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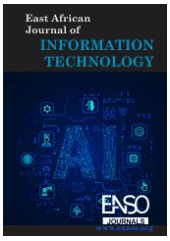

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Original Article

Assessment of the Influence of Contextual Issues in Evaluating eHealth Systems Usability in Tanzania

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ABSTRACT

The adoption of eHealth systems in healthcare facilities has rapidly increased in many countries. However, the main challenge has been the quality and level of usability of those adopted systems, and the complexity of the challenge varies from one country to another based on contextual issues. Usability is also linked to contextual issues, which have a direct impact on deciding the methods for providing services on similar systems. This research focuses on assessing the influence of contextual issues on metrics that are applicable for evaluating the usability of eHealth systems through a case study of Tanzania. The findings of this research were obtained through the quantitative method, and the analysis was performed through structural equation modelling (SEM) using AMOS and SPSS applications. It is evident from this research that contextual factors, such as user characteristics, goals and tasks, technical environment, physical environment, and resources and technology, significantly impact the usability metrics that are important to the evaluation of eHealth systems. The usability metrics for eHealth systems identified in this research include navigation visibility, accessibility, perceived ease of use, error correction, internal collaboration, information quality, external collaboration, technical quality, guide and support, and perceived benefits. This study also revealed that the usability evaluation of eHealth systems should consider both common metrics and specific metrics in order to uncover both general information system and health context-specific usability issues.

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INTRODUCTION

The trend in today's world shows that when users wish to purchase a digital facility or piece of equipment, such as a mobile phone, laptop, or iPad, they seriously check the ease and understand-ability of the tool's functionality to determine whether those tools can perform the required operations quickly and whether they are able to understand the icons on the interface easily without any help. This is to say, surely the users are focusing on the usability of the device to make a decision about whether it is worth purchasing and whether there is value for money. Therefore, usability has become an important parameter in the process of choosing and adopting digital solutions today [1].

The pace and trends at which digital technologies are being adopted and customized in the business world have been witnessed in the health sector, both in developed and developing countries. The adoption of eHealth systems in healthcare processes and transactions has rapidly increased in many countries while being almost complete in developed countries [2]. However, the level of its adoption is different from one country to another in those developing countries. This is caused by differences in many factors, such as economic level, illiteracy level, cultural and taboo practices, political willingness and commitment, and the context of healthcare environments, among others. While all those factors are important and influence the pace at which digital technologies are adopted in health service provision, this paper focuses on the "context of use" to assess the usability of adopted eHealth systems. In this paper, we have adopted the definition of the context of use as comprising a combination of a number of indicators, including user characteristics, goals, tasks, resources, and environmental contexts (i.e., technical, physical, and social environments), in which a system, product, or service is used [3]. Each indicator also has a set of characteristics that show how that indicator can influence the system's usability.

The user indicator of the context of use has characteristics that include the background of the individual person, such as level of education, experience, and computer literacy, among others. The context of use also depends on the goal that the system is expected to accomplish; thus, a similar system might perform differently depending on the specific goal that it is intended to accomplish. Additionally, the type of tasks and how such tasks are organized can differentiate the level of use of the system in different contexts. It is emphasized that resources and technologies (i.e., hardware and software, source of power, availability of the internet, etc.) could be very important factors that determine how well the system could be applied effectively and efficiently and satisfy the user [3]. Furthermore, it has also been observed that the physical environment, technical environment, and social environment can motivate or demotivate the smooth usability of the technology and, hence have an influence on how the goals of the organization are met.

Usability is the degree to which a system, product, or service can be used by specified users to accomplish a set of goals with effectiveness, efficiency, and satisfaction within a specified context of use [3]. According to [4], a system is usable if it is simple to learn and remember after a period of inactivity, efficient, has few errors, is recoverable, and the user is satisfied. For the purpose of this study, usability is defined as the degree to which the user admires using the system due to its simplicity and capability of accomplishing the intended task and goals efficiently with tolerable errors. This means the term "eHealth usability" in this study context

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refers to the ability of healthcare providers and other stakeholders in the healthcare industry to apply the eHealth system to achieve the goal without experiencing difficulties while maintaining efficiency and data integrity. The usability of eHealth systems, like other systems, is measured by using metrics that can reveal the weaknesses of the systems that hinder their applicability.

The usability of a system, therefore, depends on the proper identification of the context in which the system is going to be used, as further presented in this paper and also discussed with different views by Broekhuis et al. [5]. Thus, the context of use, if not considered in the early stages of the life cycle of an eHealth system, might lead to different aspects of such systems. Hence, system developers need to thoroughly consider the context of use and all indicators that affect directly and indirectly the usability of the system. Of all the indicators of the context of use, the user indicator is the primary one, and its consideration should get more weight than others while designing and developing eHealth systems. This is the reason why user-centred design (UCD) approaches and processes have become one of the main methods for developing eHealth systems. The UCD method enables the developer to conduct research to collect insights on the contexts in which the system will be used [5].

While at the designing and developing stage of the eHealth system, consideration of the context of use is important; it should also be possible to assess the usability of eHealth systems from time to time. In a time-based assessment of the usability of an eHealth system, the influence of contextual issues is again a necessary consideration. This is because there might be changes in contexts such as user knowledge, experience, and technological changes [3]. This paper assesses the influence of contextual issues on the usability of eHealth systems in the case of health provision in the United Republic of Tanzania. The motive for doing such a study is to measure the association between the usability metrics and the contextual issues to help the evaluators of the eHealth systems identify the important contexts to consider during the evaluation process. The locally made eHealth system owned by the government of Tanzania, known as the Government of Tanzania Hospital Management Information System (GoTHOMIS), was used by this study as a platform for data collection, whereas its users were the major participants.

