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Looking to the Future: AI In Education

Duarte Miguel dos Reis Batuca

Dissertation submitted as partial requirement for the conferral of the master's degree In Management of Services and Technology

Supervisor
Henrique O'Neill, Associated Professor, Department of Marketing, and Operations and General Management (IBS),
ISCTE- University Institute of Lisbon

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Acknowledgments

This journey of acquiring knowledge has been the most precious time for me, although it will never end, the closure of this chapter in my life was only possible due to the fabulous people, I crossed paths with. Without them this past year would be too heavy to bear and too short to celebrate alone.

The guidance of Professor Henrique O'Neill was essential for the conclusion of this work, and I appreciate the time and effort gifted as a token of belief and trust bestowed upon me. His knowledge and reliability led me to strive for more.

After such a terrible year for everyone my closest friends and I were there for each other every day during the pandemic, although we could not see each other our bond did not falter, and we kept communicating and laughing together safely and I am thankful for that.

To my family, José Batuca, Isabel Batuca and Ana Batuca, I would like to say that many obstacles appeared in a daily basis but after so many years of overcoming them I do not fear what comes next and owe this to you.

Abstract

Artificial intelligence today rises mixed impressions amongst society. It is well-established that artificial intelligence brings advantages to different process, but these come at a cost. There is fear about the negative impacts of artificial intelligence on society. The aim of this thesis is to study acceptance about artificial intelligence in education. It investigates a group of individuals about their experience or lack of it, in learning using artificial intelligence tools, their experience and acceptance of the technology.

To determine the factors that may influence the adoption of AI in education, an online survey and interviews were made online to anyone willing to answer. The questionnaire divided respondents into two different groups, people with experience and people without it. Their answers to the technology acceptance model were used to study acceptance and it was proposed social interaction as an additional factor that can influence acceptance in the education domain. The questions were analyzed by using One-Way ANOVA and multiple linear regression analysis.

These conclusions point to the acceptance of both nonusers and users of AI to a mixed service, integrating traditional learning and artificial intelligence is valued by the sample acquired. It is to be expected acceptance will increase with more knowledge and social interaction. On this basis schools or learning institutions should try to implement this technology in their educational system and educate professors.

Keywords

Artificial intelligence; Services; Resistance; Fear; Trust; Market analysis; Education; Acceptance model.

JEL: I Education, Health, Welfare; 2 Education, Research Institutions, Teachers; 60 Educational Outcomes, Human Capital, Human Capital Investment, Labor Productivity, Mincer Earnings Function, Returns to Education

Resumo

A inteligência artificial hoje gera impressões diversas entre a sociedade. Está bem estabelecido que a inteligência artificial traz vantagens para diferentes processos, mas a um custo. Há medo sobre os impactos negativos da inteligência artificial na sociedade. O objetivo desta tese é estudar a aceitação da inteligência artificial na educação.

Investigando um grupo de indivíduos sobre a sua experiência, ou falta dela, em usar ferramentas de inteligência artificial na aprendizagem, sua perspetiva e aceitação da tecnologia.

Para determinar os fatores que podem influenciar a adoção da IA na educação, uma pesquisa online e entrevistas foram feitas online para qualquer pessoa disposta a responder. O questionário dividiu os respondentes em dois grupos diferentes, pessoas com experiência e pessoas sem experiência no uso de IA na educação. As respostas às perguntas usam uma versão do modelo de aceitação de tecnologia para estudar esta aceitação e foi proposto um fator adicional que pode influenciar a adoção no domínio da educação. As perguntas foram analisadas por meio de One-Way ANOVA e análise de regressão linear múltipla.

Essas conclusões apontam para a aceitação de não usuários e usuários de IA a um serviço misto, o processo integrando da aprendizagem tradicional com a inteligência artificial é aceite pelo grupo estudado. É esperado existir um aumento da aceitação com o aumento da familiaridade e interação social. Com base nisso, as escolas ou instituições de ensino devem tentar implementar essa tecnologia em seu sistema educacional e formar professores.

Palavras-chave

Inteligência artificial; Serviços; Resistência; medo; Confiança; Análise de mercado; Educação; Modelo de aceitação.

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1 Introduction

1.1 Contextualizing

Today it is possible to find artificial intelligence in many different industries, not only in very technological oriented sectors like finance and retail but also in education (Norvig & Russell, 2021). Although it may be hard to find it, it is important to further analyze the acceptance of different technologies in the learning process according to Granić, and Marangunić (2019).

Educational institutes are challenging the core structure of learning, operations, and governance that remined the same for years (Popenici & Kerr, 2017). These new structures open education for all, technology is making it more accessible to learn skills causing higher education to rethink their function as pedagogical models.

The use of technological advancements such as “management systems´” or “IT solutions” creates questions about the impact of private companies in the educational system. There are other impacts that cause concern, but the biggest concern is unemployment (Bird et al., 2020), mimicking human labor will eventually lead to fully automated workspaces. This is a concern that society has but still does not know how true it is. The juridical system proves the opposite, artificial intelligence will be improved, better case processing, sentences, and law making but the human will not be replaced (Vitorino, 2022). Law is a science, but the norms of law have human values that can not be computed into a machine.

It is possible to argue both sides, artificial intelligence can have negative and positive impacts on society, but today a good percentage of the world population have rational or/and irrational worries (Mason, Stevenson & Freedman, 2014) about AI. Artificial intelligence has been implemented in healthcare, it is possible today to prevent, diagnose and treat skin cancer with the same or better efficiency as a doctor but most people choose traditional methods over artificial intelligence (Longoni et al., 2019).

There is lack of studies about artificial intelligence acceptance in education. Companies like Thinkster Math (Valli, 2010) and Duolingo (Ahn & Hacker, 2011) prove that there is use for the technology, but the information about acceptance is unclear.

1.2 Research Questions

1. What is the knowledge of individuals about artificial intelligence?
2. What factors may increase acceptance of artificial intelligence in the population?
3. How should individuals be approached with artificial intelligence in education?

1.3 Research aims and objectives

The role of technology is to serve human progress and increase quality of life. The aim of this thesis is to study acceptance about artificial intelligence in education. The following objectives were defined:

- Understanding artificial intelligence acceptance, gathering information about the technology behind it and its implementation in education.
- Test propositions by collecting data from non and current users of artificial intelligence.
- Gather data about the preference of learning services amongst students.
- Promote a greater understanding of educational services that use AI.

It will be investigated acceptance using the model TAM2, technology acceptance model, (Venkatesh & Davis, 2000). This model was slightly altered to better fit the education domain and address other factors outside of this model that can potentially increase acceptance. This choice of domain was made to improve a sector mostly unchanged and to facilitate access to information.

The instruments chosen were a questionnaire and interviews, intending to assume relationships between two or more variables using statistical analysis, a correlational research addressing online groups associated to technology and learning languages, the population will be from different online communities with different backgrounds to achieve a large enough sample to generalize. The expected results are gathering valuable data about the acceptance in artificial education and understand what type of service, traditional, only AI or a mixture of both are valued by the sample.

The work structure is as follows. The first topic, literature review, learning the concepts that envelopes this work. The second is the methodology, includes the design, practice and instruments applied. The third is results and discussion, the pertinent data about the instruments used and the data analysis. The conclusion contains the outcome of the entire work, evaluating the subject as a whole. Lastly it is discussed future direction and limitations of this research.

1.4 Contributions of the thesis

The goal of the literature review was to gather knowledge within the areas of the study: artificial intelligence, the resistance/acceptance to the adoption of this technology and the AI applications in education. According to the literature review social interaction is related to technological acceptance, which is lacking in the current technological model. Social media and a mixed service (traditional learning with AI) were tested to prove the importance of social interaction.

The methodology describes the process to answers the research questions. A global questionnaire aiming to understand the acceptance of using AI tutors. Reaching two different groups, individual with no experience using AI tutors and individuals who have this experience. To reach the niche of AI tutors' users it was challenging. The most effective way was to approach individuals in online communities about technology, artificial intelligence, and learning.

The questionnaire implemented the TAM2 model (Venkatesh & Davis, 2000). It enabled to study the overall acceptance and analyze it, between the 9 factors of Intention to Use, Perceived Usefulness, Perceived Ease of Use, Subjective Norm, Voluntariness, Image, Relevance, Output Quality and Result Demonstrability.

Besides the questionnaire interviews were made to complement the questionnaire sample. The questionnaire had a population of young adults with high affinity to technology. Unlike the interviews were the sample had more representation of age and no experience with artificial intelligence in education.

The results show that experienced users value both AI (artificial intelligence) and traditional methods. It made sense for the population that both services would work well together. Most non experienced users value traditional methods more, but there is a large group that is open to accept a mixed strategy. The acceptance of this technology is expected to grow in the future.

Because of the literature review and the positive results of the questionnaire and the interviews it is suggested that technology acceptance models include social interaction as a variable.

2 Literature Review

Starting a work about technology it is necessary to know what it is. A simple definition would be artificial intelligence is a mimic of human intelligence, according to Duin and Bakhshi (2020) we learn by repeated experience or by watching/hearing, the technology functions the same way, the more information it has the better it will do its job, but it is oversimplified. There is no standard definition for artificial intelligence but there are common features in diverse definitions of this technology, perception of the environment, information processing, decision making and achievement of specific goals (Samoli et al., 2020). According to the European Commission of independent high-level expert group on artificial intelligence (HLEG, 2019, p. 1) "Artificial intelligence (AI) systems are software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the given goal. AI systems can either use symbolic rules or learn a numeric model, and they can also adapt their behavior by analyzing how the environment is affected by their previous actions.".

2.1 History of AI technology

Artificial Intelligence as currently known can be traced from the mid-20th century. This thinking played a significant role in the invention of programmable digital computers in the 1940s (Tobin et al., 2019). In 1956, AI was officially founded at a workshop held and organized by John McCarthy, Marvin Minsky, Nathan Rochester, and Claude Shannon at Dartmouth College, New Hampshire, United States. From 1956 to the mid-1970s were considered the golden years of AI because of what was developed. Computers at the time could be used to solve math problems and speak languages. These developments were considered astonishing because, at the time, people never thought such things could be done by a machine (Haenlein & Kaplan, 2019). Research expressed optimism and hopped that a fully intelligent machine would be developed in about 20 years. Governments, particularly the US, Japan, and UK governments, poured money into the field. However, that did not happen because no better computer technology could handle difficult AI problems. Besides, governments and industries stopped their funding because of the lack of significant breakthroughs and development, thus hampering further development.

Financial setbacks delayed the AI development from 1974 to the late 1990s. In the United States, Congress stopped funding all research work related to AI, leading to stalling developments and the evolution of AI-related technologies. That period was known as AI winter because AI development faced serious challenges. Beginning mid to late 1990s, interests in the field boomed, and investment increased, and by the turn of the 21st century, perception and interests changed in matters AI had

gained a positive momentum, and new heights were reached (Haenlein & Kaplan, 2019). In the first decade of the century, investment and interest boomed when machine learning was widely used in academia and industry because of the availability of better computers and hardware and the ability to collect large data set. Besides, many other technological developments, including the birth of internet technology, facilitated developing AI in the industry. Access to large amounts of data (better known as big data), faster and cheaper computers, and advancement in machine learning became common in some industries. Deep learning and machine learning marked a new wave of AI development, and the industry expanded significantly. By 2016, the AI industry was worth 8 billion dollars, and as of 2020, the global AI industry was valued at 62.35 billion dollars and is projected to expand a compound annual growth rate of 40.2% between 2021 and 2028. It is projected that AI technologies could grow the global GDP by $15.7 trillion by 2030 (West & Allen, 2018).

2.2 The Value of Artificial Intelligence

Davenport et al. (2020) state that AI technology has become the heart of business operations in many industries because of enabling smart decision making. AI technology can coordinate data analysis, forecast, and quantify uncertainties, thus allowing organizations to make better decisions. Indeed, there are many cases where AI technology is already making a significant impact by augmenting human capabilities in great ways. One clear example of this is in the healthcare industry. AI analyzes mammography images and medical records, iron deficiency and other elements to predict breast cancer (Akselrod-Ballin et al., 2019). The accuracy is similar as a specialize doctor, but this preventive system warns the doctor and the patient, preventing health problems in the future.

Industries that have large data banks such as finance, logistics, and healthcare are improving with the help of AI technologies and solutions (West & Allen, 2018). Real-time data collection, better and timely analysis of data and improved operation monitoring helps organizations make decisions that improve their performance in key business areas. Apart from performance improvement, another gain of AI in organizations is reduced operation cost (Wamba-Taguimdje et al., 2020).

