicide. The last competency in the framework emphasizes on the need to inculcate and encourage the AI mindset amongst budding therapists and professionals.

Value: Recent AI apps in field of education and psychotherapy, through therapy chatbots and diagnostic apps, have successfully provided effective solutions for complex subjective forms of behaviour like depression and dyslexia by analysing verbatim and real-time data. Chapter sets positive outlook towards AI application for resolving global pressing problems of health care and education.

Keywords: Competency framework, Artificial Intelligence, Psychometric Assessments

I. INTRODUCTION

The present era is a witness to the global and pervasive impact in health care and education industries, brought in by Artificial Intelligence (AI). Artificial Intelligence (AI) can be likened to the multi-headed or multi-handed technology capable of accessing, providing information and performing services which often is perceived as a threat to humankind's natural intellectual capacities to understand, analyse and provide care, instruction& guidance

Irrespective of how much by leaps and bounds AI has managed to acquire control of our education and health care systems, it is important to take cognizance of the remarkable breakthroughs it has managed to make especially when the world witnessed the existing global human capacities coming to a standstill in the Covid 19 pandemic years. the present chapter intends to provide a wider lens to review the milestones reached in health & academic AI aided interventions during and beyond the COVID-19 pandemic years.

The chapter via research evidence would also unlock the human competencies required to develop new and finetune existing AI integrated services for further augmentation of quality of education and health care service providers.

The present chapter provides a comprehensive understanding of classification of four broad set of AI competencies for researchers and professionals in health care and educational settings. Employing secondary data analysis, laced with anecdotal references from research, the readers would get a good understanding as to how by learning and imbibing these skills sets, one can make the best utilization of natural human competences merged with AI for educational and healthcare advancements.

As envisioned by the authors, the four broad competencies that would enable successful application of AI in health care and education are **scientific thinking skills, design thinking skills, a psychometrician's competency and AI-self efficacy.**
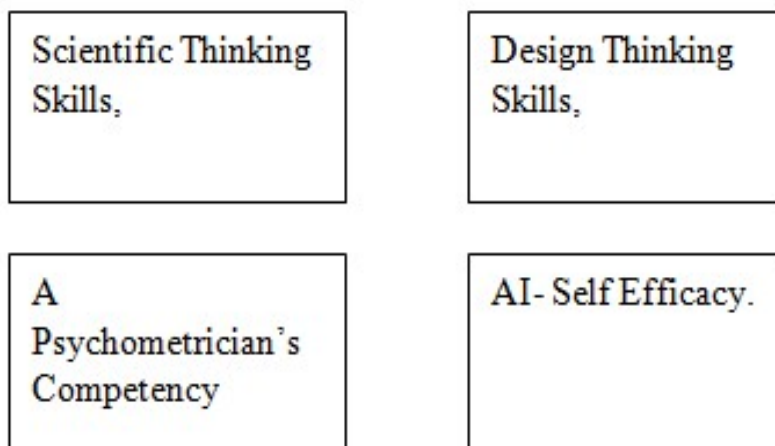
Scientific Thinking Skills,	Design Thinking Skills,
A Psychometrician's Competency	AI- Self Efficacy.

Figure 1: Conceptual framework of competencies for AI application for health care and educational interventions

II. SCIENTIFIC THINKING SKILLS

The first set of skills are the foundational competencies which refers to the more general, basic yet desirable attitude and temperament required for successful application of AI. It is inspired by Alan Turing's core experimental enquiry conducted by him in a series of experiments done to answer the question- is computer intelligence similar to human intelligence. The "computer intelligence" has travelled many frontiers of achievements since then, thanks to human brain's relentless zest at getting better with AI application. As Turing had strongly opined, that the network of human brains managing the AI technology, has to be constantly rejuvenated with child like curiosity and zest to know every possible strategy that could be answer to our problems at hand. It is important to note that while AI integrated human services offer instant & economical remedies to our health related problems of patients and education related problems of both teachers and students alike, the vision and road map on which AI application is modelled, has to be well conceived and meticulously worked out in a way that that the researchers and developers anticipate, look into and work on every possible aspect of the problem at hand and also every possible unique & regular strategy that can work as solution. Why is it important to have the childlike enthusiasm and sustained interest to solve problem was addressed in an experimental study by **Schulz,** Wu & Meder in 2019. The study examined the task performing abilities of three groups of subjects – first group comprised children aged 7 to 8 years, second group having older children aged between 19 to 55 years and a third group which had adults with age ranging from 19 to 55 years.The study concluded that even though the first group of younger children participants could not accomplish the task goals, they explored and searched every possible location in the activity. The study concluded that children search for answers and solutions more extensively that adults irrespective of whether the search earns rewards or not. It is therefore advisable for all the budding AI users and developers to have the child-like curiosity and enthusiasm that would help them holistically look at a broad range of possible solutions at hand. The scientific thinking skills are derived from the core Turingian philosophy which refer to scientific traits viz. curiosity, skepticism and empiricism necessary to envision AI in solving psychosocial problems.

