Users' satisfaction evaluation of telemedicine mobile applications based on ISO standards

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Abstract: This study focuses on assessing the satisfaction of telemedicine mobile application users. Four perspectives, namely acceptance, quality as a software product, content quality and usage quality are assessed. The applications selected in the study are from two Portuguese market leaders in the sector. A model is tested based on the ISO 25010:2011 and ISO 25012:2008, and data from a survey to gather the user's opinion of this type of mobile application. We conclude that there is a direct connection between the acceptance and the content quality of telemedicine application as well as the quality of the application as a product software, being possible to identify that the users consider the content and the application quality as fundamental factors to accept these applications.

Keywords: telemedicine; mobile applications; quality; user satisfaction, software evaluation, ISO standards.

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1 Introduction

The entry of smartphones into the daily lives of individuals has completely changed the way in which they interact with each other and the way in which they are permanently active and contactable. According to Carvalho and Freire (2017), the immense growth and popularity of smartphones is a global phenomenon and the popularity of such devices continues to expand. However, statistics show that despite the existence of 5 billion mobile subscribers around the world, there are only 1 billion smartphone users, but the market is growing roughly 42% per year.

Smartphones are a combination of two classes of devices: mobile phones and personal digital assistants (PDA - Personal Assistant Device). Unlike all their predecessors, these allow access to the internet using 3G or Wi-Fi connections enabling a huge variety of resources to the user. Nowadays this type of devices, even simple and affordable ones, allow access to the Internet, provide email access, GPS, recording and viewing videos as well as serving as a modem for Internet access on other devices (Morimoto, 2009). Whereas the Mobile Computing Promotion Consortium (MCPC) in its report Shiraishi et al. (2011) states that the smartphone is a universal designation that contributes to promote the free use of its users in the acquisition of applications, extension of functionalities and/or customization. The potential of smartphones is enhanced by the diversity of smartphone applications (app) available (Tavares and Alturas, 2018).

Marktest's Telecommunications Barometer states that 6,900,000 individuals own a smartphone in Portugal. In particular, the Portuguese smartphone penetration rate is higher among males, residents of Greater Lisbon, the younger generation, and higher social classes. Of note is the 99% usage rate among young people aged between 10 and 24 years (Marktest, 2018).

According to Bajpai (2012), Telemedicine is the exchange of information at a distance, whether that information is voice, image, medical elements or commands for a surgical robot. We can consider Telemedicine as the remote communication of information to facilitate medical care.

Studies on app usage and satisfaction are known (eg Lee and Kim, 2021), but as far as we know, there are no studies on Telemedicine apps. Hence the significance and importance of this study.

This study focusses on assessing the satisfaction of telemedicine mobile application users. The applications selected in the study are from the two Portuguese market leaders

in this sector. Several assessment models of mobile applications are combined to assess four main perspectives, namely acceptance, quality as a software product, content quality and usage quality. More precisely, the analyses are conducted to assess the user acceptance rate and the quality and satisfaction of the Telemedicine applications regarding the mentioned perspectives. In addition, a model is tested to understand which are the application characteristics that determine their usage acceptance.

2 Mobile applications and Telemedicine

2.1 Mobile applications

The development of applications for mobile devices has grown, as well as their popularization. In parallel with the growing development of applications for the platforms, the use of the operating system has also grown. Different means can be used to create applications for the mobile devices, conceiving various forms of applications (Jobe, 2013). Mainly three types of applications are created:

- Native applications: It is possible to fully exploit the full range of resources available on the device, such as sensors, accelerometer, compass, calling and interface capabilities, graphics processing and others, allowing the construction of feature-rich applications capable of processing high resolution videos and images. These applications can use system notifications and run offline (Carvalho and Freire, 2017).
- Web applications: they are Internet pages accessed like any other through a browser that is previously installed on mobile devices. These websites are developed using widespread technologies, such as HTML, CSS (Cascading Style Sheets) and JS (JavaS-Crypt), making the development process more agile by not requiring different codes for each platform. On the other hand, web apps have limited access to the hardware and data resources of the devices, being dependent on Internet connection to access the content (Carvalho and Freire, 2017).
- Hybrid applications: they aim to combine the advantages of native and Web development to create applications. For this, different frameworks and tools assist the developer (Carvalho and Freire, 2017).

2.2 Telemedicine

Craig and Patterson (2005) describes Telemedicine as the remote delivery and exchange of medical care.