USABILITY EVALUATION OF EHEALTH SYSTEMS

Usability evaluation is an important part of today's system development process and system acceptance probability since it is a crucial prerequisite for improving the serviceability of the respective systems. Usability evaluations can save money, time, and effort if introduced correctly and at the right time. The chance of being accepted right away is high. The basic aim of usability evaluation is to improve the usability of products. Through usability evaluation, possible weaknesses regarding a system's usability with the involvement of actual users can be identified. Usability evaluation involves presenting the users with some tasks that are reflective of future system use. The results of a usability evaluation can be represented in different ways, such as error rates, time taken to complete the task, and the number of usability problems found. Usability evaluation is generally carried out in usability laboratories (in vitro), but in some cases, it can be carried out in the field (in situ) [6], [7].

This study examined the impact of contextual issues on usability metrics as well as the impact of both usability metrics and contextual issues on the usability of eHealth systems. The results showed that contextual issues have a great impact on determining the usability metrics that are required for evaluating the usability of eHealth systems. Moreover, the impact of common metrics on the usability of eHealth is significant only when they are combined with specific metrics.

Usability Metrics

Usable systems have a great deal of potential to deliver substantial benefits to their intended businesses and users. A system with good

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usability is one that allows people or machine users to complete their tasks easily, quickly, and without frustration; therefore, the system will save time and money for businesses and allow business goals to be met efficiently. For a meaningful evaluation of usability, there is a need to establish metrics. In the literature, usability metrics have been referred to as criteria that are used to measure the serviceability of a system in many dimensions, including effectiveness, efficiency, and satisfaction, which are also referred to as common metrics in this research [8]. Other common usability metrics are learnability, memorability, and error correction [4]. Each of these metrics focuses on different aspects of usability and hence stresses the fact that the set of these metrics might differ from one type of system to another as well as between different users. In this study, we define these metrics as follows:

- Learnability measures how quickly and effortlessly a new user can complete activities after becoming acquainted with the system.
- Efficiency is a metric that measures how quickly a skilled user completes a task.
- Memorability: a metric that covers the measurement of a user's ability to remember with ease the use of a system after some time.
- Error correction: a metric that covers the frequency with which users make errors, how significant the errors are, and how easy it is for users to recover from such errors.
- Satisfaction is the usability metric that is used to measure the user's enthusiasm for or appreciation for the system.
- Effectiveness: A metric that covers the measurement of the ability of the user to achieve a specified goal accurately and completely. Accurate here means that the goal achieved through a system is equivalent to the intended goal.

Therefore, a highly usable software system is much easier for users to learn than one for which usability was not a high priority during the development stage of the said system. Users learn features more quickly and retain their knowledge longer in systems with good usability, which directly correlates to decreased training costs and time.

Contextual Issues and eHealth Usability Evaluation

The evaluation of the usability of a system involves testing the system for its expected serviceability. Usability testing and evaluation may be performed in a natural (field) or artificial (laboratory) environment, here referred to as the context of the system. The environment in which the testing and evaluation are carried out here referred to as contextual issues, affects the result of the usability evaluation. Issues related to the context of use are fundamental in determining and assessing the usability of an eHealth system. This is because any change that may occur in the context of use will definitely affect the usability of a particular system [6] [3]. However, many developers of eHealth systems frequently ignore the context of use aspects [9]. Tiihonen et al. in [10] recommended that in developing countries, where there are limited resources and the contextual issues are quite different from Western culture, for effectiveness purposes, the local needs and the social-technical context of the eHealth systems must be considered. This will enhance the developers' ability to design systems that are familiar to the users and can cope with the available resources.

The usability evaluation of information systems cannot rely on the technical perspective alone, such as the quality of the interface, etc. Rather, there are many aspects of context that should be considered vital during the evaluation process, including the users' characteristics, the environment, culture, technology, knowledge, and nature of the tasks [11], [12]. Thus, the same system can be perceived with different usability levels depending on the context of use. For example, the study conducted by Kaikkonen et al. in [13] on testing mobile consumer applications in two different environments revealed a significant difference in the results obtained from the two

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locations. Besides, as the users change their characteristics (for example, by adding skills), there will be changes in their eHealth system usability level. Also, the combination of the different activities may lead to a different level of usability.

It can be argued that most systems that fail are due to a gap between the system's design and real contextual issues. This is even more challenging for developing countries, as in most cases, the acquisition of information systems is through the purchase or borrowing of the system or even its designs from abroad, without considering context issues of the local environment, such as historical and cultural aspects, infrastructure, people, and economic and government structures. A study by [9] on assessing the implementation of the Electronic Medical Records (EMR) system at the Kilimanjaro Christian Medical Centre (KCMC) in Tanzania showed that one of the reasons for the failure of the EMR implementation at KCMC was the ignoring of the users' context. An example of such a mismatch is naming locations like "state province" (in the American context), which does not exist in the Tanzanian context, instead of "region." Therefore, in this study, we argue that context issues are crucial factors in evaluating the usability of any system. A number of context-specific issues affecting health systems that are applicable during the process of interaction, such as the user's characteristics, goals and tasks, resources and technology, and environment (physical and technical), are identified in this article.

Proposed set of Usability Metrics for eHealth systems evaluation

The source of the usability metrics and the contextual issues that are applied in this study are the results of the literature review that led to the combination of two frameworks, including Fit between Individuals, Tasks, Technology, and Environment (FITTE) and ISO 9241-11:2018. Both frameworks contemplate contextual issues such as user characteristics, tasks, technology, and environments. Moreover, specifically, FITTE was selected due to its ability to show the relationships between the contextual issues. For example, between an individual (user characteristics) and technology, between tasks and technology, and between the environment and all other contexts [14]. ISO 9241-11:2018 provides the common usability metrics that are used in evaluating generic systems, including efficiency, effectiveness, satisfaction, accessibility, and avoidance of harm (similar to error prevention) [3]. Furthermore, various pieces of literature were reviewed to acquire more specific usability metrics that are mostly applied to evaluating the usability of eHealth systems.