Expenses are reduced through a reduction in time used to solve issues, reduction in waste because of efficient use of raw materials and high product quality and freeing up of resources which are in turn used in other important things (Bharadwaj, 2000). In other words, through automation of services, organizations have been able to cut expenses, some of which have been achieved by eliminating human involvement in certain tasks and activities (Rampersad, 2020). AI technologies increase efficiency and accuracy in operations. Unlike human beings, AI chances of making errors are limited, thus improving the quality of services, and increasing the profit margin. Human beings will take much time when processing data manually and even make mistakes. However, AI and machine learning analyze data efficiently with minimal chances of making errors. Besides, AI guarantees 24-hour service

delivery and delivers the same quality and standard because it is not affected by psychological fatigue and burnout. Therefore, adopting AI can help organizations achieve high-level efficiency in business operations and reduce stress on employees.

In some cases, AI technology has helped save expenses by reducing the need for human resources. Some highly advanced organizations today in technology have been using digital assistance to interact with users and customers, thus saving human resources (Kitsios & Kamariotou, 2021). Technologies such as Chatbots or voice bots are developed such that it has been impossible for users to know that they are chatting or communicating with non-human persons. Chatbots respond to human queries the same way a human does, and their effectiveness has eliminated the need for human resources in some customer service options. Such developments have helped many companies, especially those that operate online consumer platforms.

Organizations can now predict the relationship between various business activities and tell their fate in the coming years. For example, Davenport et al. (2020) note that using a predictive algorithm in supply chain management, it is possible to predict inventory needed for producing certain products and forecast the quantity to be shipped by comparing the past relationship between demand and supply. With predictive analytics, organizations have been able to optimize processes greatly, cutting overhead and warehousing costs. By using predictive analytics, organizations have made proactive moves and decisions instead of reactive moves. With Internet-of-Things embed devices, organizations have been able to monitor their operations remotely and make strategic decisions based on a constant report they access. Industries such as agriculture and healthcare has tapped into predictive analytics to help them monitor and stay connected even when in a remote location (Piccialli et al., 2021).

2.3 Artificial Intelligence in Education

When looking to this market some conclusions are readily apparent, (Francesc et al., 2019) in most countries, being the United States and China the most influential, artificial intelligence in education has been developed mostly by private companies. There are concerns about the policy regarding protection concerning data from educational systems and it is important to note initiatives that can guide a coherent framework. Thinkster Math (Valli, 2010) and Duolingo (Ahn & Hacker, 2011) are two examples of services in this domain. They are fully AI services that promise different advantages from traditional learning: 24-hour access to learning from anywhere and adapted programs for each student's skills. Both these companies state advantages for teachers that might want to use their services on their students. One example is the time management benefits because of the automation of tedious task like record keeping.

AI has become a transformative tool in providing education in different parts of the world, especially in developed nations. AI-powered technologies have been deployed in various aspects of

education, especially in teaching and delivering academic content (Zhai et al., 2021). For example, AI has brought new methods for students to access content and achieve success. It has revolutionized the idea of smart content, including digitized books, video conferencing, video lectures, and automated lessons. Through AI, virtual learning has become possible. By powering platforms that digitize textbooks, students can learn virtually using different devices, from anywhere and anytime (Guan et al., 2020). Such development has been fundamental to students across the world because international students are now able to study some courses which are not offered in their countries. An institution that offers virtual or online learning, which has thrived in recent years, especially with the outbreak of covid-19, schools are using AI-powered assessment tools to monitor exams and maintain academic quality and integrity on the side of students and institutions. On student security, AI-powered scans are being used to identify students when entering and leaving schools and even when taking exams, among other school activities.

Lee et al. (2011) concludes that noninteractive educational games is only a complementary tool, social interaction is important to enhance learning evaluation and test performance. There is a need to increase interaction to maximize the learning results, also interactivity is valuable in e-learning, allowing students to communicate with peers and the faculty increases their willingness to continue using the platform (Rodríguez & Meseguer, 2016) as well as providing them with feelings of "being placed in" and "being part of", engaging them in the task.

AI technology is also being modelled and deployed to perform basic education activities such as grading homework and test for large lecture courses. Grading is one of the areas that is tedious and takes so much time, which could be used to interact with students. From kindergarten to graduate level, AI can transform education by facilitating individualized learning, which is currently happening through a growing number of adaptive learning programs, software, and games (Chatterjee & Bhattacharjee, 2020). These kinds of systems are known to respond to the needs of students because they put greater emphasis on certain topics and offer repetitive teaching on areas and concepts that students have not mastered while helping learners work at their pace.

For years, the adoption of AI technologies and solutions has been slow in the education sector, but recently, following the emergence of the coronavirus pandemic, the perception of digital technology on education has changed greatly. Practitioners in the industry continue to call for technological solutions that can support learning, especially remote learning (Zhai et al., 2021). A lot is expected to happen as the demand quest for virtual learning continue to increase.

Following the work of (Castañeda & Selwyn, 2018), the digitalization of education needs to be put in problematic terms. It is necessary a suspicious and skepticism view before artificial education or other digitalization transforms into a core part of the learning background. Education is profoundly

emotional and human focused. It is important to know how to change between the use of digital technology and people's emotions. Also, social media suffered the same judgment but data shows data the social interactions that social media provides do not serve as replacement for other interactions, this interaction provided by the platform reduce loneliness increasing our wellbeing (Twenge et al., 2019).

2.4 Trust and Fears Associated with AI

Despite its transformative nature in organizations and industries, AI acceptance is not happening at the rate one would expect. There is a general resistance to AI technologies. Researchers have been investigating why there is resistance to technological solutions despite being aware of the accruing benefits. The primary reason is associated with the perception of loss (Fountaine et al., 2018). People fear losing their jobs and employment when AI technologies are introduced. One thing about AI is that it imitates intelligent human behavior at such a higher level, and it performs better in some situations than a real human being. Research shows that there is immense pressure to resist some technologies that will lender people jobless. AI threatens occupations, such as office receptionists, data analysts, driver jobs, waiters, waitresses and many other careers. Indeed, some jobs such as data analyst and driving are slowly being taken by technology.

Another argument against AI technology rests on general anxiety about AI. People are concerned about what AI is and what it is potentially capable of doing (Li & Hunag, 2020). People do not like working with machine technologies that get too smart for fear they cannot control them. Human beings always want to control everything, and therefore, they express resistance to technology that they feel they cannot control over time (Alfonseca et al., 2021). There is a general argument that AI will reach a point where it will out rule humanity. In other words, there is a widespread fear that technology will get to a point where it controls itself without human intervention, thus making human beings' servants of the technology it created. Also, some people have expressed concerns about the ability of the human brain to keep up with the advancement and development of inventions forever. The concern is that the human brain will be limited at a certain point, and humanity will not be able to control the technology. Elon Musk once said, "Mark my words — A.I. is far more dangerous than nukes" (Clifford, 2018). Such remarks create fear of what AI technology does. Indeed, experts in the industry argue that the representation of AI as a technology gone too far has caused general wariness in public as far as the development of AI systems and technologies are concerned.

There is also the problem of trust deficit on AI tools among the users. Indeed, this issue has been touted as a significant problem that causes worry on AI technologies. With AI, it is not known to what extent can deep learning models can predict the output. An ordinary person cannot understand how a specific set of inputs can devise a solution for different kinds of problems (Dietvorst et al., 2018).

Besides, AI knowledge is limited only to researchers, some college students, and technology enthusiasts. Majority of people who control areas targeted by AI do not know or have no idea about AI techs. There is also the question of trust and fear of private information. All machine learning and other AI models are based on the availability of data to train them. Since the data needed to train these models is generated from millions of users worldwide, there is fear that the data could be misused. People do not fully trust people handling their data because they are aware of cybercrimes that can potentially harm them (Ünver, 2018; Bird et al., 2020). Industries such as healthcare and finance are quite sensitive to poor data management, and the deployment of AI technology could end hurting people. Also, there are concerns about the impact of AI on the environment. An important question is how AI technology will impact the planet. The fear of a destroyed planet like shown in some science fiction movies. Political leaders also expressed concern about the future of the world with AI technology as far as global peace is concerned. Global security can be undermined should certain AI capabilities are in the hands of the long people, such as terrorists and unstable nations.

2.5 Workers and AI

Fountaine et al. (2019) insist that the world will not reap the full benefits of AI technologies if the fear and trust issues levelled against the AI technology solutions are not addressed amicably. Developers, organizations, and experts in the AI industry must go a mile further to change the notion attached to AI technologies, fundamentally on the question of job disruption. Human beings are and will remain resistant to any technology change that they do not understand its impact on their life. Likewise, organizations will not embrace technological solutions that they lack detailed understanding about their impact in transforming and moving their business to a higher level. From their perspective, suggest the need to offer assurance to organizations and the general public that AI tools will make life better by highlighting the impeccable benefits of AI tools. Organizations must ensure that they do not render people jobless by tapping on some technologies because if that happens, future acceptance of technological advancement will face significant resistance. Education is termed as a key enabler of success.

Organizations need to be educated on how certain technologies will benefit them without compromising their security and the security of their client. Leaders must raise and provide a vision that gets everyone on board under a common goal (Russell et al., 2015). Organization leaders must understand what certain technologies will benefit them and transfer that knowledge to their employees. Workers, who strongly resist technology, must be told how the AI technology solutions will transform the business and how they will fit into the AI-oriented culture (Fountaine et al., 2019; Bird et al., 2020). They need string assurance that AI will come to enhance and not eliminate and diminish their roles. Evidential research shows that several workers prefer to be trained to work in an AI-

oriented environment and not being replaced by AI. Also, people need confidence that the AI tool is working to benefit them. For example, in the health care industry, a key reason why consumers (patients) resist AI tools is that they do not understand if the technology is good for them (Longoni et al., 2019). However, when physicians explain why some AI tools are used in the treatment process, patients cannot accept it.

2.6 Technology Acceptance

According to Granić, and Marangunić (2019), the technology acceptance model, TAM, (Davis et al., 1989) is important to predict human behavior towards the use of technology. The many varieties of the technology acceptance model represent a reliable standard for helping assessment of diverse learning technologies which current research lacks.

In order to study acceptance of AI tutors it was researched the technology adoption models TAM, TAM2 and UTAUT. TAM2 was the model chosen for this work.

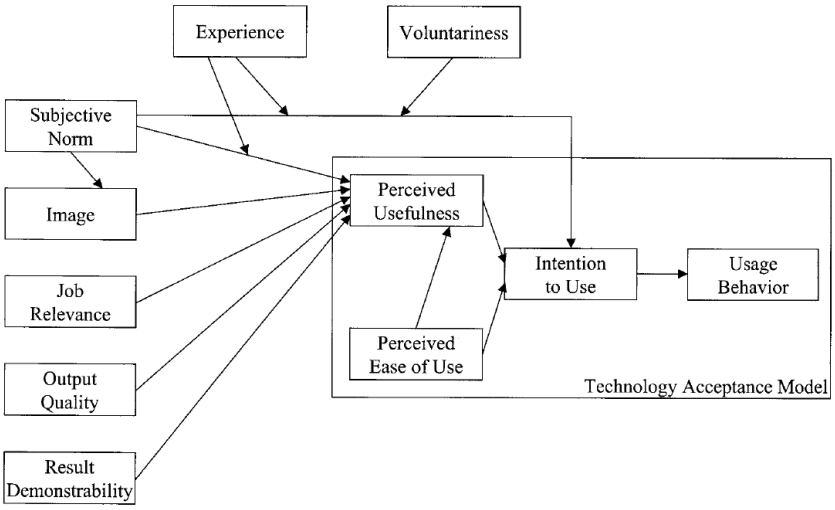

Figure 1 Proposed TAM2—Extension of the Technology Acceptance Model

Source: Venkatesh and Davis, (2000)

TAM2 is an improvement of the TAM model so understanding the first one is important. It was developed by Fred Davis and Richard Bogazzi in 1989 (Davis et al., 1989), this first model analyses if externals factors change their idea in how difficult and useful the technology is.

Evaluating perceived usefulness and perceived ease-of-use, entails if the individual sees the technology more useful than harmful and if is achievable for them to understand and use (how long

and what cost is necessary for someone to be capable of using it). Those factors create an attitude towards that technology, positive or negative revealing if the individual will adopt the technology.