A successful AI service is only possible with serious cognizance and acknowledgement of day-to-day problems that ranges from accessing remote interventions, and receiving tentative data along with tips of remediation about present symptomatology. Medical AI initiatives like Fitbit and Samsung health allow consumers (usually aiming at adopting healthy lifestyle on account of diagnosed or borderline conditions like diabetes & cardiovascular disorders) to monitor their fitness routine, sleeping pattern, calorie consumption. Fitbit, Samsung Health and Apple Watch offer wearable devices serving as the scientifically designed forms of prevention that help individuals avail health monitoring from the comfort of their homes.

In the field of school education, it is important to mention the breakthroughs made by Microsoft Corporation particularly. The Microsoft Education has time and again considered the lapses in education system which either emanate from individual related factors like disabilities of students or contextual factors like schools adopting online education system due to lockdown enforced by outbreak of the COVID virus. The various accessibility features rolled out one after another by Microsoft, be it the Dictate feature, speech to text and text to speech, Immersive Reader (that allows to read without distractions) and a whole range of

Microsoft accessibility features speaks volumes of the intent to make people's live simpler, solution centric for people with and without neurodiversity. A remarkable contribution by Microsoft Education during the Covid pandemic period was the offing of AI aided reading intervention for children particularly struggling in reading, diagnosed with reading in early and middle school grades. Dyslexic children often evade and fear situations of open classroom reading sessions that often lead to panic, embarrassment and incidents of bullying leaving students with lower self-esteem. to combat the situation, Microsoft offered the AI reading app named Reading Progress that was made available in its virtual meeting and classroom interaction portal Microsoft Teams. Reading Progress is a systematically and scientifically designed application that analysed the reading quality of a reading session, recorded and uploaded by a child from the comfort of home. The app also provided the statistics of errors in articulation, pronunciation and other parameters of reading to the teachers which further gave a clear pathway to the teacher for designing next course of improvement in child's reading abilities.

While there is scope and need for improvement in quality of feedback which Reading Progress provides to struggling readers in classrooms, its emergence for teachers, parents and struggling students in the times of pandemic, makes it a prominent AI development in field of school education (Molenda & Grabarczyk, 2022).

III. DESIGN THINKING COMPETENCIES

Connected with the first competency (i.e the basic childlike quest to understand a human problem from various lens before arriving at best possible solution) is the next set of skills which requires necessary adoption by researchers and professionals in health care end education industries. The design thinking skills emphasize on the importance of combination of both cognitive and affective traits like empathy, ideation and interdisciplinary collaboration which are perquisites of AI prototyping and testing phases. this domain calls for individual experts from the disciplines of bio-medical and behavioral health sciences and education to collaborate with the machine learning experts of AI for joint multi-disciplinary deliberation and troubleshooting of AI based solutions. A good precedence can be the new wave of app-based interventions for accessing mental health care facilities at home. The app-based interventions are products of joint collaborative efforts of deliberations made jointly by psychologists and app developers. The effectiveness of these smart phone interventions is making significant contributions towards making mental health more accessible in a destigmatized manner to diverse populations and cultures. The empirically designed smart phone interventions for tracking mood, anxiety, momentary depression, and negative emotional states, etc are beginning to pick pacy popularity with the younger generation and college goers who often experience prejudicial and financial hurdles in accessing and continuing offline counselling and psychotherapy-based services. A comprehensive and systematic review of effectiveness of various app-based interventions for self-management of depression, generalized anxiety disorder, social anxiety, alcohol consumption, etc, has been provided by Oliviera, Pereira, Vagos, Nobrega, Gonsalves & Afonso in 2021. Oliviera, et.al reviewed 28 studies (RCT based studies =11; quasi-experimental =2; single sample pretest post studies=4 and 1 study using two groups through iterative processes) that assessed the effectiveness of mobile app-based interventions on mental health state outcomes of college goers. this study further reports sharp reduction in depression and anxiety with usage of apps namely Lantern and Feel Stress Free (Newman, et.al, 2020; McCloud, et.al, 2020),