By providing greater accessibility to medical care, Telemedicine can reduce medical diagnoses where geography is an issue between patient and doctor. Teleconsultations have proven to change medical diagnoses and recommendations as well as reduce the waiting time associated with high-demand medical consultations (Heinzelmann, Lugn and Kvedar, 2005).

According to Parmanto et al. (2016), it was necessary to develop a questionnaire that took into account the changes in Telemedicine services and the technology required for this purpose. Their study used the Telemedicine Usability Questionnaire (TUQ) in a sample of 53 participants and concluded that the TUQ is solid, robust, and versatile and

can be used to measure the quality of Telemedicine services and interaction as well as the quality of the program or software on which it is based.

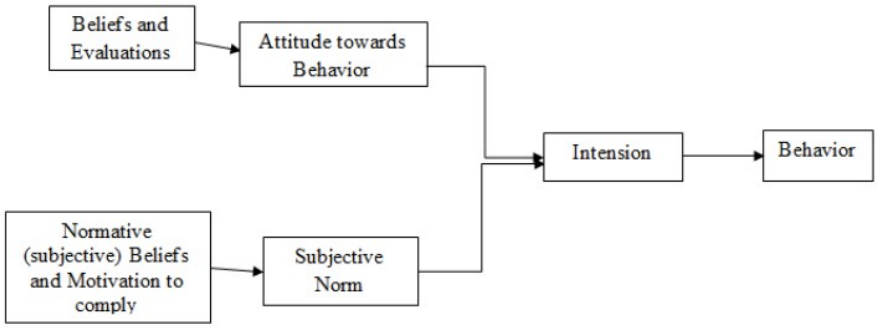
Telemedicine cannot be considered the method that will solve all health-related problems in the world or a means by which health workers can be replaced (Craig and Patterson, 2005).

3 Evaluation of mobile applications

3.1 TRA – Theory of Reasoned Action

Over time, several models for technology assessment have emerged, many of which have also been used to assess mobile applications. One of the oldest and most used is the Theory of Reasoned Action (TRA). The TRA was developed by Martin Fishbein and Ice Ajzen and defines the link between beliefs, attitudes, intentions, and behaviour of individuals (Alturas, 2021). The foundations of this theory coming from bases grounded in psychology (Otieno *et al.*, 2016). It indicates that the individual's behaviour is based on his intention, which is fundamentally supported by the individual's attitude towards the behaviour and the subjective norm. Both the attitude towards behaviour and the subjective norm are directly related to the individual's beliefs and motivations (Fishbein and Ajzen, 1975) (see Figure 1).

Figure 1 Theory of Reasoned Action model (Fishbein and Ajzen, 1975)



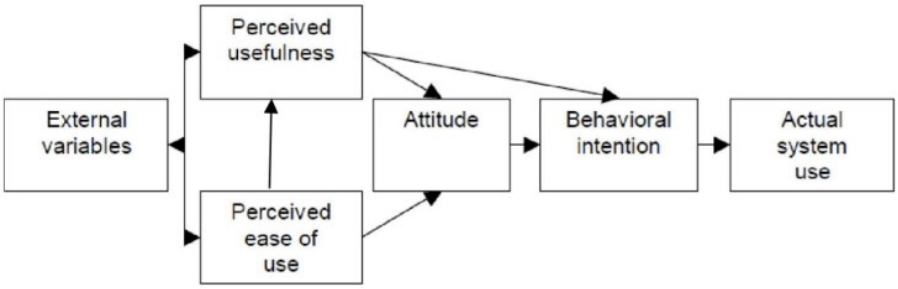
The creation of TRA occurred after an attempt to estimate the discrepancy that existed between attitude and behaviour.. However, Fishbein and Ajzen recognised the limitations of their model in distinguishing between the intention to achieve a goal and the behaviour to achieve it (Sheppard, Hartwick and Warshaw, 1988).

3.2 TAM – Technology Acceptance Model

According to Lee et al. (2003), the Technology Acceptance Model (TAM) is the most influential and applied theory to describe individual acceptance of an information system. TAM consists of an adaptation of TRA, having been originally proposed by Davis in 1986, and assumes that information system acceptance is mostly linked to two variables:

perceived usefulness and perceived ease of use (Alturas, 2021). The major factor that triggered the development of TAM consisted of the lack of a measurement scale that could be used to predict user acceptance of technology (Dwiyana Putra, 2018).

Figure 2 Technology Acceptance Model (Davis, 1989)



The TAM model has been used to study the acceptance of various types of technologies such as e-learning, social media, Telemedicine, software maintenance tools, buyer-seller technology, mobile applications, and even virtual worlds (Alturas, 2021).