This model although popular is not fully complete, it is the base of many other models like TAM2. Another model used to study adoption is UTAUT, also improved by the same author Venkatesh et al. (2003), this model was not chosen because the model studies perceived risk, what was not considered relevant for this work.

TAM2 approaches technology adoption by believing individuals will be more likely to adopt if they see the technology fit their job and increase performance. This model in education will determine the adoption by studying the compatibility with their learning process and if the final results (learning something new) is efficient. The factor added to study acceptance are intention to use, perceived ease of use, usefulness, subjective norm, voluntariness, and output quality.

2.7 Conclusion

AI technology has been impactful for digital technologies in the world today, with its value being seen in critical industries such as banking, healthcare, national security, and supply chain management. AI will continue to better the world if it is developed and implemented in the interest of users, consumers, and industries. With AI, organizations may improve their performance in many aspects because of bettered decision-making practices, waste reduction, and time management. However, the adoption of AI technologies is slow across industries partially because of fear and trust issues levelled against AI tools. Data privacy and security concerns, fear of job loss, disruption of status quo in the organizations, and fear that technology might render human servants or technology will reach uncontrollable heights. There is also great concern about the impact of technology on people health and the environment. Organizations will have to invest heavily in employee training to explain and assure them that technology will not replace and diminish their role. Technology developers also need to come on board and engage their clients, assuring them that AI tools they develop will increase business performance without creating more problems for their businesses and operations. For this reason, the most conscious and effective method is to use artificial intelligence as a tool for teachers. The importance of the human interaction as a potential factor that can change the acceptance of artificial intelligence in education needs to be studied.

3 Methodology

3.1 Introduction

The work was achieved by three different processes to answer the research questions. Starting with the first interviews, that gathered the knowledge of 8 individuals about AI. The second process, the online questionnaire, applying the TAM2 model and the social interaction factor. Lastly 20 interviews to complement the data from the questionnaire.

3.2 What is the knowledge of individuals about artificial intelligence?

The first process, 8 interviews, acted as a pilot for the work. These interviews were structured, having demographic questions, age, gender and occupation in addition to a technology literacy test. The sample was five males, with the ages 21, 23, 24, 47 and 60. Three females, with the ages 27, 29 and 50. Three students, the interviewees under 25 years, and four working.

Interviews were used because they are more flexible. It is easier to the interviewees answer complicated topics like acceptance and fear. Another reason for making interviews was the time needed to gather all the information would take some time, making possible to continue study the same individuals. Interview guide in annex C.

Artificial intelligence is a complex subject to evaluate with many subsets, machine learning is one example (Kong et al., 2021). Therefore, a test of knowledge was the guide of the interview (Guo, 2020), with only demographic questions before. It followed the normal objective test format. The individual needed to recognize and recall the subject with only one correct answer. The result led in a score that can be compared with other interviewees and statistics of other studies.

The results of this structured pilot run of interviews helped shape the next processes, majority of individuals never even heard about AI tutors, and some had very little if any knowledge about this technology. When evaluating their initial knowledge in the pilot test, they had no point of reference in which to compare it to, ending the test before finishing.

From now the work narrowed the focus of the sample to also gather individuals who had some experience using artificial intelligence in learning.

3.3 Questionnaire and interviews

An online questionnaire and interviews were design to answer the remaining research questions.

In order to reach individuals with experience in artificial intelligence it was made a questionnaire. The point was to gather a sizable population of two groups: experienced AI users in education and

individuals with no experience. Reach was the main reason to use this instrument, overcoming the challenge of acquiring persons that have used some type of artificial tutors.

This questionnaire was made using the tools provided by google allowing to distribute and create questionnaires online (google docs). The sample of this questionnaire was 71 individuals with majority young male students that used the platform Duolingo (Ahn & Hacker, 2011). These sample characteristics happen because Facebook (Zuckerberg et al., 2004), Reddit (Huffman, 2005) and Discord (Citron, 2012) were used to gather the interviewees with public posts and asking individuals in discord chats to participate in the questionnaire. The reason so many individuals used the language learning platform Duolingo is because asking people in Duolingo discord was the most effective.

The reliability analysis was carried out to find the internal consistency of the questions raised in the questionnaire. This is followed by the One-Way ANOVA, and multiple linear regression analysis to determine the influencing factors for the use of AI at the alpha level of 95%. The tools used were Microsoft Excel and SPSS.

After the questionnaire, in October, interviews were used to complement the results. The interviews possess a sample with more age diversity and less technological experience. Testing the mixed service in a less specific sample gives information needed to acquire some conclusions. These interviews were made with the objective of understanding the general population (a broader sample compared with the questionnaire), because the questionnaire sample were mostly young adults with above average knowledge in artificial intelligence. This last data will conclude the acceptance of a different group and if it aligns with the population of the questionnaire.

Due to the nature of the questionnaires and interviews the model is analytical and descriptive, cross analyzing the variables to cause/effect relationship between the people and their acceptance with an exploratory goal.

It is an experimental design (Mcleod, 2020), participants are studied between groups. Being a mixed study (quantitative and qualitative) and cross-sectional, where the pertinent information is in the present and the upcoming education sector.

3.4 What factors may increase acceptance of artificial intelligence in the population?

To answer the question about acceptance it was used a technological acceptance model. By applying the extended model of Technology acceptance model, TAM2 (Venkatesh & Davis, 2000), it is possible to achieve a more detailed conclusion than using an older model.

According to TAM2 the main reasons that allow humans to accept something new are intention to use, perceived ease of use, usefulness, subjective norm, voluntariness, and output quality. All these topics are broken down into a group of questions that are destined to give a complete picture about acceptance.

Each question is answered in a scale between 1 and 7, strongly disagree to strongly agree accordingly. In the end we can extract the results to single answers and calculate the value for the whole category.

	Strongly Disagree	**Moderately Disagree**	**Somewhat Disagree**	**Neutral**	**Somewhat Agree**	**Moderately Agree**	**Strongly Agree**
Intention to Use							
Assuming I have access to the system, I intend to use it.							
Given that I have access to the system, I predict that I would use it.							
Perceived Usefulness							
Using the system improves my performance in my activity as a student.							
Using the system in my activity as student increases my productivity.							
Using the system enhances my effectiveness in my activity as a student.							
I find the system to be useful in my activity as a student.							
Perceived Ease of Use							
My interaction with the system is clear and understandable.							
Interacting with the system does not require a lot of my mental effort.							
I find the system to be easy to use.							
I find it easy to get the system to do what I want it to do.							
Subjective Norm							
People who influence my behavior think that I should use the system.							
People who are important to me think that I should use the system.							

Voluntariness							
My use of the system is voluntary.							
My supervisor/parent does not require me to use the system.							
Although it might be helpful, using the system is certainly not compulsory in my activity as student.							
Image							
People in my school/work who use the system have more prestige than those who do not.							
People in my school/work who use the system have a high profile.							
Having the system is a status symbol in my school/work activity as student							
Relevance							
In my activity as a student, usage of the system is important.							
In my activity as a student, usage of the system is relevant.							
Output Quality							
The quality of the output I get from the system is high.							
I have no problem with the quality of the system's output.							
Result Demonstrability							
I have no difficulty telling others about the results of using the system.							
I believe I could communicate to others the consequences of using the system.							
The results of using the system are apparent to me.							
I would have difficulty explaining why using the system may or may not be beneficial.							

Table 1 TAM2 model

3.5 How should individuals be approached with artificial intelligence in education?

One important factor missing in the TAM2 is social interaction. Part of learning is emotional (Castañeda & Selwyn, 2018), the interactions students have with their teachers plays an important role. With this in mind it was considered important to gather data about this topic. Besides the technology acceptance

model, it was implemented in the questionnaire questions about feedback, social media and a mixed service.

The feedback was implemented due to potentially increasing the use of technology (Dietvorst et al., 2015). It was asked the individual if they had some interaction with company support and how it affected their use of the service.

Social media has been increasing as a major tool for the youth to learn new skills (Bal & Bicen, 2017), for that reason a social media sector was considered relevant because it has social interaction and approaches education from a technological standpoint. The questions asked if social media is important for their learning process, what social media is better to learn and how impactful it is.

Lastly the mixed service serves to answer the question of this topic and approach some factors of acceptance: output quality and social interaction. The mixed service is studied at the end of the questionnaire and in the last interviews.

The interviewees were collected within local Facebook communities, gathering a sample with a diverse age gap.

The interviews started in a structured mannered. Learning about the interviewee with background questions and making the interviewee comfortable, this allowed to get more elaborate answers. After this initial phase the next point was understanding what type of experience they had before with artificial intelligence in education to keep the same division as the questionnaire. No one had any.

Then it was presented 3 different pamphlets of each service, marketed in similar ways to not influence the interviewees opinions, they were asked to rank from least appealing (0) to most appealing (2).

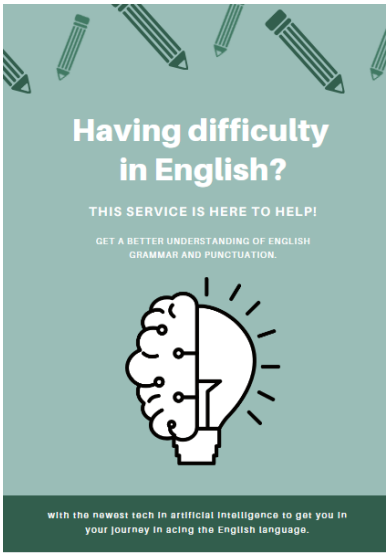

Figure 2 Marketing for AI service

Figure 3 Marketing for mixed service

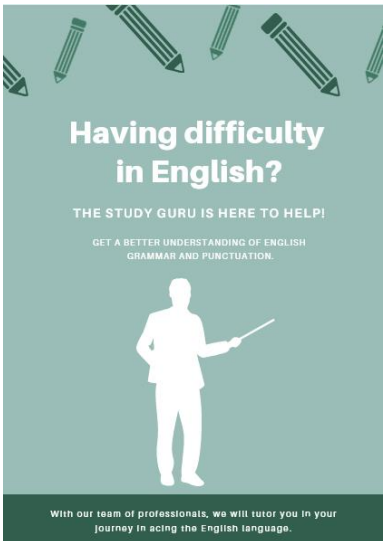

Figure 4 Marketing for traditional service

After this answer, it was asked to detail their answers, TAM2 topics were used as factors for analysis. This latest section was unstructured due to the complexity of answers that contain past experiences, feelings and emotions. The interview guide is in annex B.

3.5.1 The structure of the questionnaire

The questionnaire was divided between different sector in order to guide the interviewee. The following structured was carried:

- Entry screen

The volunteer is greeted with a small synopsis of the questionnaire, the purpose for this study and the privacy policies.

- Background and Attitude Profiles of Respondents

The sector discusses the demographic profile: age, occupation, gender and previous experience with AI. Background information allows a better understanding of the data.

- Characterize the population

There are two questions inserted in this section to understand the difference of this group from a more random sample.

The first was comparing knowledge from a study made in the United States of America (Pega, 2018), with the population of the questionnaire.

The second was to see if they were aware of important impacts artificial intelligence might have on society according to the Europe parliament (Bird, 2020).

- TAM2

This is where the TAM2 is presented, being the content table 1. Only individual with experience answered the table.

- Social interaction

Following the topic, it is broken down by the topic of feedback, social media and the mixed service

Ending in answering the question “which service is preferred, traditional, only artificial intelligence or a mixture of both?”.

4 Results

4.1 Data analysis and Findings

This report presents and discusses the results of the AI in education and the individual's acceptance. The descriptive analysis discusses the socio-demographic profile and background of the respondents, their perceptions, and attitudes.

Responses related to 71 respondents worldwide were recoded through an online survey questionnaire.

The reliability analysis was carried out to find the internal consistency of the questions raised in the questionnaire. This is followed by the One-Way ANOVA (Bevans, 2021), and multiple linear regression analysis to determine the influencing factors for the use of AI at the alpha level of 95%.

$$F = \frac{MST}{MSE} \tag{1}$$

$$MST = \frac{\sum_{i=1}^{k}\left(\frac{T_i^2}{n_i}\right) - G^2/n}{K-1} \tag{2}$$

$$MSE = \frac{\sum_{i=1}^{k}\sum_{j=1}^{n_i} Y_{ij}^2 - \sum_{i=1}^{k}\left(\frac{T_i^2}{n_i}\right)}{n-K} \tag{3}$$

F= variance ratio for the overall test.