Thus, for this study, the usability metrics for evaluating eHealth systems are divided into two categories: common and specific metrics. The common usability metrics are those that have been used to evaluate generic systems, products, and services. Specific usability metrics are those that are mostly applied in evaluating eHealth systems. The common usability metrics include navigation, accessibility, visibility, and perceived ease of use.

Navigation is aimed at measuring how easy it is to understand how to move from one page (or screen) to another, has a consistent layout, and has the correct links to the correct tasks. The system should make it easy to access information and enter data without taking away the attention of the user (in this case, a doctor) from the patient during the diagnosis. Visibility is the common metric that is used in assessing whether the icons, pictures, and fonts are clear, readable, and attractive [15]. Also, the system should be easy to use in terms of being easy to learn at first and easy to remember when the user has not used it for a while.

The specific metrics include collaboration, information quality and terminologies, technical qualities, guidance and support, and perceived benefits of the system. Additionally, although the metric error correction has been used in evaluating generic information systems and thus can be categorized as a common usability metric, this study revealed that it has more impact in evaluating the usability of eHealth systems when it is grouped with other specific metrics than when it is grouped with other common metrics.

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Therefore, this study has categorized error correction as the specific metric for evaluating eHealth systems.

The error correction metric measures the ability of a system to cancel the process, undo the action, avoid duplicates, and provide alerts and warnings to prevent errors from occurring. Information quality and terminologies are the specific metrics for evaluating eHealth systems that are used to assess the quality of the information in the system, such as laboratory results, patients' medication lists, the ability to generate a summary of the patient's health status, clear and understood medical terminologies, etc. The technical quality metric deals with the suitability of the technical functionality (no downtimes) and the ability of the system to retain data. Collaboration metrics (both internal and external) assess the ability of the system to allow interaction within and without health facility stakeholders. Internal collaboration measures the ability of the system to allow interaction between healthcare professionals and inter-department interaction, while external collaboration assesses the ability of the system to allow external stakeholders, such as the government, to access the statistical data, interaction with outside stakeholders such as suppliers, and interaction with other health facilities, for example, on referral cases. Guide and support are the metrics used to assess how the system provides enough instructions to accomplish the tasks accurately and has the ability to notify users when a current task is taking place, such as saving data, sending or delivering messages, and updating [16]. The metric named benefits assess how the system improves the quality of care. *Table 1* presents the usability metrics constructs corresponding to their measurement indicators, with the codes per indicator as used in the analysis.

Proposed Set of Contextual Issues for eHealth Systems Usability Evaluation

Contextual issues are the constructs that are used to describe which system is to be used, for whom the system should be designed, what will be used, and where it will be used [11]. Based on these questions, the consideration of the context of use in evaluating the usability of a system is inevitable, as it is a vital link between the usability metrics and the usability of the system. Therefore, although there are several usability metrics that exist in the literature that could be used to evaluate eHealth systems, the evaluators need to know exactly the contexts in which the system is used so as to identify the appropriate usability metrics for evaluation.

Contextual issues in usability evaluation include user characteristics, physical environments, technical environments, resources and technology, and goals and tasks [3] [14]. The user characteristics evaluate the experience of the user, computer literacy, and training the user has received on the current system. Goals and tasks assess the ability of the user to perform healthcare tasks and the organization of the tasks in the system. Resources and technologies concentrate on assessing the quality of hardware and software, the availability of supporting personnel, etc.; the technical environment assesses the availability of sufficient computers; the availability of internet and electricity; and the physical environment deals with the availability of sufficient space for working with the system smoothly; and the safety of the environment in using the system. The contextual issue constructs corresponding to their measurement indicators are further presented in detail in *Table 2*.

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Table 1: Usability metrics and Measurement indicators

Common Usability Metrics		
Constructs	**Code**	**Measurement indicators**
Navigation (NAVIG)	NAV1	Ability to "go back" to the previous screen
	NAV2	Easy to go to the next screen
	NAV3	Ability to predict the following procedure
	NAV4	The consistency of the system's layout from screen to screen.
	NAV5	No need to stop and think about which icon to click
	NAV6	Correct icon or link to navigate to correct task
Perceived ease of use (PEOU)	PEOU3	Ease to learn
	PEOU4	Ease to remember
	PEOU5	Ease to cope with the system skillfully.
	PEOU6	Simplifying data entry exercise
Visibility (VISIB)	V1	Pictures, icons, texts, and links on the screen are visible
	V2	The interface of eHealth is attractive.
	V3	The fonts (style, colour) are easy to read on-screen.
Accessibility (ACCESS)	ACC1	eHealth system supports diverse users to accomplish tasks
	ACC2	Ability to serve patients easily while entering data into the system
	ACC3	The ability to use the system without taking away attention from the patient
Specific eHealth Usability Metrics		
Error Correction (ERROR)	EC1	Reminders, alerts, and warnings to avoid errors
	EC2	Ability to cancel the process prior to completion
	EC3	Default values to select and check for validity
	EC4	Ability to undo action to avoid errors
	EC5	Popup message to understand what is going on
	EC6	Ability to avoid duplicate tests and examinations
	EC7	Recover easily from errors and mistakes.
External Collaboration	EXTCOL1	The eHealth system allows government authorities to access the statistical data and influence its usability.
	EXTCOL2	The system allows interaction with other health facilities.
	EXTCOL3	The information on medications ordered in other organizations
	EXTCOL4	I can obtain patients' information from other health facilities quickly.
	EXTCOL5	The system supports cooperation and communication between doctors working in different health facilities.
Internal Collaboration	INT COL6	The system supports cooperation and communication between healthcare multi-professionals
	INT COL7	I can work together with other members (other health professionals) from other departments through the eHealth system.
	INT COL8	The work of one user does not interrupt the work of another user in the system.
Benefits	BEN1	The systems help to improve the quality of care
	BEN2	The system helps to ensure continuity of care.
	BEN3	The system provides information about the need for and effectiveness of treatment of the patients.
Technical Quality	TQ1	The system is stable in terms of technical functionality (does not crash, no downtime)
	TQ2	The system has never caused serious adverse events to the patient's safety/health.
	TQ3	The system responds quickly to inputs.
	TQ4	Information entered/documented never disappears from the system.
	TQ5	There is quick help whenever the problem occurs.