experience of loneliness during college years with usage of Nod (Bruehlman-Senecal et al. (2020), academic stress with usage of Study care Stress (Harrer, et.al, 2018). Oliveira, et.al's review also reported how an app based intervention Telecoach led to strong decrease in alcohol consumption in both experimental and waiting control group of college going participants examined by Gajecki et al in 2017.

The aforementioned studies account for the vision, deep and intellectual understanding of mental health problems of the population of concern which have been considered by the brains behind the app developers. with the union of mental health experts and machine learning specialists, the app-based interventions are believed to be the preferred option for accessing instant, realistic and economical mental health first aid thereby making these interventions accessible, feasible and adherable. Their preference for availing free mental health first aid and remote psychotherapy-based services can be attributed to three characteristics namely ease of habit, low effort expectancy and high hedonic motivation. (Chandrashekhar, 2018). An effective and successful AI intervention would be the one that has addressed the design thinking elements viz desirability, viability and feasibility (https://www.ideou.com/blogs/inspiration/what-is-design-thinking). The preference for app based interventions and other AI aided interventions are due to collaborative empathetic understanding about the common problems of the society and an enriched understanding of problem behaviour and consumer behaviour that lead to successful prototyping and testing phases.

The design thinking competencies underscore the importance of addressing the management of problems from various multidisciplinary perspectives and consider suspending stereotypical & fixated pathways of ideas as solutions. The neural language programming combined with catchy graphics and interactive and empathetic Chabot features, simple user interface features, real time engagement and reinforcing tasks and activities to be accomplished by the users make these interventions highly engaging and efficacious in management of symptoms of depression, anxiety & schizophrenia (Chandrashekhar, 2018; Bakker, Kazantzis &Rickwood, 2016; Fleming, Bavin, Stasiak, 2017; Rickard, Arjmand, Bakker, 2016).

IV. THE PSYCHOMETRICIAN'S COMPETENCY

With readiness to incorporate impactful design thinking approaches for developing AI integrated services to combat health or learning problems, the product developers would then most likely be ready develop AI models with strong psychometric properties. Strong psychometric properties in AI products, derived from rich, scientific and collaborative design thinking methods, are capable of making better prediction of human behaviour and onset of diseases/disorders. Today, the exhaustively derived problem specific algorithms help the AI oriented machine learning "detectors" provide accurate predictions and diagnostics with regard to wide spectrum of health and education related problems. Some recent noteworthy milestones in terms of AI algorithms making a dent in health care diagnostics have been vividly documented by Dr Bertalan Mesko in his recent post on the online medicine portal *The Medical Futurist*. Mesko's article explains how machine learning algorithms have revolutionized screening diagnosis and predictions of DNA mutations in tumour, heart attacks, skin cancer, breast cancer and even prediction of suicial behaviour. Orru, et.al, 2020, describes the commonly used AI algorithms utilized to make accurate AI predictions in

healthcare accurate. While discrimant analysis based algorithms find more usage in mental health related predictions, logistic regression and Naïve Bayes based algorithms help to improve the quality of health care for patients with critical diagnoses (Orru, et. al.,2020; Chatterjee, 2020). although a rarity, there is scanty evidence of effectiveness of prediction of dyslexia through the medium of machine learning and deep learning methodologies (Sharma, Chatterjee, Kaur, Vavilala, 2022; Prabha & Bhargavi, 2019).

A recent study by Alqahtani, Alzahrani & Ramzan, 2023recommend adoption of Deep Learning methods for diagnosis and prediction of dyslexia.