MST= mean square due to treatments/groups.

MSE= mean square due to error

Background and Attitude Profiles of Respondents

To reach a population that has used AI it was used Reddit with 49% between 18 and 29 according to Agrawal (2018), and discord and Facebook with targeted groups of young adults.

The professional background and attitudes of respondents are recoded in graphs and shown below under each question.

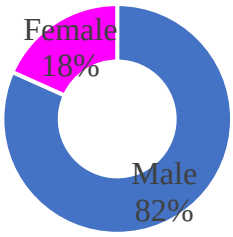

Figure 3 Gender of the respondents (n = 71)

When considered the figure 5, 18% of respondents are females and majority of 82% of the respondents of the survey are males. This shows a quite unbalanced gender proportion.

Furthermore, the reason why the number of males is much higher than the females can be explain with the platforms used are mostly male populated.

Age influences the performance in incidental memory, immediate memory, learning and recall of the drawings, while educational level does not influence the incidental memory (Ishizaki J, 1998). Ishizaki J, 1998 found that both age and educational level have an influence on the global scores, as well as on all specific items of the test, except for naming. Age and education also can affect learning, besides their clear influence on general cognition (Leibovici D, 1996). Meaning that this population would have better results in learning through the platform than older individuals, increasing slightly the probability of better satisfaction.

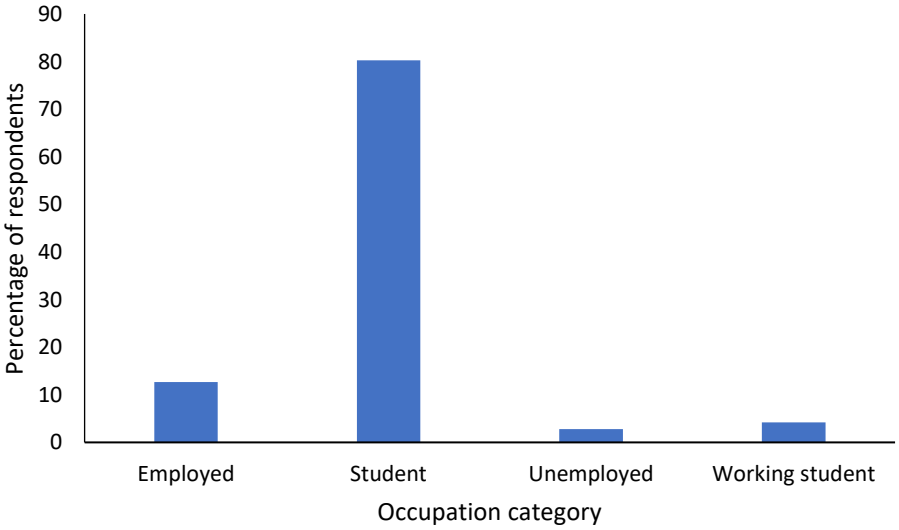

Figure 4 Occupation of the respondents (n=71)

According to the figure 6 above, only 13% of the respondents are employed and majority of 80% are students. There are 3% of them who are unemployed. Only 4% of them are working students.

Several studies have been carried out to examine the association between education and occupation. The role of education in improving the finding for high level of job opportunities in both salary and social position (Khamis, Hanoon, & Belarbi, 2010). As majority of the respondents are students, we can expect that they are using more AI than other groups.

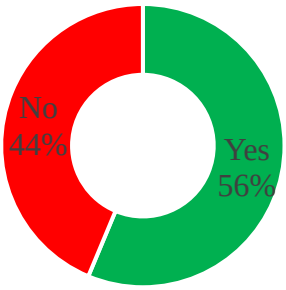

Figure 5 Previous user experience on AI (n=71)

When consider figure 7, more than a half of respondents have used AI. However considerable proportion of 44% have no experiences in using AI before. As nearly equal portions are “used” and “not used AI”, results of the survey reveal the perception of both the groups.

31 respondents who have not used AI, were asked for the reasons. The results are shown in the figure 8 below.

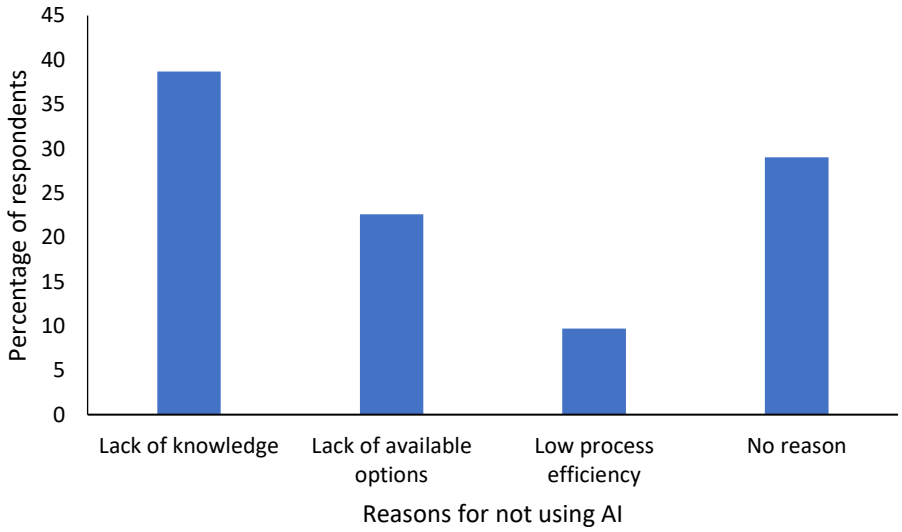

Figure 6 Reasons for not using the AI (n=31)

According to the figure 8 above, 39% of the respondents who do not use AI is due to lack of knowledge and 23% of them are due to lack of available options. 10% are saying that AI has low process efficiency. 29% of them have no specific reason for not using AI. The results are vital as it explains the reasons of not using as well as give some insights on how to promote AI.

There are several reasons can be seen why people are not using AI, some of them are governance and ethics, culture & talent, data security, transparency, data, and infrastructure readiness (Rowe et al., 2021).

Characterize the population

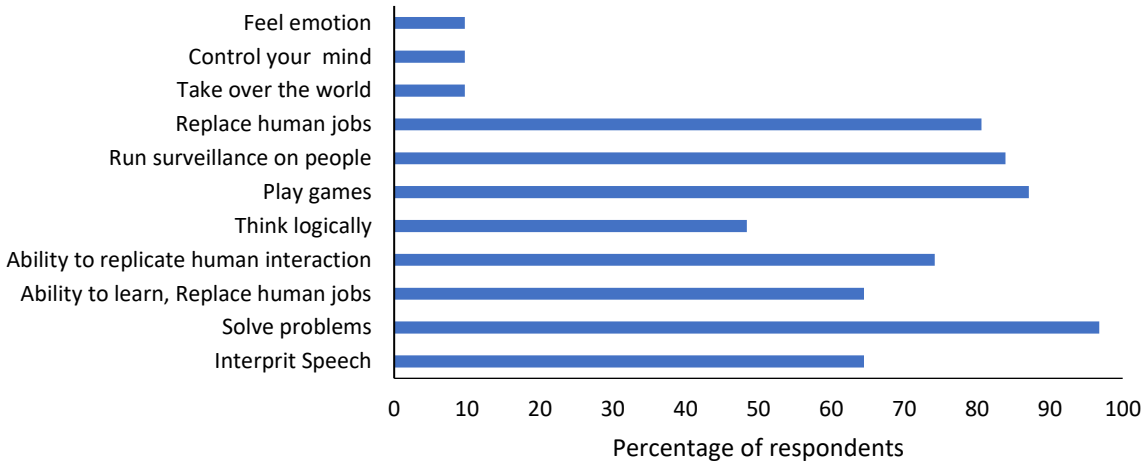

Figure 7 What capabilities can AI achieve?

When considered the figure 9, almost all the respondents (96.8%) agree that AI has the capability of problem solving. 64.5% of the respondents believe that AI systems can learn, replace human jobs, and 74.2% says it has the ability to replicate human interaction. According to 48% of the respondents AI systems can think logically, 87.1% thinks that it can play games, 83.9% thinks that it can run surveillance on people, 80.6% for Replace human jobs. 9.7% of the respondents for each believes that AI systems can take over the world, control your mind and feel emotion. This sample has above average knowledge about AI when compared to US (United States) studies (Pega, 2018).

AI offers reliability, cost- effectiveness, solve complicated problems, and make decisions; in addition, AI restrict data from getting lost. AI is applied nowadays in various fields whether business or engineering (AlSedrah, 2017).

4.2 Belief on the relevant impacts about AI

The construct for "I believe that these impacts about AI are relevant" was analyzed for the descriptive statistics to get an overall idea about the responses given by the studied subjects. The following formulas were used.

$$\bar{x} = \frac{\sum x_i}{n} \tag{4}$$

$$SD = \sqrt{\frac{\sum |x - \bar{x}|^2}{n}} \tag{5}$$

Factor	Mean	SD	Interpretation
Society (inequality, democracy)	4.26	0.73	Relevant
Human psychology	4.26	0.86	Relevant
Legal system (tort and criminal law)	4.13	0.85	Relevant
Environment (Use of natural resources)	3.61	1.15	Neutral
Trust (fairness, transparency)	4.26	0.77	Relevant
Financial system	4.32	0.75	Relevant

Table 2 Descriptive statistics of the constructed questions under "I believe that these impacts about AI are relevant"

According to the results impact of Society (inequality, democracy), Human psychology, Legal system (tort and criminal law), Trust (fairness, transparency) and financial system (Bird, 2020) are relevant to the AI. However, there is a neutral belief that Environment (Use of natural resources) impact on AI, by the respondents.

TAM2:

For further analysis, the questions were segregated as follows into seven predictor groups and a dependent variable. The descriptive statistics of the selected construct are given in the table 4. The scale used to classify each group is the following:

Score	Description
6.5 - 7	Remarkable

6 – 6.5	Very good
5.5 - 6	Good
5 – 5.5	Fairly good
4.5 - 5	Decent
4.0 – 4.5	Neutral
3.5 - 4	Concerning

Table 3 TAM2 caption

Construct	**Mean**	**Standard Deviation**	**Contribution**
Given that I have access to the system, I predict that I would use it.	5.68	1.17	Good
Intention to Use			
Using the system improves my performance in my activity as a student.	5.78	1.21	Good
Using the system in my activity as student increases my productivity.	5.73	1.20	Good
Using the system enhances my effectiveness in my activity as a student.	5.68	1.21	Good
I find the system to be useful in my activity as a student.	5.70	1.19	Good
Perceived Ease of Use			
My interaction with the system is clear and understandable.	5.80	0.93	Good
Interacting with the system does not require a lot of my mental effort.	5.78	0.96	Good
I find the system to be easy to use.	5.90	0.86	Good
I find it easy to get the system to do what I want it to do.	5.93	0.82	Good
Perceived Usefulness			

People who influence my behavior think that I should use the system.	5.50	1.12	Good
People who are important to me think that I should use the system.	5.58	1.18	Good
Subjective Norm			
My use of the system is voluntary.	6.53	0.77	Remarkable
My supervisor/parent does not require me to use the system.	6.38	0.80	Very good
Although it might be helpful, using the system is certainly not compulsory in my activity as student.	6.28	0.84	Very good
Voluntariness			
People in my school/work who use the system have more prestige than those who do not.	4.08	1.25	Neutral
People in my school/work who use the system have a high profile.	3.98	1.35	Concerning
Having the system is a status symbol in my school/work activity as student	4.00	1.32	Neutral
Image			
In my activity as a student, usage of the system is important	5.68	1.19	Good
In my activity as a student, usage of the system is relevant.	5.78	1.23	Good
The quality of the output I get from the system is high.	5.73	1.18	Good
I have no problem with the quality of the system's output.	5.73	1.16	Good
Output Quality			
I have no difficulty telling others about the results of using the system	6.10	0.80	Very good
I believe I could communicate to others the consequences of using the system.	5.93	0.75	Good
The results of using the system are apparent to me.	6.10	0.70	Very good
I would have difficulty explaining why using the system may or may not be beneficial	5.90	0.86	Good

Table 4 Descriptive statistics of the factors contribute for the use of AI tutor.

According to the above results almost all the considered factors have a high impact on the use of AI. However, questions raised under voluntariness shows neutral influence. “My use of the system is voluntary” is marked as a strongly contributing. However, the higher standard deviations show the dispersion of the responses among respondents.