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Common Usability Metrics		
Constructs	**Code**	**Measurement indicators**
Information Quality and Terminologies	IQ1	The laboratory and diagnostic imaging results are easily available and logically presented.
	IQ2	The patient's medication list is presented in a clear format.
	IQ3	eHealth system generates a summary view that helps to develop an overall picture of the patient's health status
	IQ4	Terminologies on the screen are clear and understandable (e.g., titles and labels)
	IQ5	Patients' data are comprehensive, up-to-date, and reliable.
Guide and support	GF1	The system provides sufficient information about the patients' progress.
	GF2	The system provides enough information and instructions to help accomplish tasks accurately.
	GF3	The system monitors and notifies when the orders given to nurses have been completed.
	GF4	The system clearly informs about what it does (e.g., saving data, message delivery, data updated, etc.)

Table 2: Contextual issues

Contextual Issues		
Constructs	**Code**	**Measurement indicators**
Users' Characteristics (USERCHAR)	UC1	The contribution of the previous experience to the current system's usability
	UC2	The contribution of trainings on the usability of the eHealth system
	UC3	The contribution of the knowledge of computers in using the eHealth system
Goals and Tasks (GOALS)	GT2	Routine tasks are performed in a straightforward manner without the need for extra steps.
	GT3	The tasks are well organized in the system to allow smooth recording and retrieving of information.
	GT4	Ability to perform healthcare tasks easily compared to manual system
Resources and Technology (RESTEC)	RT1	The quality of the hardware and software is good enough to influence the usability of an eHealth system.
	RT2	The information is relevant and well understood (use of common language to the user)
	RT3	There is a system-support-personnel to solve the problem with the system.
Physical Environment (PHYSENV	EP1	The office has enough space to work with the computer system
	EP2	The working environment is safe to protect the users' physical, legal, confidentiality, and property.
	EP3	There is enough space, safety and comfort for working with the system.
Technical Environment (TECHENV)	TE1	The health facility has enough computers
	TE3	The speed of the computers available is good enough to accomplish the tasks quickly.
	TE4	There is no high frequency of internet outage (internet problem)
	TE5	The eHealth system allows working offline (without internet)

ASSESSMENT OF THE INFLUENCE OF CONTEXTUAL ISSUES ON EHEALTH SYSTEMS

In this section, we address the question of how contextual issues influence the usability of eHealth systems using a quantitative method, whereas a survey was conducted at six health facilities in Tanzania, comprising three levels of health facilities, including 1 regional referral hospital, 3 district hospitals, and 2 health centres. The analysis was performed through structural

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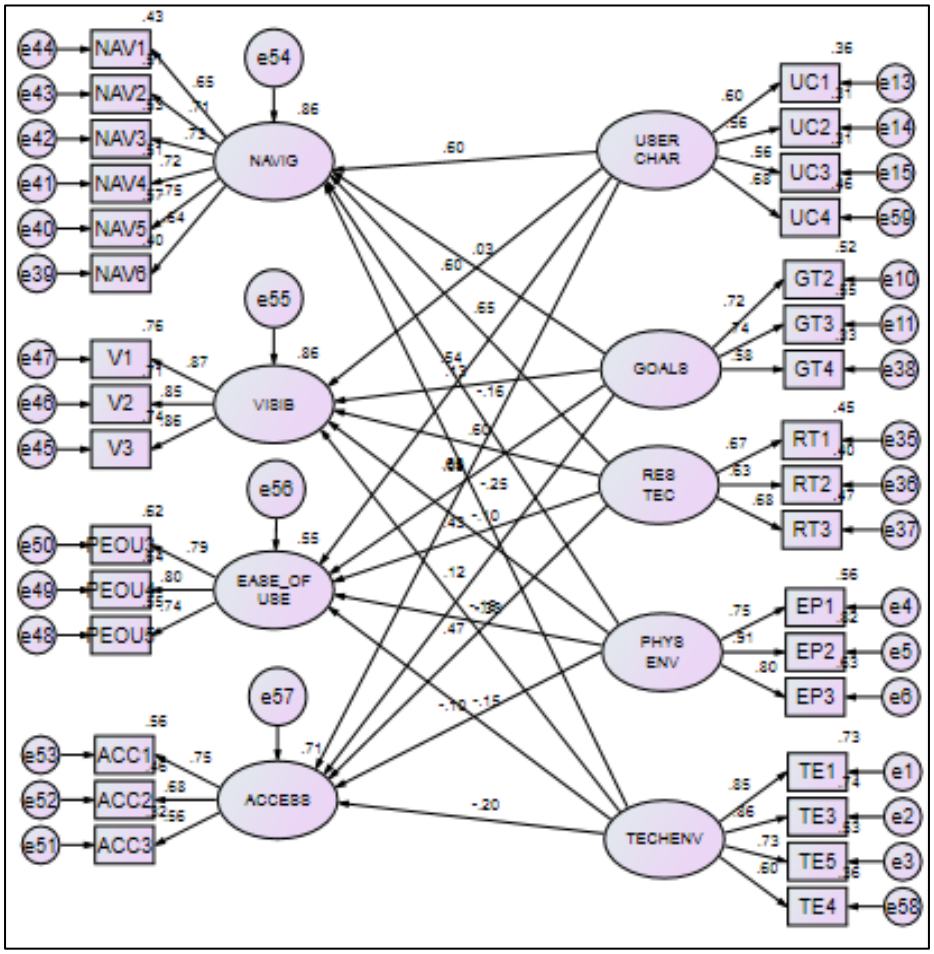
equation modeling (SEM) using AMOS and SPSS applications. To answer this question, first, we present the influence of contextual issues on the metrics that are used to evaluate eHealth systems. The purpose of testing for the influence of contextual issues is to determine how contextual issues can decide which metrics are to be applied in evaluating the usability of eHealth systems based on the contexts in which they operate. Secondly, in this section, we present the influence of both contextual issues and usability metrics on the overall usability of an eHealth system. Moreover, the testing of the influence of contextual issues on the usability metrics is performed by separating the common metrics from the specific metrics in order to determine their contributions to the evaluation of eHealth systems.