Perceived usefulness and perceived ease of use are being directly influenced by external variables and are linked to the user's attitude consequently giving rise to the behavioural intention and actual use of the system (see Figure 2).

According to Dulipovici and Vieru (2015), TAM cannot be used because it does not take into account the nature of shared knowledge. Therefore, Venktatesh and Davis (2000), using the foundation laid in TAM, developed TAM2 and TAM3 which elucidate perceived usefulness and usage intention in terms of external variables, namely social influence processes and the instrumental cognitive process.

TAM has already been applied in different technologies, having also been applied to mobile applications, for example by Tavallaee, Shokouhyar, and Samadi (2017). Also Lee and Kim (2021), studied the user, the system, and social related factors affecting perceived usefulness for continuance usage intention of mobile apps.

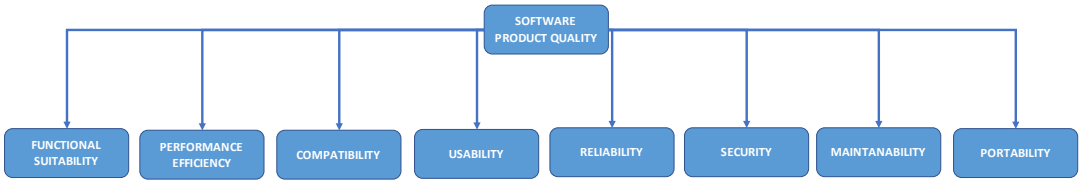
3.3 ISO 25010:2011 – Quality in use and quality as a software product

The International Organization for Standardization (ISO) is an independent, international non-governmental organisation with members from several countries. Founded in 1947, the organisation promotes international standards for products, services, and systems with the aim of creating standardised standards of quality, efficiency, and safety for all countries.

The quality model defined for product quality evaluation consists of an important milestone within the product. This project considers the model defined by ISO 25010:2011 - Systems and Software Quality Requirements and Evaluation, which replaced the former ISO 9126-1 Information technology - Software product quality, Part 1, Quality model. The standard states that the quality of a software should be based on a quality model consisting of a hierarchical structure defined according to the users' needs (Tavares and Alturas, 2018).

The ISO 25010:2011 standard introduced the main characteristics of "security" and "compatibility" to the already existing six characteristics defined in the 9126-1 standard: functionality, reliability, usability, efficiency, maintainability, and portability. The internal characteristics are set out in Figure 3.

Figure 3 Internal characteristics of quality model



According to ISO 25010:2011 the functionality characteristic represents the degree to which the product or system enables the user to perform functions that meet their explicit and implicit needs.

The efficiency of a product or system is its ability to deliver appropriate performance with respect to resource and time use.

Compatibility characteristic consists of the degree to which a product, system or component can exchange information with other products, systems, or components and/or perform their functions while sharing the same hardware or software environment.

Usability is entirely linked to the user's ease of understanding, learning, using, and enjoying the product or system. It must encompass all the environments that the software can affect, including preparation for use and analysis of the results generated.

Reliability refers to the product or system's ability to avoid failures and maintain adequate performance when they occur, under specific conditions. From the product or system perspective, all failures that may occur are consequences of design and implementation defects, if the product or system does not wear out or age.

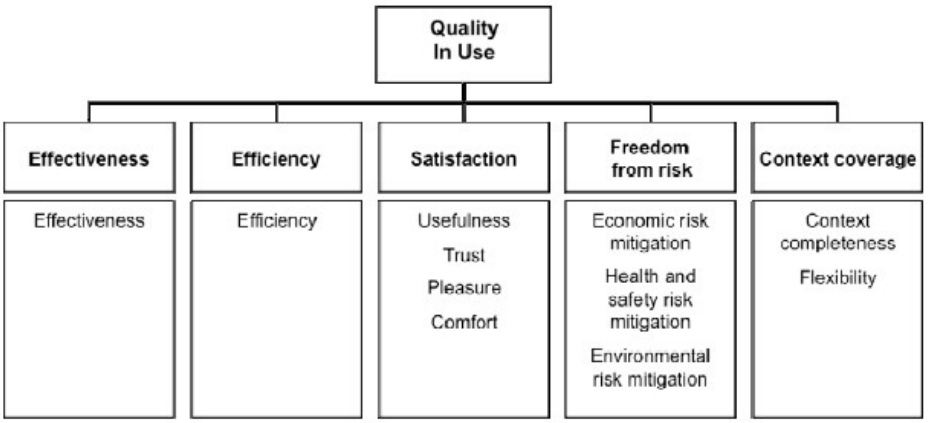
Security feature is the degree to which a system or product protects data or information so that other users, products, or systems have their level of access to the data and information appropriate to their level of authorisation.