For social scientists aiming to contribute to AI products and services for resolving psycho-social problems, an area of challenge would be comparison of predictive qualities of AI based predictions vs traditional clinical /psychometric assessments of human behaviour and symptomatology. A more advantageous approach to improve experience and quality of testing in psychology and allied fields related to behavioural and mental health would be to consider AI models as tools to improve results of traditional psychometric tests rather than approaching them as substitutes of classical psychometric testing. A strong rationale behind this approach has been provided by Maxwell Uduafemhe in the research opinion article *Exploring the Potential of Artificial Intelligence to Improve Psychological Testing Accuracy.* Uduafemhe reports "AI can be used to improve the accuracy of existing psychological tests and develop new tests. AI algorithms can analyze large datasets to uncover patterns and correlations that may not be apparent to the human eye. This type of analysis can be used to supplement existing psychological testing methods and provide more accurate results. AI can also be used to develop new tests, such as the Cognitive Assessment System (CAS), which uses AI to create a cognitive profile of the test taker." (Uduafemhe, 2023).

Recent reports of AI integrated psychotherapy sessions have proven how by AI driven analysis of quality of transcripts of therapy conversation, help psychologists improve their quality of their services in subsequent sessions with clientele.

The psychometrician cluster of skills in AI encompasses detailed understanding of all probable behavioural and symptomatic characteristics that would help differentiate between high probable carriers of conditions low/non probable carriers of the condition. This understanding intertwined with ML and DL skills complete the cluster competency.

V. AI EFFICACY COMPETENCY

The AI competency refers to self-efficacy oriented belief system that would boost researchers and professionals with positive self-esteem in envisioning innovation of AI aided products and services that can improve quality of learning in educational sectors and also quality of patient diagnosis and care in health sector. it is a common parlance that budding researchers and interns in social science disciplines often experience unreadiness, lower self esteem and disconnect to experiment with AI approaches in provision of quality health care and education. however, the promising contribution which AI integrated products of late, have helped diverse populations in leading empowered and healthier lives, throw light on how collective interdisciplinary brains can make AI a meaningful, empathetic and compassionate solutions to human problems. Neurodiversity is one domain wherein AI has made profound impact in terms of enabling people with neurodiversity live lives with

acceptance, independence and dignity. AI today can be seen as the most powerful tool for enabling inclusive societies. Inclusion as defined by UNESCO report, 2017 is *a process that helps to overcome barriers limiting the presence, participation and achievement of learners.* (UNESCO, 2017: 7). Microsoft's offing of accessibility features to make technology accessible and usable for people with neurodiversity, Immersive Reader app& OrCamdevices for those who struggle with reading even in adulthood, Milo & Kaspar robots to assist children with Autism spectrum disorder in social communication and MyEye wearable devices to help the visually challenged navigate their physical spaces- are all examples of AI's sensitivities to human problems related to impairments and disabilities for all age groups. These AI devices are fast emerging into means by which we can achieve inclusive and dignified societies, learning systems and workspaces crucial for healthier environment (UN, Transforming our world: the 2030 Agenda for Sustainable Development, 2015).

The AI self competency belief system needs to be understood as creation of opportunities for collaboration and application of other 21st century learning skills amongst social scientists and machine scientists for innovation of AI driven therapies, interventions and devices. As explained by Gado, Kempen, & Bipp (2021) following individual and institution level factors are required to encourage AI acceptance amongst scholars and students of psychology:

- Perceived usefulness
- Ease of use
- Perceived obstacles (internal + external)
- Perceived support system for AI

Gado, Kempen & Bipp developed and AI acceptance framework based on classical theories of self-efficacy (Theory of Reasoned Action, Fishbein & Ajzen, 1975; Theory of Planned Behaviour, Ajzen, 1991; Technology Acceptance Model, Davis, 1985) and tested it in a sample of 218 psychology students. They concluded that out of all the factors perceived usefulness and ease of use were the best predictors of acceptance of AI. the study called for making psychology curriculum at higher institutions more AI friendly.