Each construct of the contextual issues was tested with all usability metrics constructs to find whether it has a significant influence on any aspect of usability metrics. The contextual aspects are labelled as USERCHAR to represent the user characteristics, GOALS for goals and tasks, RESTEC for resources and technology, PHYSENV for the physical environment, and TECHENV for the technical environment, as presented in *Table 2*.

The Influence of Contextual Issues on Common Usability Metrics

The constructs for common usability metrics are labelled as NAVIG for navigation, PEOU for perceived ease of use, VISB for visibility, ACCESS for accessibility, and ERROR for error correction, as presented in *Table 1*. *Figure 1* illustrates the path analysis diagram of the relationships between the contextual issues and the common usability metrics. The relationship between the contextual issues and the usability metrics is considered statistically significant if the p-value is ≤ 0.05 and the critical ratio (C.R.) value is ≤ -196 or C.R. ≥ +1.9 [17].

Figure 1: The influence of the context of use on the common usability metrics



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The results express that all contexts of use have a statistically significant influence on one or many usability metrics. Thus, of all the relationships tested, only 3 were not statistically significant, as their p values are greater than 0.05 (P >.05) and their C.R. values are less than 1.96 (P < 1.96). These relationships are between the goals and tasks and navigation (GOALS ---> NAVIG), which resulted in a P =.489 and a C.R = 0.691; between the goals and tasks and ease of use (GOALS ---> EASE_OF_USE), which has a P =.052 and a C.R = 1.942; and between the physical environment and accessibility (PHYS_ENV ---> ACCESS), which has a P =.053 and a C.R = 1.935.

Table 3: The influence of the context of use on the common usability metrics

Endogenous		Exogenous	Estimate	S.E.	C.R.	P	Significance	Hypothesis supported
NAVIG	←	USERCHAR	0.767	0.094	8.181	***	Significant	Yes
VISIB	←	GOALS	0.148	0.051	2.899	0.004	Significant	Yes
EASEOFUSE	←	RESTEC	0.419	0.052	8.07	***	Significant	Yes
ACCESS	←	TECHENV	-0.103	0.029	-3.591	***	Significant	Yes
ACCESS	←	RES_TEC	0.344	0.053	6.44	***	Significant	Yes
VISIB	←	RES_TEC	0.622	0.06	10.305	***	Significant	Yes
NAVIG	←	RES_TEC	0.58	0.065	8.902	***	Significant	Yes
VISIB	←	USER_CHAR	0.891	0.093	9.548	***	Significant	Yes
EASE_OF_USE	←	USER_CHAR	0.755	0.085	8.871	***	Significant	Yes
ACCESS	←	USER_CHAR	0.679	0.094	7.233	***	Significant	Yes
ACCESS	←	GOALS	0.103	0.049	2.128	0.033	Significant	Yes
NAVIG	←	GOALS	0.032	0.046	0.691	0.489	Not	No
NAVIG	←	PHYS_ENV	-0.145	0.039	-3.745	***	Significant	Yes
EASE_OF_USE	←	PHYS_ENV	-0.191	0.043	-4.416	***	Significant	Yes
EASE_OF_USE	←	TECHENV	-0.107	0.03	-3.524	***	Significant	Yes
VISIB	←	TECHENV	-0.246	0.03	-8.075	***	Significant	Yes
NAVIG	←	TECHENV	-0.158	0.029	-5.492	***	Significant	Yes
EASE_OF_USE	←	GOALS	0.103	0.053	1.942	0.052	Not	No
VISIB	←	PHYS_ENV	-0.101	0.041	-2.48	0.013	Significant	Yes
ACCESS	←	PHYS_ENV	-0.075	0.039	-1.935	0.053	Not	No

These findings reveal that user characteristics, resources and technology, and the technical environment are the vital contextual issues that determine all common usability metrics that could be used to evaluate the usability of eHealth systems. This means that if users have previous experience with similar systems, are well-trained, and have computer knowledge, they will be able to access the system, navigate from one screen of the system to another, and use the system easily. The results, on the other hand, show that the context-named goals and tasks have no effect on the ability to navigate within the system or the ease of use of the system. Moreover, the results also show that the physical environment has no influence on the accessibility of the system or the information within it. In conclusion, the majority (82.3%) of the relationships between contextual issues and the common usability metrics have statistical significance, showing that the contextual issues have an impact on the common metrics for evaluating eHealth systems.