Maintainability represents the degree of effectiveness and efficiency at which a system or product can be modified to be improved, corrected, or adapted for changes that may occur in the environment or requirements.

Portability consists of the capacity in which a product or system operates in different environments, whether organisational, hardware or software.

During the use of the product, the user has a perspective of the software quality (Tavares and Alturas, 2018). Quality in use is composed of five characteristics that relate to the interaction outcome when a product is used in a particular context of use. Quality in use defines the ability of the product or system to complete the user's goal (Tavares and Alturas, 2018) by complying with effectiveness, efficiency, satisfaction, security and context coverage, as shown in Figure 4.

Figure 4 Quality model for quality in use (Source: ISO 25010:2011)



Quality in use is defined by the following attributes:

- Effectiveness: The ability of the product or system to enable its users to achieve their objectives with accuracy and precision.
- Efficiency: The product or system's ability to allocate resources in correlation with user objectives with accuracy and precision.
- Satisfaction: The ability of the product or system to satisfy user needs when the system is used in each context.
- Freedom from risk: The ability of the product or system to mitigate risk to people, business, and the environment in each context.
- Context coverage: The ability of the product or system to be used effectively, efficiently, risk-free, and satisfactorily in each context of use and in contexts beyond those initially identified.

3.4 ISO 25010:2011 – Quality of content

Due to the relevance of electronic data, data quality plays a central role in all business and governmental decisions. Data quality is recognised as relevant for decision-making in operational processes, decision-making activities and in requirements for cooperation between organisations (Batini *et al.*, 2019).

The growing relevance of data quality has revealed the need to tailor metrics, because quantifying data quality is central to planning measures with an acceptable level of quality (Heinrich, Kaiser and Klier, 2007).

Data quality varies according to its specific application and each dimension of data quality is specifically relevant to a specific aspect of data, such as visualisation, values, and representation (Batini *et al.*, 2019). The term data quality is described as data that is "fit for purpose", data considered fit for a purpose that may not have sufficient attributes for the purpose (Tavares and Alturas, 2018).

ISO 25012:2008 can be used to establish requirements for data quality, to define quality metrics, or to plan and perform data quality assessments (ISO, 2008).

The data quality model is characterised by 15 characteristics, which are integrated into one or both of the inherent and the pending system perspectives (ISO, 2008). The

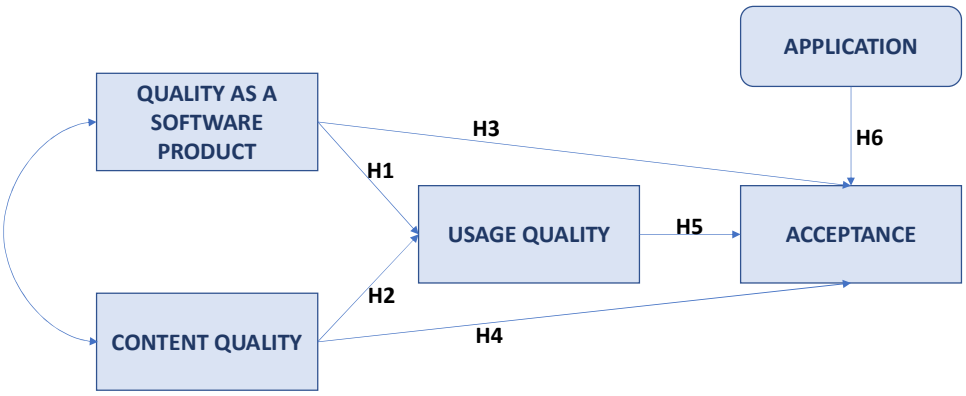
inherent perspective refers to the degree to which data characteristics have the intrinsic potential to meet the implied and expected needs when the data are used under specific conditions. The pending system perspective refers to the degree to which data quality is achieved and preserved within a system when used under given conditions.

According to Rafique et al. (2012), the 15 characteristics are defined as accuracy, completeness, consistency, credibility, currentness, accessibility, compliance, confidentiality, efficiency, precision, traceability, understandability, availability, portability, and recoverability.