“I would have difficulty explaining why using the system may or may not be beneficial” this question presents itself in a negative scale, the higher number the worse, which until now the same did not apply. All questions had a positive scale, where the bigger number meant a better result.

The question at end intrinsically can be confusing and mislead the reader, causing some doubt or confusion. In the end although it can be seen as a contradiction it did not change much in the global scale.

Social interaction

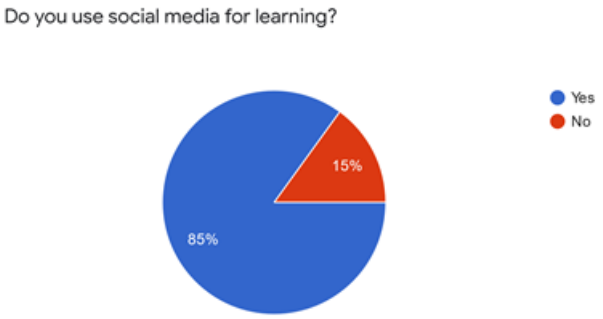

Figure 8 Do you use social media for learning

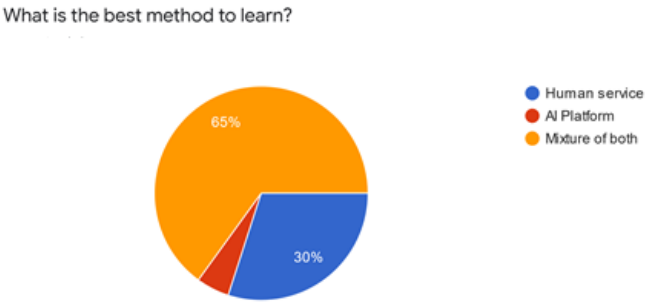

Figure 9 What is the best method to learn?

According to the data gathered, social media and a mixed service are very well accepted in the learning procedure. 85% of the interviewees use social media to learn and 65% of all interviewees prefer a mixed service (a mixture of traditional and AI). The feedback sector resulted in neutral effect on the acceptance making it less relevant than the previous two.

4.3 Reliability Analysis

The constructed 25 questions shown in table 4 above were analyzed using the reliability Analysis and the results obtained are shown in table 5. Cronbach's Alpha (Venkatesh & Davis, 2000) for the questions raised on employee satisfaction is 0.9561. This shows a very high level of internal

consistency. Hence the questionnaire feedback can be considered as very good data set to get analyzed by inferential statistics.

$$alpha = \frac{k}{k-1}\left(1 - \frac{\sum V_i}{V_t}\right)$$

K= number of scale items

Vi= variance associated with each question

Vt= variance associated with observed total scores

Cronbach's Alpha	**N of Items**
0.9561	25

Table 5 Results of the reliability analysis performed for factors contribute for the use of AI tutor.

4.4 Multiple linear regression analysis for "Given that I have access to the system, I predict that I would use" vs total score received for seven subcategories.

A multiple linear regression analysis (Uyanık & Güler, 2013) was performed between "Given that I have access to the system, I predict that I would use" vs total score (sum) received for seven subcategories namely Intention to Use, Perceived Ease of Use, Perceived Usefulness, Subjective Norm, Voluntariness, Image and Output Quality. "I predict that I would use" was the dependent variable. The seven subscales used were the independent variables.

According to the regression results (DF = 7, R-sq = 94.12%, P-Value = 0.000), there is a significant relationship between "Given that I have access to the system, I predict that I would use" vs total score (sum) received for seven subcategories used (P, 0.00 < 0.05). However, out of the 07 subscales undergone in regression analysis only 2 of them the "Intention to Use" and "Image" ($p < .005$) shows significant influence on "predict that I would use". The following formulas were used.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_i X_i + \in_i \quad (7)$$

Y= dependent variable

B0= y-intercept (constant term)

Bi= slope coefficients for each explanatory variable

Xi= Expandatory variables

E= the model's error term

$$z = \frac{\hat{p} - p_0}{\frac{\sqrt{p_0(1-p_0)}}{n}} \quad (8)$$

$\hat{p}$= sample proprotion

p0= assumed population proportion in the null hypothesis

n= sample size

Source	F value	P value
Regression	73.21	0.00[a]
Intention to Use	7.42	0.01[a]
Perceived Ease of Use	1.99	0.17
Perceived Usefulness	1.04	0.32
Subjective Norm	0.68	0.42
Voluntariness	0.04	0.85
Image	8.34	0.01[a]
Output Quality	0.38	0.54

Table 6 Results of the multiple linear regression analysis between "Given that I have access to the system, I predict that I would use" vs total score (sum) received for seven subcategories.

a = Significant at the alpha level of 0.05

R Square, the coefficient of determination, is the squared value of the multiple correlation coefficient. The model summary shows R square of 94.12%. This means the regression equation explain 94.12% of the total variance among variables used to build the relationship. As this well explained the variance in better manner, this regression equation can be used for predictions.

I would use AI = -0.388 + 0.1184 Intention + 0.0586 EasyUSe - 0.0452 Useful

- 0.0341 Subjective - 0.0028 Voluntary + 0.1114 Image

+ 0.0293 Quality

4.5 Is there an influence of Gender for preference of Use AI?

For this analysis responses given for the question "Given that I have access to the system, I predict that I would use it" is used as the response variable showing preference to use AI. One way ANOVA analysis was performed to determine the influence of gender towards the preference to use AI.

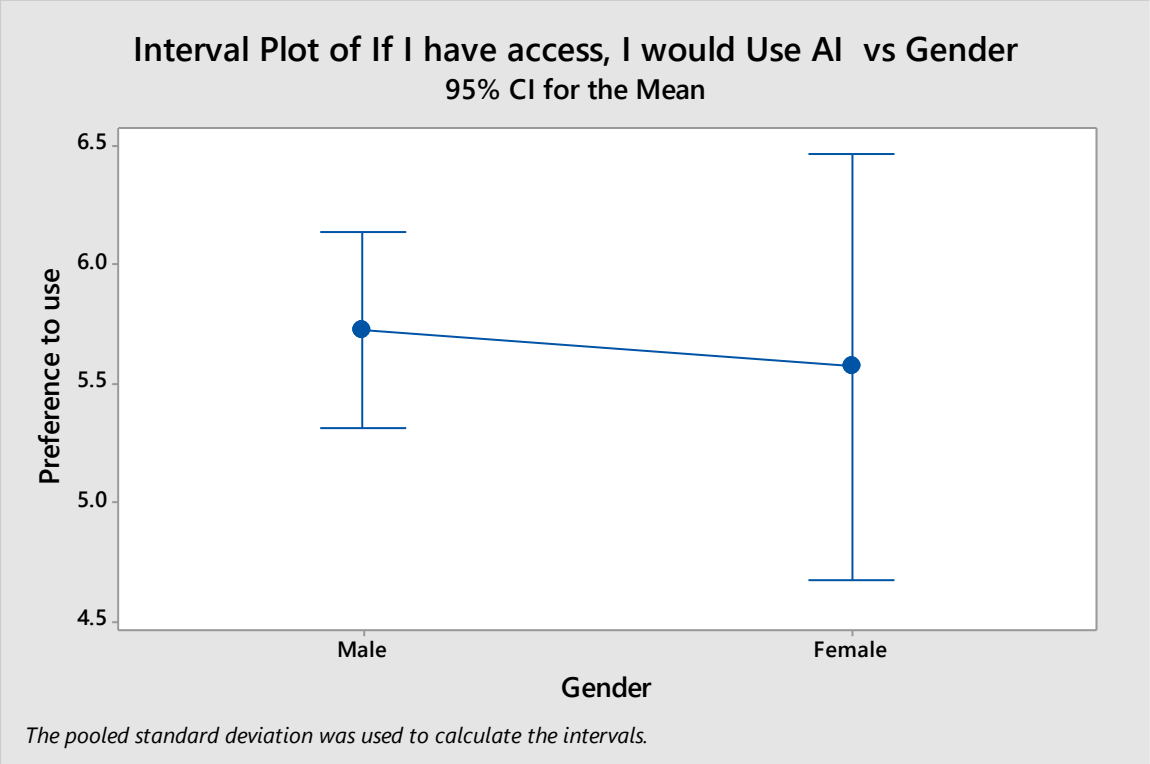

Figure 10 Interval plot of preference to use AI vs gender.

According to the above interval plot, both male and female have good preference to use AI (above 5 meaning Agree). However, female shows very long whiskers, which touch the neutral region.

According to the One-way ANOVA no significant difference is there for the preference to use AI among male and female groups (P, 0.751 >0.05). Tukey Pairwise Comparisons analysis further confirm that with respective to the preference to use AI, both male and female groups are same, as they all make one group (A letter for all). So, we can conclude that no impact of gender on preference to use AI. Tukey Pairwise Comparison formula:

$$T = q_a \sqrt{\frac{MSE}{2}\left(\frac{1}{n_i} + \frac{1}{n_j}\right)} \tag{9}$$

Qa= critical value from studentized range table

n= number of observations per population

4.6 Is there an influence of Age category for the preference of Use of AI?

For this analysis responses given for the question "Given that I have access to the system, I predict that I would use it" is used as the response variable showing preference to use AI. One way ANOVA analysis was performed to determine the influence of age towards the preference to use AI.

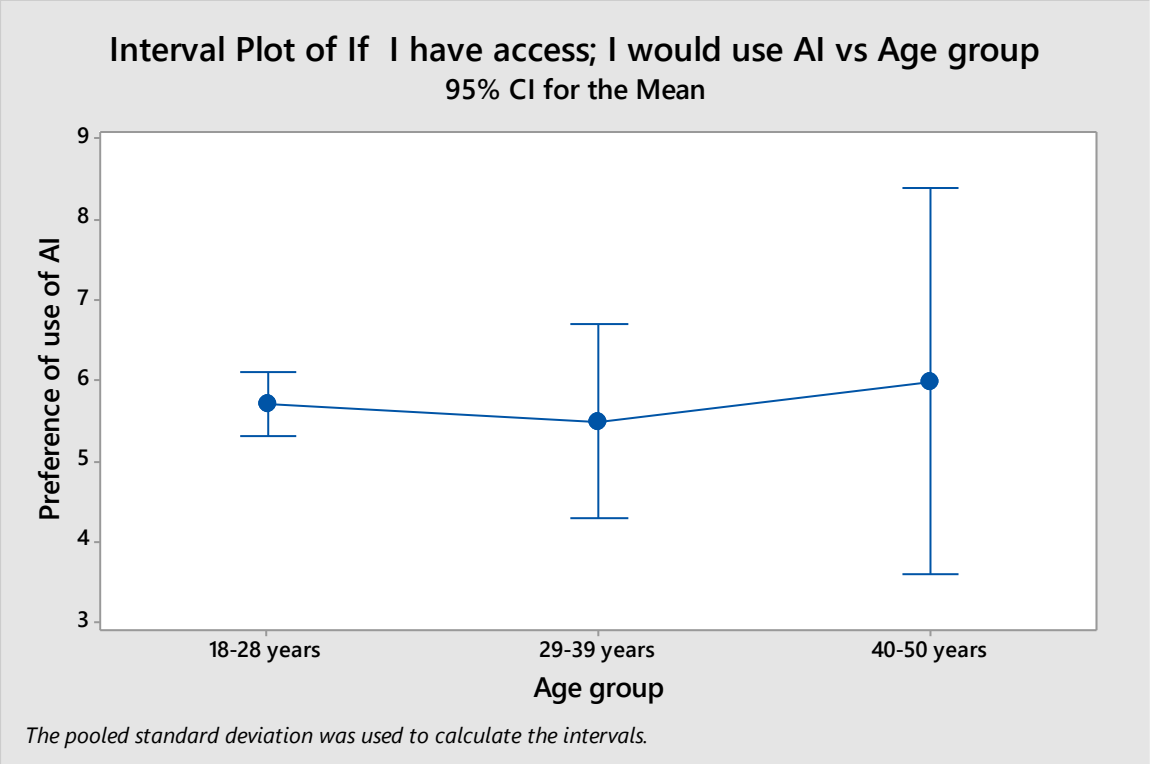

Figure 11 Interval plot of preference to use AI vs age.

According to the above interval plot, all are having good job preference mean (above 5 meaning Satisfied). Oldest group has better intention to use average. However, according to the One-way ANOVA results no significant difference exists for preference to use AI of different Age categories (P, 0.913 >0.05). Tukey Pairwise Comparisons (Benjamini & Braun, 2002) analysis further confirm that with respective to the preference to use AI, all age categories are same, as they all make one group (A letter for all). So, we can conclude that no impact of Age category on the preference to use AI.