The Influence of Contextual Issues on the Specific Usability Metric

Each construct of the context was tested to find whether it has a significant influence on any construct of the specific eHealth usability metric. The aim of this test was to identify how contextual issues affect the usability metrics. For example, how can the users' characteristics (previous experience, formal training, and computer literacy) influence their ability to reduce or cause errors in a system? How do they increase the internal collaboration among users? How do they influence the collaboration with other external stakeholders? Additionally, do the user's characteristics have any influence on the guide and support provided in the use of the system? How does it influence the perception of the users

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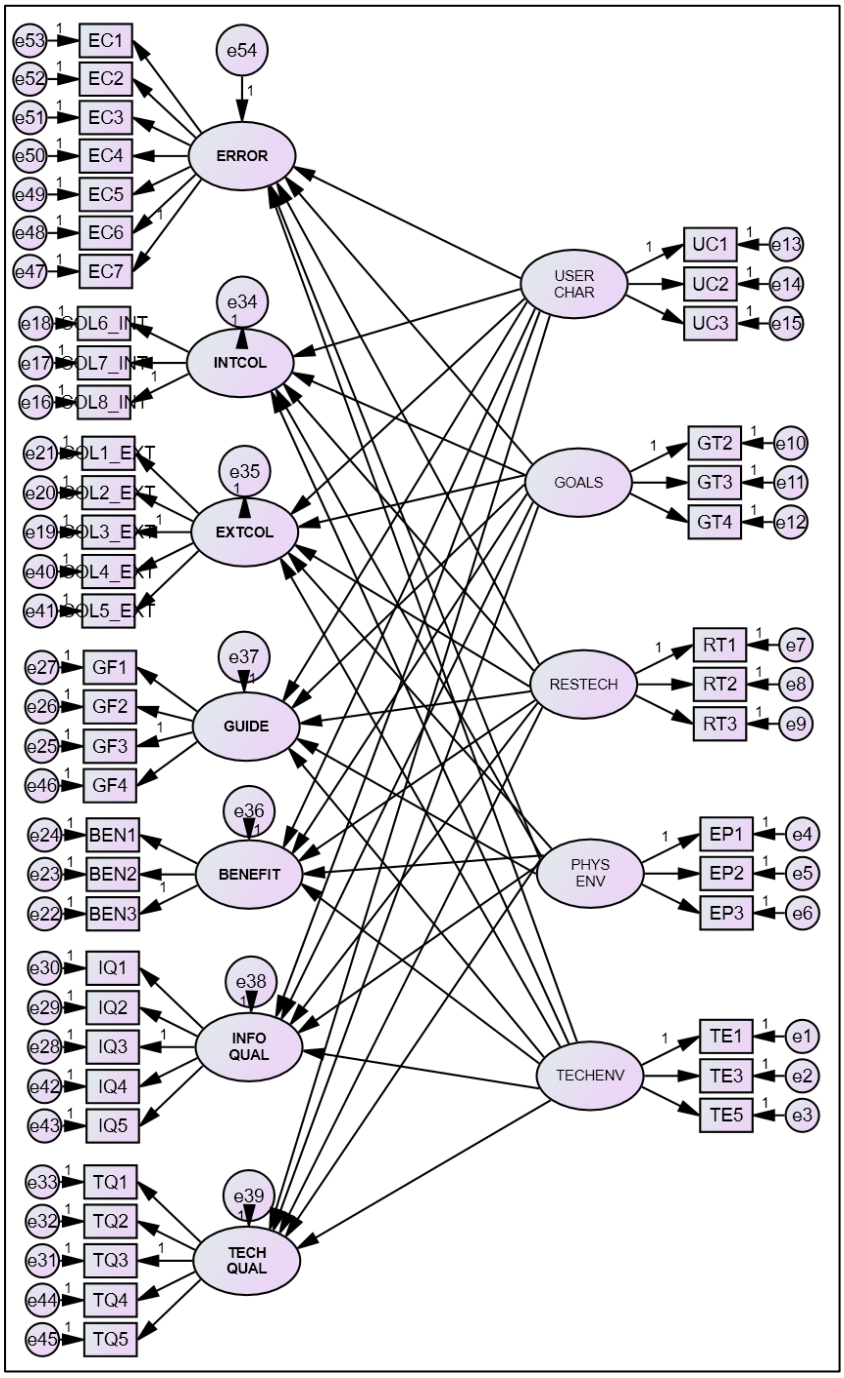
about the benefits of using the system? How do user characteristics influence the quality of information in the system and the quality of the technical issues of the system? Likewise, other contextual issues are also tested to determine whether there is any statistically significant influence on the specific usability metrics.

Figure 2: The influence of the context of use on the specific usability metric



The specific metrics include error correction (ERROR), internal collaboration (INTCOL), external collaboration (EXTCOL), guide and support (GUIDE), perceived benefits (BENEFIT), information quality (INFOQUAL), and technical quality (TECHQUAL). Each construct of the specific metrics and construct of contexts contains the measurement indicators that have already been proven to fit in the model. The results of the relationships between the contextual issues and the specific eHealth usability metrics are illustrated using the path diagram in *Figure 2*. The

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level of significance is concluded based on the P-value and the critical ratio (C.R.), and the hypotheses are either supported or not supported depending on whether the results are significant or not, as presented in *Table 4.*