VI. DISCUSSION

The present chapter sets a positive and realistic outlook for adoption of AI based ideology in designing interventions and assessments amongst developing social scientists, psychologists, educationists and other professionals allied with health care and education. The review of the four requisite competencies would allow multidisciplinary researchers from social scientific, biomedical and mental health related disciplines, collaboratively deliberate and contribute to effective management of health and education related issues and problems predominantly experienced by the vulnerable populations. The four competency framework intends to have a broader and holistic view of people's problems in which every discipline expert can contribute significantly with agency and expertise.
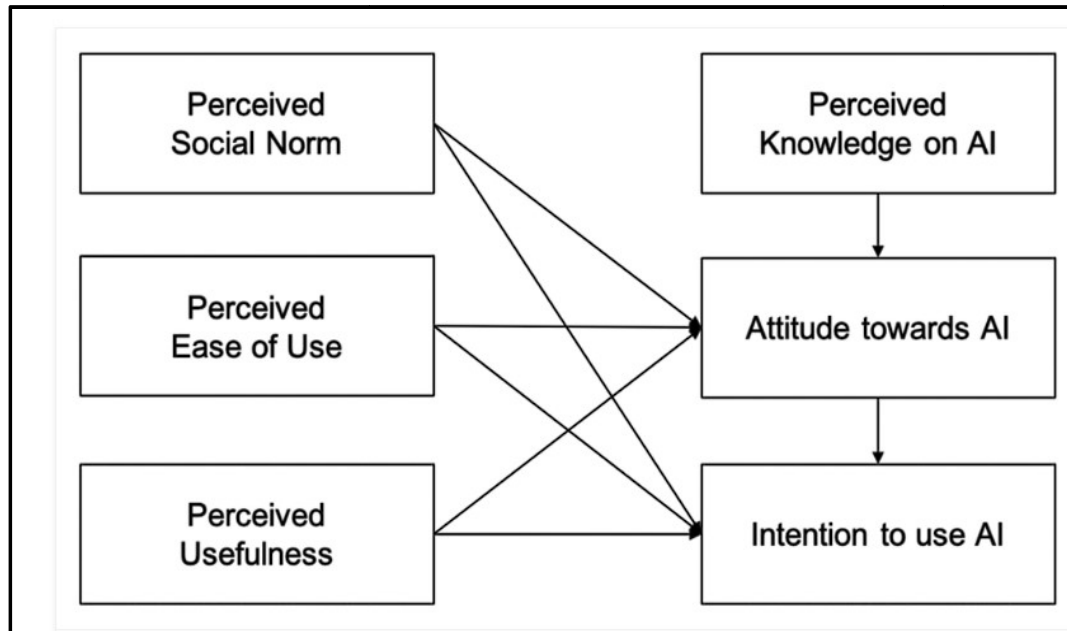
Figure 2: Schematic representation of factors influencing students' acceptance of AI in learning &research

Source: Artificial intelligence in psychology: How can we enable psychology students to accept and use artificial intelligence?- Gado, Kempen, & Bipp, 2021.

REFERENCES

[1]   Ajzen,I.(1991).The theory of planned behavior. Organizational Behavioral and Human Decision Processes, 50,179–211.

[2]   Alqahtani, N. D., Alzahrani, B., & Ramzan, M. S. (2023). Deep learning applications for Dyslexia prediction. Applied Sciences, 13(5), 2804.

[3]   Bakker, D., Kazantzis, N., Rickwood, D., & Rickard, N. (2016). Mental health smartphone apps: review and evidence-based recommendations for future developments. JMIR mental health, 3(1), e4984.

[4]   Bruehlman-Senecal, E., Hook, C. J., Pfeifer, J. H., FitzGerald, C., Davis, B., Delucchi, K. L., ... & Ramo, D. E. (2020). Smartphone app to address loneliness among college students: pilot randomized controlled trial. JMIR Mental Health, 7(10), e21496.

[5]   Chandrashekar, P. (2018). Do mental health mobile apps work: evidence and recommendations for designing high-efficacy mental health mobile apps. Mhealth, 4.

[6]   Chatterjee, R. (2020). Top 6 AI Algorithms in HealthCare Top 6 AI Algorithms In Healthcare (analyticsindiamag.com)

[7]   Davis, F. D. (1985). A technology acceptance model for empirically testing new end-user information systems: Theory and results (Doctoral dissertation, Massachusetts Institute of Technology).