4.7 Is there an influence of Occupation for the preference of Use of AI?

For this analysis responses given for the question "Given that I have access to the system, I predict that I would use it" is used as the response variable showing preference to use AI. One way ANOVA analysis was performed to determine the influence of occupation towards the preference to use AI.

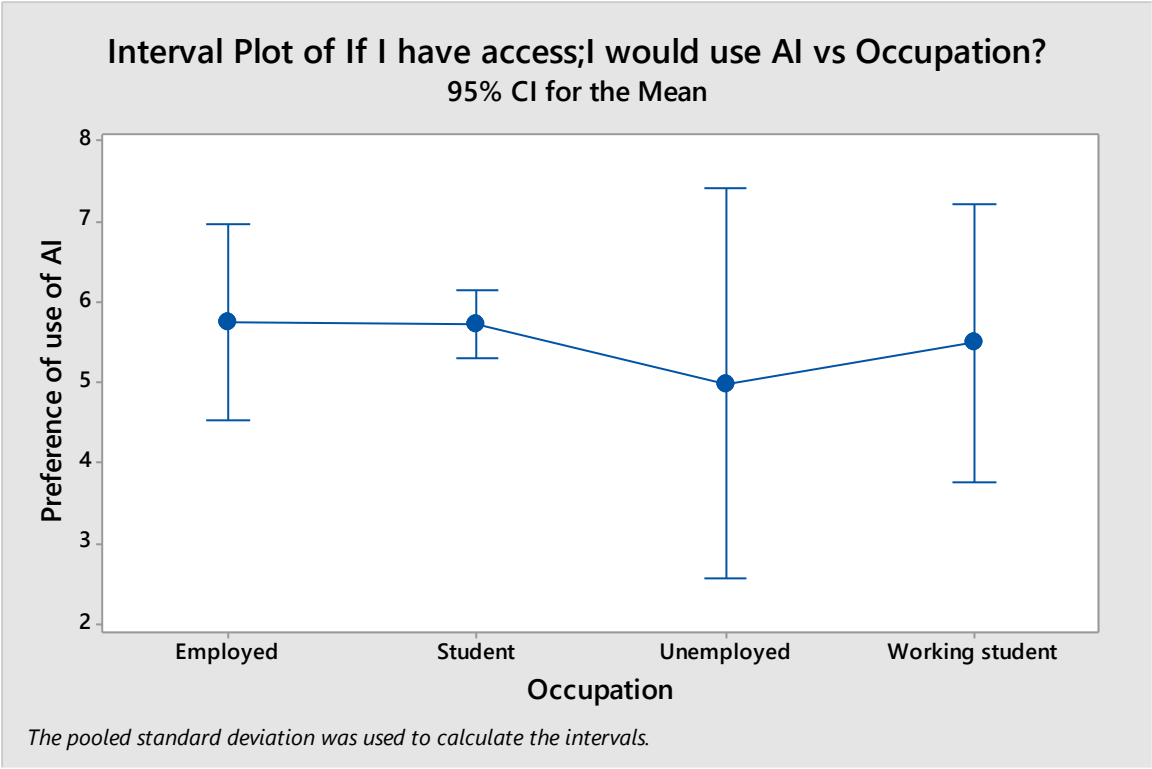

Figure 12 Interval plot of occupation vs the preference to use AI.

According to the above interval plot, all are having preference to use AI mean (above 5 meaning Satisfied). Unemployed category shows a relatively lower preference compared to other groups. However, according to the One-way ANOVA results no significant difference. Tukey Pairwise Comparisons analysis further confirm that with respective to the preference to use AI, all occupations are same, as they all make one group (A letter for all). So, we can conclude that no impact of occupation on preference to use AI. However, on a broader scale, educators have started to explore the potential pedagogical opportunities that AI applications afford for supporting learners during the student life cycle (Zawacki-Richter, Marín, Bond , & Gouver, 2019) and many education institutions have initiated introduction of some AI plat forms to their students.

4.8 Is there a relationship between on best method to learn on preference of AI use?

Figure 15 below shows the responses for the question “Do you have human help in the same area as the AI tutor?”. Accordingly, 32.5% gets human help for the same area. Majority are not obtaining human support. However, the contribution of human factor in AI based education is worth to study.

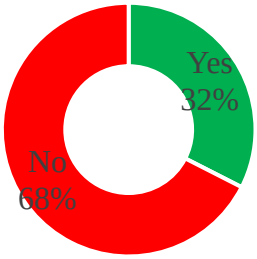

Figure 13 Use of human support by the respondents in the same area of AI tutor (n = 40)

For this analysis responses given for the question "Given that I have access to the system, I predict that I would use it" is used as the response variable showing preference to use AI. One way ANOVA analysis was performed to determine the influence of each method to learn on the preference to use AI.

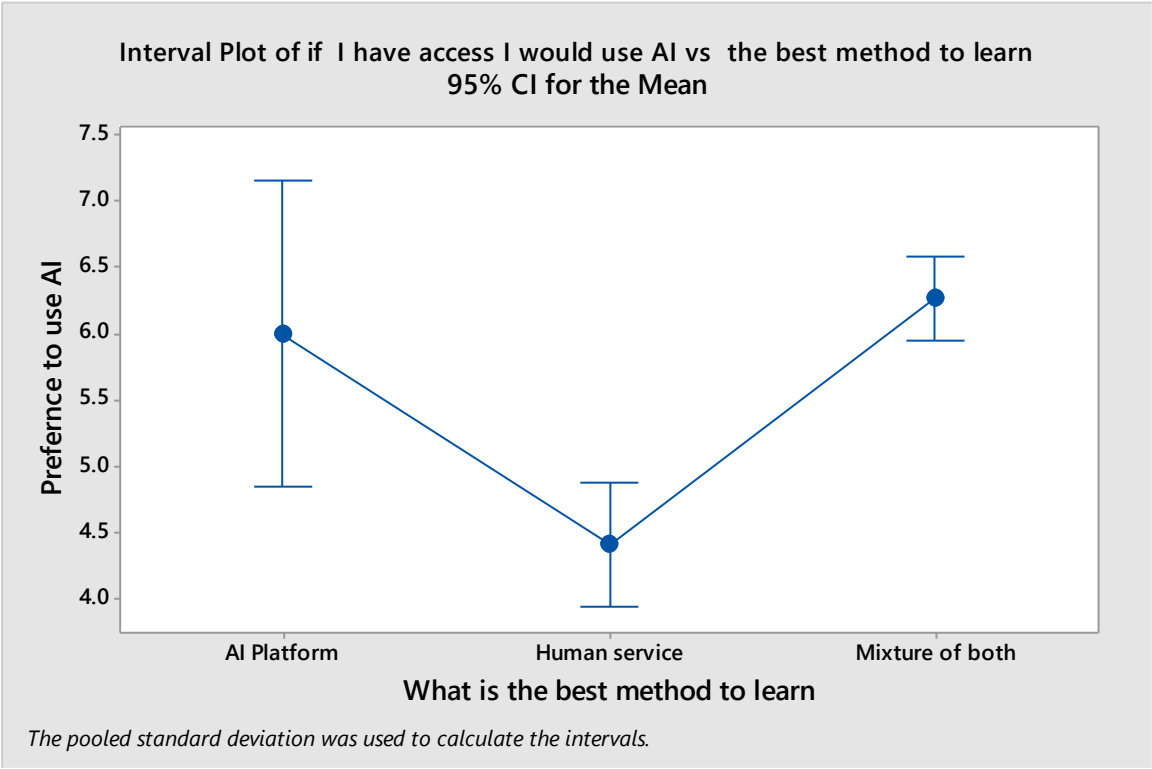

Figure 14 Interval plot of best method to learn vs the preference to use AI.

According to the above interval plot, respondents who think mixture of both AI platforms and human services are needs to be used for education has highest (6.27 ± 0.67) preference on AI. The lowest (4.42 ± 1.08) preference for the use of AI, is from the group who says human service is the preferred method for education. According to the One-way ANOVA results there is a significant difference in the preference to use AI by three groups (P value, 0.00 <0.05).

Tukey Pairwise Comparisons analysis further confirm that with respective to the preference to use AI, AI platform only recommending group and mixture of both recommending group cluster as one group and human service only forms a significantly different group on the preference to use AI. So, we can conclude that there is a significant impact of the method for education on preference to use AI. A vast array of research shows that learning is a social exercise; interaction and collaboration are at the heart of the learning process. However, online collaboration must be facilitated and moderated (Zawacki-Richter, Marín, Bond , & Gouver, 2019). This highlights the need for having a mixture.

4.9 Is there a relationship between use of social media for learning on preference of AI use?

For this analysis responses given for the question "Given that I have access to the system, I predict that I would use it" is used as the response variable showing preference to use AI. One way ANOVA analysis was performed to determine the influence of use of social media for learning on the preference to use AI.

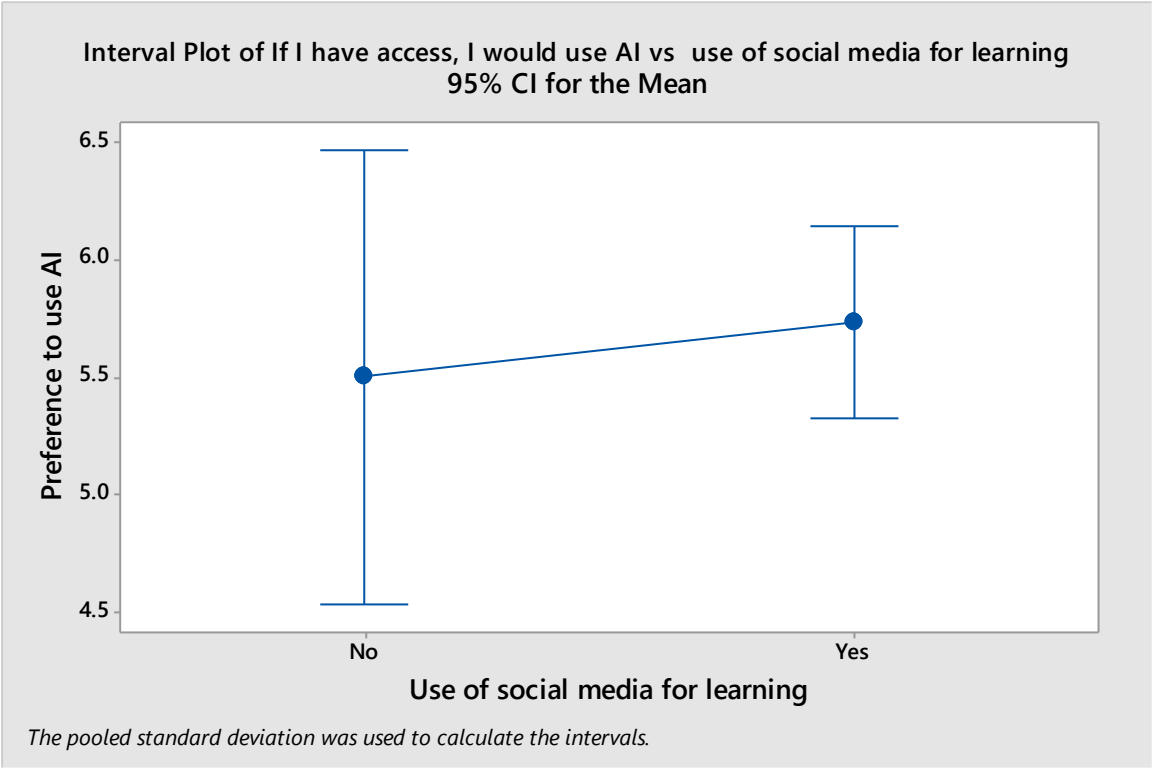

Figure 15 Interval plot of use of social media for learning vs the preference to use AI.

According to the above interval plot, both groups have better preference above 5. However, "no" group have longer whiskers showing higher dispersion of their response. According to the One-way ANOVA results no significant difference exists for preference to use AI of different Age categories (P, 0.653 >0.05). Tukey Pairwise Comparisons analysis further confirm that with respective to the

preference to use AI, use of social media for learning or not are same, as they all make one group (A letter for all). We can conclude that no impact of use of social media for learning on preference to use AI.