Table 4: The influence of the context of use on the specific usability metrics

Endogenous		Exogenous	Estimate	S.E.	C.R.	P	Significance	Hypothesis supported
ERROR	<---	USERCHAR	-.487	.079	-6.192	***	Significant	Yes
EXTCOL	<---	RESTECH	.185	.047	3.908	***	Significant	Yes
GUIDE	<---	PHYS_ENV	-.018	.037	-.501	.617	Not	No
BENEFIT	<---	TECHENV	-.197	.029	-6.806	***	Significant	Yes
INTCOL	<---	USERCHAR	.363	.067	5.389	***	Significant	Yes
EXTCOL	<---	USERCHAR	-.025	.062	-.408	.683	Not	No
GUIDE	<---	USERCHAR	.245	.060	4.066	***	Significant	Yes
BENEFIT	<---	USERCHAR	.294	.061	4.865	***	Significant	Yes
INFO_QUAL	<---	USERCHAR	.120	.041	2.923	.003	Significant	Yes
TECH_QUAL	<---	USERCHAR	.198	.062	3.216	.001	Significant	Yes
ERROR	<---	GOALS	1.688	.175	9.652	***	Significant	Yes
INTCOL	<---	GOALS	.270	.067	4.001	***	Significant	Yes
EXTCOL	<---	GOALS	.148	.068	2.156	.031	Significant	Yes
GUIDE	<---	GOALS	.504	.082	6.114	***	Significant	Yes
BENEFIT	<---	GOALS	.515	.082	6.301	***	Significant	Yes
INFO_QUAL	<---	GOALS	.362	.068	5.354	***	Significant	Yes
TECH_QUAL	<---	GOALS	.705	.099	7.121	***	Significant	Yes
ERROR	<---	RESTECH	.004	.050	.073	.941	Not	No
INTCOL	<---	RESTECH	.130	.043	3.049	.002	Significant	Yes
GUIDE	<---	RESTECH	.564	.068	8.347	***	Significant	Yes
BENEFIT	<---	RESTECH	.508	.063	8.086	***	Significant	Yes
INFO_QUAL	<---	RESTECH	.444	.066	6.689	***	Significant	Yes
TECH_QUAL	<---	RESTECH	.560	.066	8.467	***	Significant	Yes
ERROR	<---	PHYS_ENV	-.050	.045	-1.109	.268	Not	No
ERROR	<---	TECHENV	-.036	.031	-1.184	.237	Not	No
EXTCOL	<---	PHYSENV	-.026	.042	-.610	.542	Not	No
INTCOL	<---	PHYSENV	.319	.046	6.885	***	Significant	Yes
BENEFIT	<---	PHYSENV	-.074	.035	-2.092	.036	Significant	Yes
INFO_QUAL	<---	PHYSENV	-.041	.026	-1.604	.109	Not	No
TECH_QUAL	<---	PHYSENV	.008	.040	.198	.843	Not	No
TECH_QUAL	<---	TECHENV	-.159	.029	-5.419	***	Significant	Yes
INFO_QUAL	<---	TECHENV	-.138	.024	-5.643	***	Significant	Yes
GUIDE	<---	TECHENV	-.136	.027	-4.941	***	Significant	Yes
EXTCOL	<---	TECHENV	.072	.029	2.451	.014	Significant	Yes
INTCOL	<---	TECHENV	.058	.027	2.196	.028	Significant	Yes

The results express that, out of 35 measured relationships between 5 constructs of the contextual issues and 7 specific usability metrics (i.e., 5 x 7 = 35), only 8 tests of the relationships failed to give statistical significance. These include the physical environment (PHYSENV) against guide and support (PHYSENV-->GUIDE), error correction (PHYSENV-->ERROR), external collaboration (PHYSENV-->EXTCOL), information quality (PHYSENV-->INFOQUAL), and technical quality (PHYSENV-->TECHQUAL). Other

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relationships that were statistically not significant were between user characteristics and external collaboration (USERCHAR->EXTCOL), resources and technology against error correction (RESTEC->ERROR), and the technical environment against error correction (TECHENV->ERROR). On the other hand, the remaining 27 relationships were statistically significant.

These results imply that there is no relationship between the physical environment and the guide and support provided to the users of the system; no relationship with the ability of the system to prevent the occurrence of errors; no relationship with the external collaboration; no relationship with the quality of information (i.e., the physical environment does not determine or influence the quality of information); and no relationship with the technical quality. Additionally, the results imply that the context user's characteristics do not influence the ability of the eHealth system to facilitate external collaboration. Moreover, the ability of the system to prevent the occurrence of errors is not influenced by the context's resources and technology or the context's technical environment.

Despite a few relationship tests that failed to give statistical significance to the influence of contextual issues on the specific usability metrics, the majority (77.1%) of relationships tested were statistically significant. This demonstrates that contextual issues have a significant impact on the specific usability metrics required to evaluate the usability of eHealth systems. In this regard, this research underscores the importance of considering contextual issues when evaluating the usability of eHealth systems. As a result, the contextual issues must also be known during the design process in order to create a system that meets the requirements and, hence, reduces the usability problems.

The Influence of the Usability Metrics and Contexts on the eHealth System's Usability

After testing the significance of the contextual issues in determining the usability metrics that are applicable in evaluating the usability of eHealth, this study tested the impact of the metrics and contextual issues on the eHealth system. The first attempt was to measure the impact of the usability metrics separately (i.e., common and specific metrics). Secondly, we tested the impact of usability metrics jointly against eHealth usability. The results of the first attempt are illustrated diagrammatically in *Figure 4*, and the summary of the findings is presented in *Table 1*.