3.5 Proposed Model

Based on the models described before, the conceptual model presented in Figure 5 is proposed for the evaluation and acceptance of Telemedicine mobile applications (Figure 5).

Figure 5 Conceptual model for acceptance of telemedicine mobile applications



H1: The application quality of use is related to the application quality as a product software

H2: The application quality of use is related to the application content quality

H3: The application acceptance is related to the application quality as a product software

H4: The application acceptance is related to the application content quality

H5: The application acceptance is associated to the telemedicine mobile application under study.

4 Applications under study

As previously mentioned, the aim of this study was to evaluate the current satisfaction of users of Telemedicine mobile applications in users' perspective. For this specific study, Médis and Multicare Telemedicine applications were chosen (market leaders in health insurance ector).

Multicare and Médis telemedicine applications allow users to perform a wide range of actions related to their medical history, health insurance, online doctor, prescription management and medication prescription. Both applications correspond to a form of interaction in the Telemedicine format since they are entirely related to the patient and his/her interaction with medical care and management of his/her health care through a mobile application.

These applications are available for download and installation, free of charge, for any user with a smartphone with Android or IOS operating systems and Multicare or Médis insurance, to access all the functionalities of the applications. With the Multicare and Médis telemedicine applications, the user will have at his disposal a tool to manage his medical data, as well as the possibility to make efficient medical appointments without the need to go to the hospital or medical post.

5 Methodology

After analyzing the state of the art, on the growing use of smartphones, which metrics to evaluate an application that meets the requirements of users, and the growing development of telemedicine applications, the main goal of this study could be detailed in the following five specific objectives:

1. Assess the user acceptance rate of the Telemedicine applications;
2. Assess the quality of the Médis and Multicare applications based on the model defined by ISO 25010:2011, where the characteristics and sub-characteristics of product quality and quality of use of the product or system are identified.
3. Evaluate the quality of the application data and content based on the characteristics, sub-characteristics and metrics defined by ISO 25012:2008
4. Assess user satisfaction with the current state of telemedicine applications as well as the functionalities currently available in both.
5. Propose improvements to be implemented in Telemedicine applications based on the users' opinion.

Studies based on the two theories, Theory of Reasoned Action (TRA) and Technology Acceptance Model (TAM), helped in the construction of the questionnaire to assess acceptance. These are the most used models to assess the adoption of mobile applications (Harst *et al*., 2019; Jacob *et al*., 2020).

The research methodology adopted was a quantitative approach based on the instrument for data collection, the questionnaire, which was divided into six groups. The first group referred to the respondents' characterization and contained a question to ascertain whether the respondent could be applicable to the study, i.e. whether use one of these two telemedicine applications; The groups 2 to 6 were composed by questions in order to answer the study objectives: Group 2 referred to the users' acceptance of telemedicine applications; Group 3, 4 and 5 referred to the evaluation of the mobile application quality as a software product, and regarding its quality of use and its content, respectively. Finally, the group 6 asked respondents to give their opinion regarding improvements to be implemented from their perspective as well as their level of satisfaction.

Except for three questions (age, satisfaction, and opinion on the improvements to implement, the questions were closed-ended using a 5-point Likert-type scale from 1 -

Completely Disagree to 5 - Completely Agree. Satisfaction was also measured in a 5-point Likert scale from 1 – Totally Unsatisfied to 5 – Totally Satisfied.

The questionnaire was distributed in various digital media (Facebook and Whatsapp) during the period of approximately 2 months, between February and March 2021.

A total of 206 valid responses were obtained; However only 160 respondents have contact with these two telemedicine applications. SPSS 27 was used to statistical analyses; In particular, items of users' opinions were descriptive analysed by frequency distributions and two multiple linear regression (MLR) analyses were used in order to understand which are the variables that influence the mobile applications acceptance. Assumptions of MRL are analysed and verified. Previous to these analyses a reduction of the number of variables were conducted.

6 Results

6.1 Characterization of respondents and application usage

The majority of respondents are male users (53.7%) and are between 24 and 36 years old (56.3%); It is in this age interval that the users with the greatest contact with telemedicine applications are found.

The respondents' level of education shows that almost 80% have higher education. However, they have little contact (42.3%) or some contact (29.1%) with Telemedicine applications and 22.4% have no contact. Thus, only 160 responses are considered in the following analyses. Regarding the use of the specific applications in this study, there is an equivalence between both applications' usage, with Médis application having a slight majority (47.7%) in relation to Multicare (41.2%) application. Users also reveal a very high satisfaction degree for the Telemedicine applications in this study (84.2% scored satisfied or totally satisfied).