Social media (SM) has been widely used in education for many years and with the rapid development of Artificial Intelligence (AI), together, they play a critical role in every aspect of teaching and learning in Higher Education (HE). SM is a way of interaction combining web-based applications and social software (Procter, et al., 2010) that can be regarded as a collaborative conversational platform that is in open or closed online communities. Popular SM tools such as Facebook, Skype, YouTube, Blogs and Twitter created from the Web 2.0 technologies are believed to improve learning outcomes and academic achievement (Junco, Heiberger, & Loken, 2010) as well as to promote networking and to strengthen the social relationships within a community of practice (Llorens & Capdeferro, 2011).

Empirical research on the use of AI tools in the HE context is scarce comparatively with the more diffused use of social media ones. One of the studies available was recently conducted in Russia by Atabekova et al. (2015) investigates university students' use of Google web-based artificial intelligent tools for informal learning purposes. The findings of this study point to the potential of such web-based tools to develop students' self-diagnostic and self-control abilities, foster their motivation for social interaction in quasi-professional contexts, and enhance learners' reproductive, productive, reflective, and strategic skills. AI tools were also valued by Turkish HE students for allowing easier access to information and speeding up learning, and for being more reliable in terms of data and information safety (Yucel, 2017).

4.10 Result of the interviews

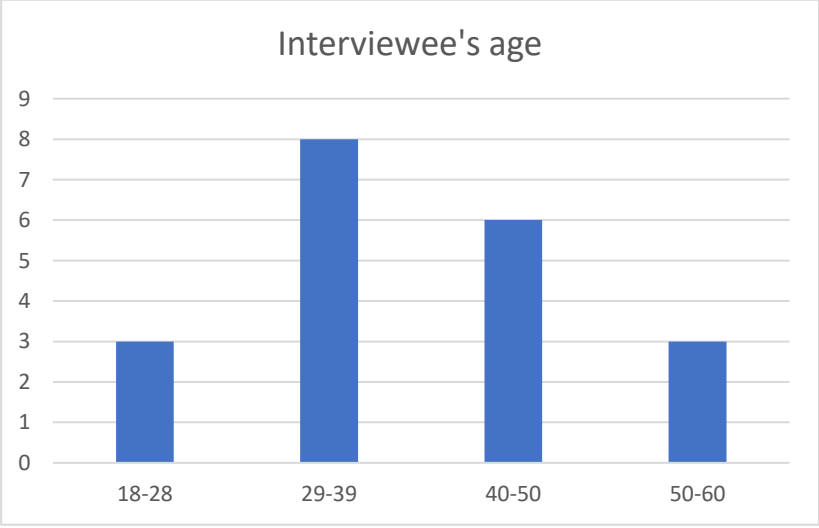

Figure 16 Interviewee's age

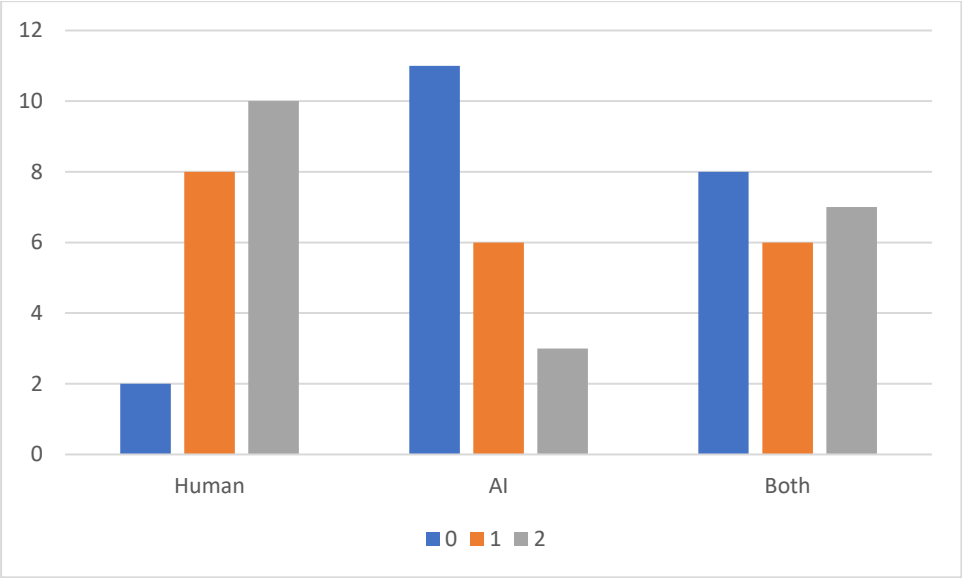

Figure 17 Scale of appeal between the 3 services

The graph above is the data gathered from 20 random people, that represent the general population. After showing them the 3 different figures 2,3 and 4, it was asked to rank them from least appealing (0) to most appealing (2).

The results of the first question shows that the population prefers the traditional method of learning, in second the mixed service and at third the AI as a marketing strategy.

After, it was asked the interviewees the reason behind their choices, almost everyone answered they do not have any experience with other methods. Two others present that it is easier to learn with someone, although either one never experienced AI tutoring of any kind.

The answers support the data from the questionnaire, no one gave importance to subjective norm, efficiency and results were vastly more important.

5 Conclusion

This study investigated research questions about the knowledge, acceptance individuals have about artificial intelligence in education and how to approach the population with this technology in education. The importance of this work derives from the fact that AI will massively improve the educational sector, but to benefit from its application, its acceptance must be ascertained. The instruments used to answer the research questions and fulfill the objectives were two different sets of interviews and one online questionnaire with the integrated model TAM2 (Venkatesh & Davis ,2000). Thanks to all the data gathered it was possible to understand the acceptance of AI and further the knowledge about this technology in education.

5.1 Discussion

The objective of reaching individuals who have experience with AI in education and people who have not was met by the different instruments and channels used. This allowed a more complete understanding to the topics at hand.

To investigate the knowledge individuals have about artificial intelligence the first interviews had a literacy test and the questionnaire had a comparative analyses. The result from a more general population follows the same conclusions as other studies (Pega, 2018), most individuals do not have the knowledge to understand AI. On the other hand, young male students had above average grading. To conclude this research question, there is a large number of individuals that do not understand artificial intelligence, but young students seem to grasp this concept better than most. The next generation of workers will have the necessary understanding of AI.

Firstly, during the study of acceptance the factors that stood out during the TAM2 analyses were image and subjective norm, although this result was rather low when compared with the rest it had no negative consequence. This means people are indifferent to individuals who use AI tutors. Their inner circle does not recommend or reject this method and does not give prestige to the user. These two factors do not influence their acceptance to the service, resulting in a neutral score. This result may change in the future with the increase of applications and regularity of AI in education. After the early adopter's stage (Rogers, 2021) it is very likely that the result in image and subjective norm will shift for the better if the technology keeps improving, or for the worse if the public image of AI decreases.

Then, the highest grading group was voluntariness, but it is not the most impactful because this is a direct result from the sample at hand and the availability of this service is very slim. Currently nearly all available choices are optional, with Duolingo (Ahn & Hacker, 2011) being the service most

respondents have experience with. If in the future artificial intelligence becomes normalized in university and schools, the mandatory aspect will change acceptance.

Lastly, the rest of the groups were all very positive, intention to use, perceived ease of use, usefulness, and output quality. This points to a high acceptance, with the most impactful factor being the output quality which corresponds with the TAM2 assumptions (Venkatesh & Davis, 2000). The service works as intended with great output quality.

It is possible to conclude that AI services in education are well accepted and most factors have a positive impact on acceptance. Lack of implementation and available options create a barrier for entry, but once that is overcome the acceptance of AI services in education is very high. If more individuals start experiencing artificial intelligence in education the acceptance of this technology would increase.

During the process of answering the research question: how to approach individuals with artificial intelligence in education, the relevance of social interaction became apparent. Education is profoundly emotional and human focused. It is important to know how to change between the use of digital technology and people's emotions (Twenge et al., 2019).

The objective of gathering data about the preferred learning service helped answer the research question above. The services in question being AI (which has no social interaction), traditional (which has the most social interaction) and a mixture of both. When evaluating the services and comparing traditional methods to the new ones, the mixed service is preferred amongst users of AI tutors (figure 11). The most effective approach to young male students would be a mixed service that utilizes both methods.

When the study investigated a more diverse sample the mixed approach did not beat the traditional methods. Looking at figure 19 artificial intelligence by itself has the most resistance of the three, despise the preferred service being the traditional there was still a sizable portion that is curious to accept a mixture of both services.

Considering both the acceptance of all services and the relevance of social media in the learning process, social interaction is a factor that influences the acceptance of AI. One of the reasons the mixed service delivers a better output is because of the social interactions between the students and the teachers. According to ThinkwithGoogle (2020) the data obtained from this study is very similar with the data from google, it is an important tool for many students that provides a community and social interaction. Google sees their platform becoming a learning service in the future. The increase of keyword related to leaning like "homeschool", increased 120% since March 13, 2020, and other keywords are increasing also at similar rates (Wiers, 2021).

To conclude the two topics about the research question, the general population prefers a more traditional approach and most individuals value social interaction. Pursuing customers with AI advertisement will, most of the time, create unnecessary resistance. On the other hand, young students prefer a mixed service, this can be achieved using tools that allow targeted marketing. Even with different opinion in which service is better both parties value human interaction, the TAM2 (Venkatesh & Davis, 2000) approaches social influence only by outside factors (image and subjective norm), the social factor during the procedure of learning (in this case) is not studied. The social interaction topic is relevant in the choice of the respondents, this factor should be included as an extension to the social influence topic in the model TAM2 when evaluating acceptance in education.

From all the data gathered about different groups of individuals and their perspectives in the topics of this work it is possible to say teachers will not be replaced in the near future because individuals do not accept that as a reality, with or without having the knowledge to understand AI. The technology is well accepted and regarded when people try it, the service offers many advantages that are recognized by the users. Even though most people will opt for traditional services, the acceptance of a mixed service will rise.

5.2 Limitations

This work has limitations that should be noted. The biggest challenge was reaching a good sample size of diverse people to participate in the questionnaire. The current sample of the questionnaire reflects only in young male students and to get the full scope of acceptance a more diverse sample would be needed. Fortunately, it is possible to conclude the objectives and answer the research questions in this group and the final interviews served to help complement this missing element. In terms of size, if the sample was bigger the statistical analysis would be more accurate, but the factorial validity of the sample assures the reliability of the data.

During the gathering of data about artificial intelligence in education it was apparent that there is very little published information about these services. This technology is being develop and tested mainly by private companies, with more data and studies about the user base of educational platforms may change the way the topic of the thesis is approached. With this in mind, the work approached a problem not well developed and gathered data to create a greater understanding in this area.

Lastly, there is a lack of consensus about the definition of artificial intelligence because it has many complex subsets. The definition used in this work congregated the definition of many experts in the AI domain and was designed by the European Commission of independent high-level expert

group on artificial intelligence (2019). With the evolution of the technology or with further study into computer science this definition might become outdated. Because of no consensus in a definition there is also no standardized model to study the general public knowledge when it comes to AI.

5.3 Directions for future research

The approached employed in this work was gathering information from the users, in this case the students. It is relevant for future research studying acceptance from the teachers. Studying persons who belong in the teaching procedure may give a different insight from the data gathered in this thesis. Besides this, the data gathered overall was more on young adults, an in-depth study of a younger (less than 18 years) sample could wield different results and is important nevertheless because they might also partake in these types of services.

The TAM2 model (Venkatesh & Davis, 2000) studies different elements that are important for acceptance, but there are other acceptance models that approach the same problem in a different light. It would benefit this sector to understand all the elements that may influence acceptance like social interaction.

The continuous trend of artificial intelligence in different sectors is relevant for society. It is necessary to understand how acceptance will influence the implementation of AI, for that reason it would be pertinent to adapt this work for the juridical side which has seen some implementation but lack of published data about it.