[8]   Fishbein, M., & Ajzen, I. (1975). Belief, attitude, intention and behaviour: An introduction to theory and research. Addison-Wesley.

[9]   Fleming, T. M., De Beurs, D., Khazaal, Y., Gaggioli, A., Riva, G., Botella, C., ... & Riper, H. (2016). Maximizing the impact of e-therapy and serious gaming: time for a paradigm shift. Frontiers in psychiatry, 65.

[10]   Gado, S., Kempen, R., Lingelbach, K., & Bipp, T. (2022). Artificial intelligence in psychology: How can we enable psychology students to accept and use artificial intelligence?. Psychology Learning & Teaching, 21(1), 37-56.

[11] Gajecki, M., Andersson, C., Rosendahl, I., Sinadinovic, K., Fredriksson, M., & Berman, A. H. (2017). Skills training via smartphone app for university students with excessive alcohol consumption: a randomized controlled trial. International journal of behavioral medicine, 24, 778-788.

[12] Harrer, M., Adam, S. H., Fleischmann, R. J., Baumeister, H., Auerbach, R., Bruffaerts, R., ... & Ebert, D. D. (2018). Effectiveness of an internet-and app-based intervention for college students with elevated stress: randomized controlled trial. Journal of medical Internet research, 20(4), e136.

[13] Jothi Prabha, A., & Bhargavi, R. (2019). Prediction of dyslexia using machine learning—a research travelogue. In Proceedings of the Third International Conference on Microelectronics, Computing and Communication Systems: MCCS 2018 (pp. 23-34). Springer Singapore.

[14] McCloud, T., Jones, R., Lewis, G., Bell, V., and Tsakanikos, E. (2020). Effectiveness of a mobile app intervention for anxiety and depression symptoms in university students: randomized controlled trial. JMIR MHealth UHealth 8, 1–22.

[15] Mesko, B., (2023). Top smart algorithms in healthcare Top AI Algorithms In Healthcare - The Medical Futurist

[16] Molenda, M., & Grabarczyk, I. (2022). Microsoft Reading Progress as Capt Tool. Research in Language, 20(2), 197-214.

[17] Newman, M. G., Jacobson, N. C., Rackoff, G. N., Bell, M. J., & Taylor, C. B. (2021). A randomized controlled trial of a smartphone-based application for the treatment of anxiety. Psychotherapy Research, 31(4), 443-454.

[18] Oliveira, C., Pereira, A., Vagos, P., Nóbrega, C., Gonçalves, J., & Afonso, B. (2021). Effectiveness of mobile app-based psychological interventions for college students: a systematic review of the literature. Frontiers in psychology, 12, 647606.

[19] Orrù, G., Monaro, M., Conversano, C., Gemignani, A., & Sartori, G. (2020). Machine learning in psychometrics and psychological research. Frontiers in psychology, 10, 2970.

[20] Rickard, N., Arjmand, H. A., Bakker, D., & Seabrook, E. (2016). Development of a mobile phone app to support self-monitoring of emotional well-being: a mental health digital innovation. JMIR mental health, 3(4), e6202.

[21] Schulz, E., Wu, C. M., Ruggeri, A., & Meder, B. (2019). Searching for rewards like a child means less generalization and more directed exploration. Psychological science, 30(11), 1561-1572.

[22] Sharma, D. K., Chatterjee, M., Kaur, G., & Vavilala, S. (2022). Deep learning applications for disease diagnosis. In Deep learning for medical applications with unique data (pp. 31-51). Academic Press.

[23] The United Nations. (2015). Transforming our world: the 2030 Agenda for Sustainable Development.

[24] Uduafemhe, M. (2023). Exploring the potential of Artificial Intelligence to improve psychological testing accuracy. leverageassessments.com https://www.leverageassessments.com/exploring-the-potential-of-artificial-intelligence-to-improve-psychological-testing-accuracy/

[25] UNESCO. 2017. A guide for ensuring inclusion and equity in education.Paris: UNESCO. Retrieved from: http://unesdoc.unesco.org/images/0024/002482/248254e.pdf

[26] What is Design Thinking (n.d) ideou.com https://www.ideou.com/blogs/inspiration/what-is-design-thinking