Based on the inherent characteristics of the TRA and TAM models of technology acceptance, we assessed the attributes that determine technology acceptance by users of Telemedicine applications. In general, users accept telemedicine applications relatively easily (90.3%), and it should be noted that 48.5% of respondents fully agree that telemedicine applications are easy to use and 62.2% agree that they are useful.

The Telemedicine applications were also assessed as a software product according to the characteristics stated in ISO 25010:2011. Regarding the functionality, efficiency, compatibility, usability and reliability, the majority of respondents agree that the applications present conditions to satisfy the user for his explicit and implicit needs, provide appropriate performance regarding the use of resources and time, have the ability to operate in different environments and contexts without neglecting its quality and functionalities, can be used to achieve specific objectives with effectiveness, efficiency and satisfaction in a specific context of use and have the ability to prevent failures and maintain adequate performance when they happen.

Regarding to Security, 54% of respondents fully agree that the applications can protect the integrity of the data linked to the profile and manage the permissions of each user without there being leaks or undue access.

However, in maintainability and portability, respondents have a neutral opinion (as 42% and 46% scored neither agree nor disagree) regarding their ability to accept

modifications, improvements, corrections, or adaptations to new requirements as well as to operate in different environments, whether organisational, hardware or software.

Concerning the quality of use, most respondents agree or fully agree with the effectiveness (91.5%) and efficiency (83.1%) of the applications to achieve the objectives with accuracy and precision and the ability to allocate resources in correlation with the user's objectives with accuracy and precision. The majority of users are also satisfied with the applications' abilities to meet the users' needs (96.6%). Regarding to the context coverage, the respondents agree that the applications can be used effectively, efficiently, risk-free and with satisfaction for the user (81.4%). Regarding security, respondents are fully satisfied with the ability of the applications to mitigate risk (91.4%).

Regarding the respondents' perspective on the quality of content of the telemedicine applications, more than 90% of respondents consider that these applications present accurate and discriminated data (accuracy), contain sufficient breadth and depth (completeness), are consistent with the information (coherence), are reliable (credibility), and can maintain the expected levels of performance (efficiency).

In addition, respondents fully agree that data is up to date (timeliness), can be accessed in a specific context of use (accessibility) and has attributes that enable users to read and interpret it (comprehensibility).

About the degree to which data are accessed and interpreted by authorised users (confidentiality), respondents are satisfied with the capabilities of the applications.

6.2 Regression analyses

To reduce the number of variables measuring the constructs (28 items), four new variables regarding each construct (ACCEPTANCE, QUAL_SOFTWARE, QUAL_USE and QUAL_CONTENT) were created by averaging their items. The variable ACCEPTANCE included all items (five) aimed at understanding the respondents' acceptance of telemedicine applications, the variable QUAL_SOFTWARE included all questions (eight) on the quality of the mobile application as a software product, the variable QUAL_USE included the five questions on the quality of use of the mobile application and the variable QUAL_CONTENT included the ten questions on the quality of the mobile application regarding the content.

In order to analyse the consistency of the variables created, Cronbach's reliability statistic was performed which estimates the internal consistency of the variables used as responses (Vaske, Beaman and Sponarski, 2017). Cronbach's alpha varies between 0 and 1, where 1 means that variables are strongly correlated with each other.

The variable ACCEPTANCE presents a positive internal consistency of 0.886. Thus, the variable ACCEPTANCE can be calculated based on the average of the items related to the acceptance of telemedicine applications. The remaining variables present Cronbach values lower, but within the limits considered as good internal consistency (QUAL_SOFTWARE presents 0.690 of internal consistency, whereas QUAL_USE and QUAL_CONTENT present 0.708 and 0.733, respectively).

Pearson's correlation coefficient measures the linear correlation between two variables, and this correlation should fall within the range -1 to 1, with -1 being considered as strongly negatively correlated and 1 strongly positively correlated. Table 1 presents the Pearson correlation matrix.

Table 1 Pearson Correlation for the variables under study (a)

	QUAL_SOFTWARE	QUAL_USE	QUAL_CONTENT
ACCEPTANCE	0.465	0.391	0.546
QUAL_SOFTWARE	1	0.598	0.699
QUAL_USE	0.598	1	0.764
QUAL_CONTENT	0.699	0.764	1

(a) All correlation values are significant at significance level of 0.01.