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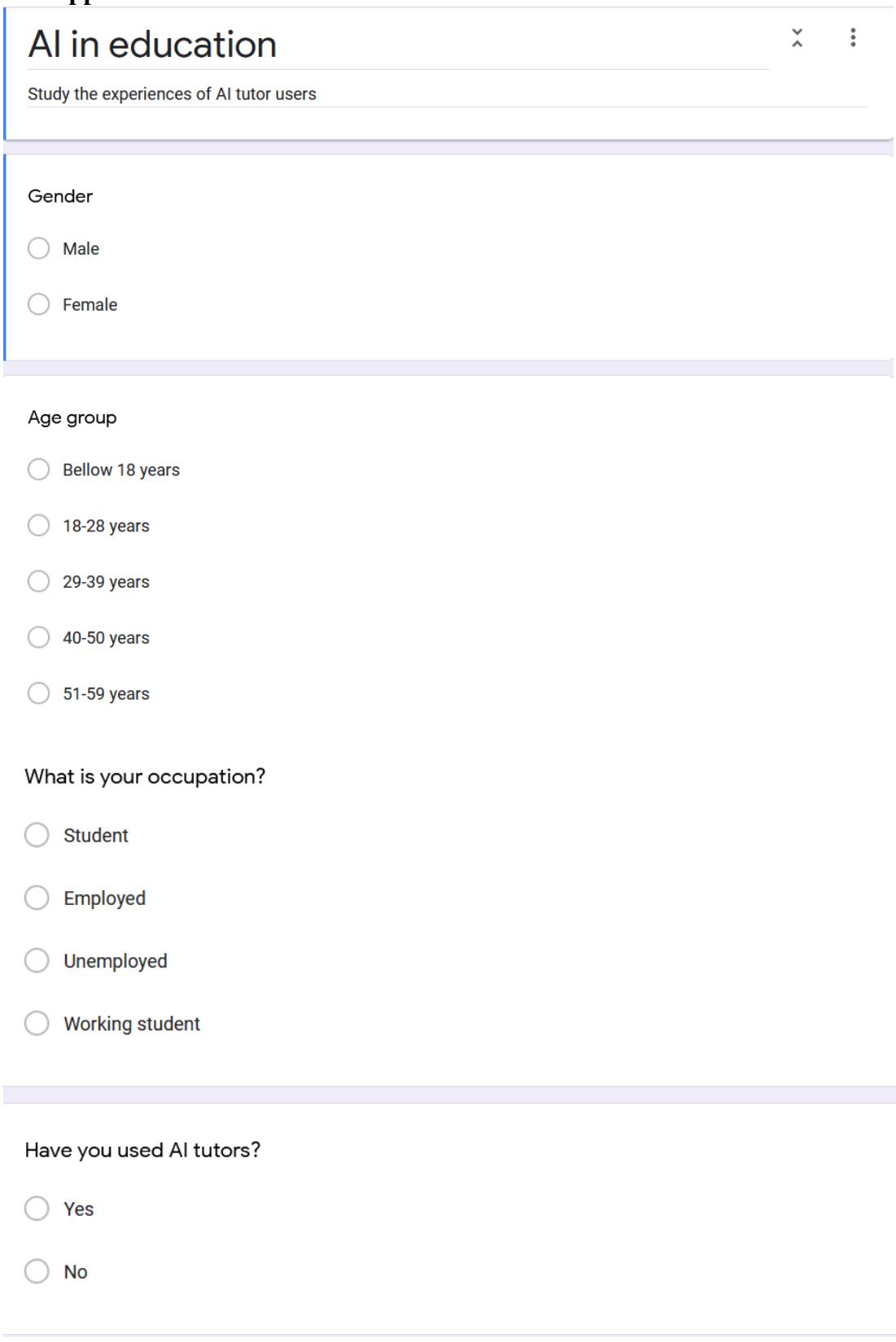
Appendices



AI in education

Study the experiences of AI tutor users

Gender

- Male
- Female

Age group

- Bellow 18 years
- 18-28 years
- 29-39 years
- 40-50 years
- 51-59 years

What is your occupation?

- Student
- Employed
- Unemployed
- Working student

Have you used AI tutors?

- Yes
- No

Secção 2 de 10

Never used AI tutor

Descrição (opcional)

What is your reason for not using an AI tutor? *

- None
- Lack of knowledge about the tutors
- Lack of available options
- Low process eficiency
- Outra opção...

Assuming I would have access to a system, I intend to use it. *

1	2	3	4	5	6	7

Assuming I would have access to a system, I intend to use it. *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

What capabilities can AI achieve? *

- [ ] Interpret speech
- [ ] Solve problems
- [ ] Ability to learn
- [ ] Ability to replicate human interaction
- [ ] Think logically
- [ ] Play games
- [ ] Run surveillance on people
- [ ] Replace human jobs

- [ ] Replace human jobs
- [ ] Take over the world
- [ ] Control your mind
- [ ] Feel emotion

I believe that these impacts about AI are relevant. *

	Not at all releva...	Not very relevant	Neutral	Somewhat rele...	Very relevant
Society (inequa...	○	○	○	○	○
Human psychol...	○	○	○	○	○
Legal system (t...	○	○	○	○	○
Environment (U...	○	○	○	○	○
Trust (fairness, ...	○	○	○	○	○
Financial system	○	○	○	○	○

Secção 3 de 10

Your experience with the AI tutor.

Descrição (opcional)

Given that I have access to the system, I predict that I would use it. *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

Using the system improves my performance in my activity as a student. *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

Using the system in my activity as student increases my productivity. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

Using the system enhances my effectiveness in my activity as a student. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

I find the system to be useful in my activity as a student. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

My interaction with the system is clear and understandable. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

Interacting with the system does not require a lot of my mental effort. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

I find the system to be easy to use. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

I find it easy to get the system to do what I want it to do. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

People who influence my behavior think that I should use the system. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

People who are important to me think that I should use the system. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

My use of the system is voluntary. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

My supervisor/parent does not require me to use the system. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

Although it might be helpful, using the system is certainly not compulsory in my activity as a student. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

People in my school/work who use the system have more prestige than those who do not. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

People in my school/work who use the system have a high profile. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

Having the system is a status symbol in my school/work activity as a student. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

In my activity as student, usage of the system is important. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

In my activity as student, usage of the system is relevant. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

The quality of the knowledge I get from the system is high. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

I have no problem with the quality of the learning experience. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

I have no difficulty telling others about the mental improvements of using the system. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

I believe I could communicate to others the consequences of using the system. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

The results of using the system are apparent to me. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

I would have difficulty explaining why using the system may or may not be beneficial. * *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

I believe that these impacts about AI are relevant. *

	Not at all releva...	Not very relevant	Neutral	Somewhat rele...	Very relevant
society (inequal...	○	○	○	○	○
human psychol...	○	○	○	○	○
legal system (t...	○	○	○	○	○
environment (U...	○	○	○	○	○
trust (fairness, ...	○	○	○	○	○
financial system	○	○	○	○	○

What capabilities can AI achieve? *

- [ ] Interpret speech
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- [ ] Ability to replicate human interaction
- [ ] Think logically
- [ ] Play games
- [ ] Run surveillance on people
- [ ] Replace human jobs
- [ ] Take over the world
- [ ] Control your mind
- [ ] Feel emotion

What AI tutor do you use?

- [ ] Wolfram
- [ ] Duolingo
- [ ] iTalk2Learn
- [ ] Thirdspace Learning
- [ ] Thinkster Math
- [ ] EdTech Foundry
- [ ] Outra opção...

Do you have human help in the same area as the AI tutor? * *

- ( ) Yes
- ( ) No

No human help

Descrição (opcional)

I feel a human in the process would increase the overall quality. * *

	1	2	3	4	5	6	7	
Strongly disagree	( )	( )	( )	( )	( )	( )	( )	Strongly agree

Have you ever contacted the company support? * *

- ( ) Yes
- ( ) No

Secção 6 de 10

With human help

Descrição (opcional)

Is the AI tutor associated with the human help or separated? *

- ○ Associated
- ○ Separate

I feel the human component is important for the overall process. *

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

Have you ever contacted the company support? *

- ○ Yes
- ○ No

Secção 7 de 10

Feedback

Descrição (opcional)

What is your experience with the company feedback?

- ○ Good
- ○ Decent
- ○ Could be better
- ○ Bad

How did the feedback affected your appreciation for the service?

	1	2	3	4	5	
Not at all	○	○	○	○	○	A lot

Secção 8 de 10

Usage of social media

Descrição (opcional)

Do you use social media for learning?

- ○ Yes
- ○ No

Secção 9 de 10

Social media

Descrição (opcional)

What social platforms do you use for learning?

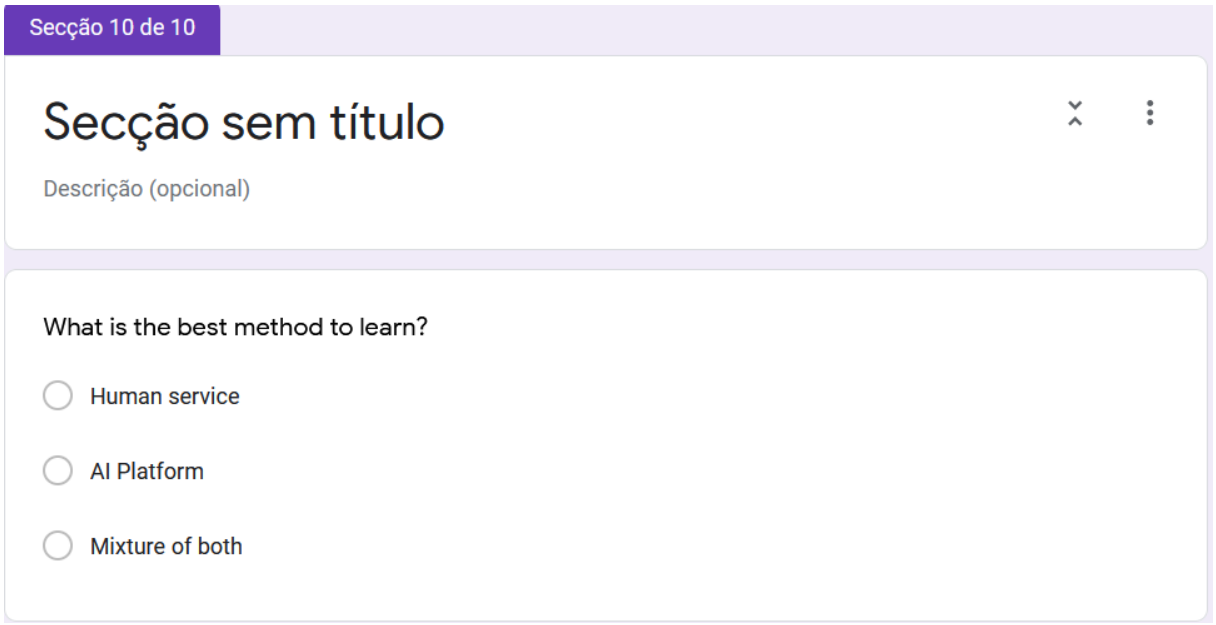
- [ ] Forums
- [ ] Youtube
- [ ] Facebook
- [ ] Twitter
- [ ] Instagram
- [ ] Blogger
- [ ] Discord
- [ ] Whatsapp

- [ ] Instagram
- [ ] Blogger
- [ ] Discord
- [ ] Whatsapp

- [ ] Outra opção...

How important is social media for your learning?

	1	2	3	4	
Not at all important	○	○	○	○	Very important



Annex A

```
Analysis of Variance

Source  DF   Adj SS  Adj MS  F-Value  P-Value
Gender   1   0.1403  0.1403     0.10    0.751
Error   38  52.2597  1.3753
Total   39  52.4000


Model Summary

      S   R-sq  R-sq(adj)  R-sq(pred)
1.17271  0.27%      0.00%       0.00%


Means

Gender      Mean  StDev      95% CI
1          5.727  1.206  (5.314, 6.141)
2          5.571  0.976  (4.674, 6.469)

Pooled StDev = 1.17271


Grouping Information Using the Tukey Method and 95% Confidence

Gender      Mean  Grouping
1          5.727  A
2          5.571  A

Means that do not share a letter are significantly different.
```

Interview Guide

Name	
Date	

Projeto 1

%	Phase	Time	Notes
0%	Candidate Information	10 min	Demographic questions.
0%	Introduction	10 min	Introduce the work and the interviewer.
0%	Showing pamphlets	5 min	Show the 3 pamphlets and read them.
0%	Rating the pamphlets	10 min	Rating the pamphlets from least appealing to most appealing
0%	Discussion of position	15 min	What is the reason behind their choice, was it hard to rate, what can be improved in the services and what are the strong points.
0%	Last remarks	10 min	Adapt some questions to the knowledge of the individual.
0%	Conclusion	10 min	Provide contact information and thank the applicant.

Annex B

Interviews Guide

Name	
Age	
Contact	
Career	

Date	Test Results	Open conversation remar	Additional information

Annex C