The quality of the content (QUAL_CONTENT) is strongly correlated with the remaining variables, constituting such an important factor for users that the content presented in the applications has quality so that these applications are accepted and frequently used, and therefore the quality of the software is consistent with the users' expectations for telemedicine applications.

Previously to the regression analysis, the multicollinearity of independent variables should be assessed. According to Daoud (2017), multicollinearity is detected by examining the Tolerance (TOL) and the Variance Inflation Factor (VIF) for each independent variable. The tolerance consists of the amount of variability in an independent variable that is explained by other independent variables, being considered that values below 0.10 indicates that we are facing a case of collinearity. Regarding to VIF, the limit defined for the non-existence of multicollinearity is 10. Table 2 presents the collinearity statistics, TOL and VIF, for the independent variables in the model.

Table 2 Model estimated coefficients

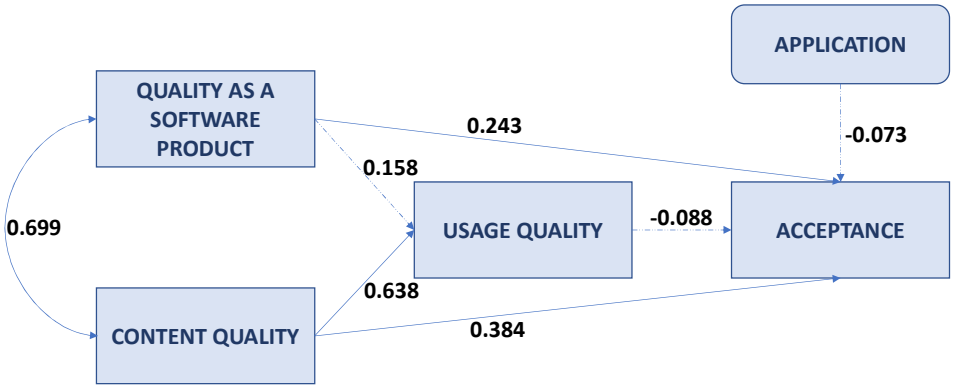
		Unstandardised coefficients						
Model		**B**	**St. Error**	**Beta**	**t**	**Sig.**	**TOL**	**VIF**
QUAL_USE	(Constant)	.602	.295		2.041	.043		
(R^2=0.571;	QUAL_SOFTWARE	.159	.084	.158	1.908	.059	.523	1.912
R^2adj =0.564)	QUAL_CONTENT	.716	.093	.638	7.678	.000	.523	1.912
ACCEPTANCE	(Constant)	1.972	.374		5.279	.000		
(R^2=0.263;	QUAL_SOFTWARE	.230	.106	.243	2.171	.032	.508	1.968
R^2adj =0.244)	QUAL_USE	-.083	.114	-.088	-.724	.470	.432	2.316
	QUAL_CONTENT	.404	.141	.384	2.854	.005	.351	2.849
	APPLICATION	-.061	.067	-.073	-.913	.363		

Results show that the tolerance, i.e. the degree by which the variables QUAL_SOFTWARE, QUAL_USE and QUAL_CONTENT is justified by the independent variables is 0.508, 0.432 and 0.351 respectively, values that indicate the non-existence of multicollinearity. The analysis of the VIF confirms that there is no multicollinearity among the variables.

According to the conceptual model, two multiple regression analyses were conducted, one for QUAL_USE and the other for ACCEPTANCE. The first one aims to understand which variable impacts the quality of the mobile application usage whereas the second aims to understand which variable affect the acceptance of this applications.

The relationship between an independent variable and a given dependent variable is often mediated by a third variable that carries the effect of the independent variable on the dependent variable (Maroco, 2007). In our model, only QUAL_USE could be considered as a mediator variable. Table 2 presents the MRL results concerning the estimated coefficients of the independent variables in the QUAL_USE and ACCEPTANCE models. Figure 6 presents the path diagram for all relationships in the model.

Figure 6 Path diagram with standardised estimated coefficients



Using a significance level of 5%, only QUAL_SOFTWARE and QUAL_CONTENT influence the acceptance of the telemedicine mobile applications (unstandardised regression coefficients of 0.230 and 0.404, respectively), verifying the hypotheses H3 and H4. Therefore, we can conclude that QUAL_USE does not mediate the relationships between the software and content quality and the application acceptance as the estimated coefficient of the relationship QUAL_USE-ACCEPTANCE is very weak and non-significant (H5 is not verified).

The variable APPLICATION was created to evaluate the relationship between the applications in this study and ACCEPTANCE, presenting a coefficient of -0.061 which indicates that this applications do not influence the choice of users regarding their levels of acceptance. Therefore, the hypothesis H6 is also not verified.

Analysing the model results globally (Figure 6), it is possible to proceed with the analysis of trajectories based on the decomposition of associations between variables and their effects between them:

- There are two direct effects on ACCEPTANCE. In fact, as previously mentioned, the quality of the applications as a software product and the content quality are the unique variables that influence the acceptance of this type of applications. R^2 value is 0.263, meaning that these two variables explain 26.3% of the variability of the application acceptance.
- There is no mediating effect of QUAL_USE, since the relationship between QUAL_USE on ACCEPTANCE is non-significant. However, results show that the quality of use is influenced by the quality of application content (standardized regression coefficient of 0.638), verifying H2.

- Quality of use and quality of software are highly positively correlated (0.699), meaning that the higher the quality of the application as a product software the higher the usage quality.
- There is no effect of the applications, so the acceptance of telemedicine mobile applications is not influenced by the application "owner".

In short, the model allows us to conclude that users consider accepting telemedicine applications considering the quality of the software but even more the quality of the content. The quality of use is also directly influenced by the quality of the content.

7 Conclusions

This study serves as an interesting starting point for a continuous improvement of this type of applications, based on the opinion and perspective of its users. It was possible to confirm that the analysed telemedicine applications are well accepted by users (90.3%), and with a satisfaction rate almost at its fullest (84.4%).

In relation to the specific objectives previously stated, it was possible to conclude that all were achieved, namely:

1. Assess the user acceptance rate of the Telemedicine applications.

Using the characteristics inherent in the TAR and TAM models of technology acceptance, we assessed the attributes that determine users' acceptance of the technology and, overall, these applications are accepted with relative ease, being considered easy to use (48.5%) and useful (62.2%). An acceptance rate of 90.3% was achieved for these applications.

2. Assess the quality of the Médis and Multicare applications based on the model defined by ISO 25010:2011 where the characteristics and sub-characteristics of product quality and quality of use of the product or system are identified.

Based on the inherent characteristics defined in ISO 25010:2011, the quality of the applications as software products was evaluated, concluding that in relation to functionality, efficiency, compatibility, usability, and reliability the respondents agree that the applications are able to meet all the conditions envisaged for these characteristics. It should be noted that for the security, the applications have the ability to protect all data linked to the profile and permission of each user without there being leaks or undue access.

Regarding the quality of use, users consider that these applications effectively and efficiently achieve the objectives they are intended to, and that the vast majority are fully satisfied with the ability of applications to meet user needs.

3. Evaluate the quality of the data and content of the application based on the characteristics, sub-characteristics and metrics defined by ISO 25012:2008

Regarding the quality of the content, it was highlighted that the applications correspond to what is expected by its users, considering the information to be accessible, up-to-date, reliable, contains the level of depth appropriate to the context in question and that it is real. It should be noted that most users consider that the information presented in the applications is not consistently comparable with other ways of accessing the same information.

4. Assess user satisfaction with the current state of Telemedicine applications as well as the functionalities currently available in both.

Regarding to satisfaction, a rate of 84.4% was achieved, which together with the acceptance rate of 90.3% demonstrates the potential for improvement in this type of application.

5. Propose improvements to be implemented in Telemedicine applications based on the users' opinion.

As a contribution to possible future implementations in telemedicine applications, respondents highlighted the need for a chat that allows contact with doctors, medical follow-up after consultations, suggestions for finding doctors in the area of residence, and warnings if preparation is required by part of the user for medical examinations (for example, fasting).

Users' acceptance of telemedicine applications is influenced by the quality of the application as a software product (β=0.243) and the quality of the content (β=0.384), verifying H3 and H4. The quality of use does not influence the application acceptance (H5 is not verified), therefore this factor does not mediate the former relationships. However, the quality of use is influenced by the quality of the application content (β=0.638), which supports H2, but not by the application quality as a product software (H1 is not supported). In short, users consider the quality of the content and software in telemedicine applications as the most relevant factors leading to their acceptance, considering that the better the quality of the content and software, the higher the application acceptance. There is no difference between Médis and Multicare application acceptance, as H6 is not verified.

The main limitation of the present study lies in the sample size, which did not allow us to obtain more data to further substantiate the results obtained. It is also necessary to emphasize that the study was conducted focusing on two telemedicine applications (Médis and Multicare) which, according to their respective Annual Report, are market share leaders, although there are other alternatives on the market that could be analysed in future research.

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