Figure 3: Common and specific metrics and contexts vs. eHealth system

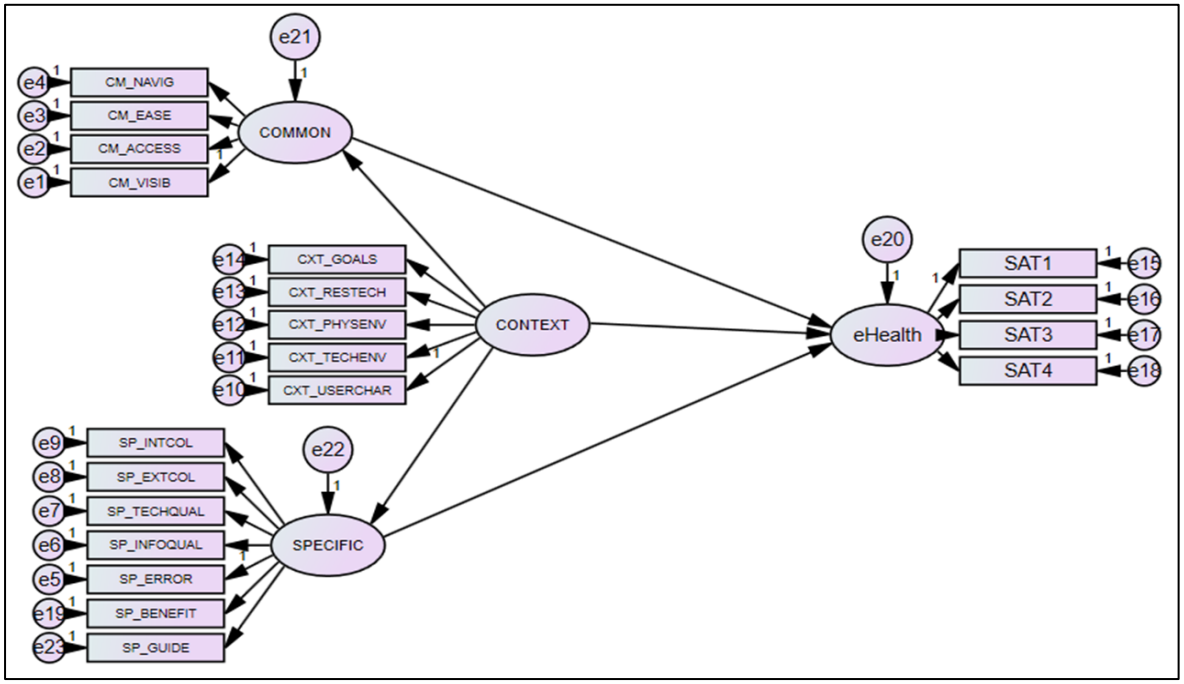

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Table 6: Influence of Metrics and Contexts on eHealth Systems

Relationships			P	Significance	Hypotheses support
COMMON	<--	CONTEXT	***	Significant	YES
SPECIFIC	<--	CONTEXT	***	Significant	YES
eHealth	<--	SPECIFIC	.002	Significant	YES
eHealth	<--	COMMON	.081	NOT	NO
eHealth	<--	CONTEXT	.622	NOT	NO

The results of the analysis showed that when the common metrics and specific metrics were tested separately, their contribution to evaluating the eHealth system's usability was statistically insignificant. Moreover, the contextual issues were also statistically insignificant in assessing the usability of eHealth systems when the common and specific metrics were separate. On the other hand, the contextual issues in general are statistically significant for both common and specific metrics when they are separately presented in *Table 1*. These results show that common metrics alone cannot reveal the usability issues of eHealth systems, while specific metrics can alone reveal the usability issues of eHealth systems. However, the previous literature expressed that, since the eHealth system is also an information system, the common IS issues must also be evaluated; therefore, we cannot ignore the involvement of the common metrics in evaluating the eHealth systems.

The second attempt was about testing the contribution of the usability metrics and contextual issues against the eHealth system's usability when both common and specific metrics are joined. The results of the analysis, as illustrated in *Figure 4* and presented in summary in *Table 4*, showed statistical significance for both usability metrics and contextual issues in the eHealth system. Moreover, contextual issues maintain their statistical significance in influencing usability metrics when these metrics (i.e., common and specific) are joined together.

Figure 4: Combined Usability Metrics and Contexts vs. eHealth System

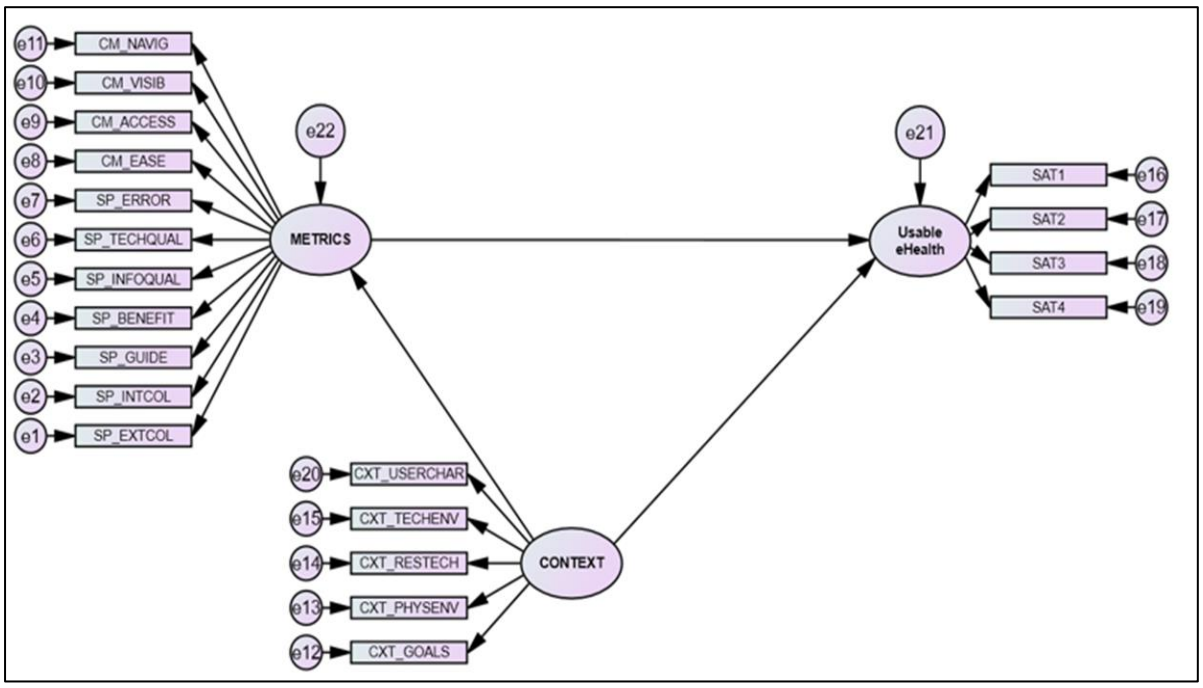

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Table 7: Influence of combined metrics and context on eHealth System's Usability

Relationships			P	Significance	Hypothesis support
METRICS	<---	CONTEXT	***	Significant	YES
Usable_eHealth	<---	CONTEXT	.007	Significant	YES
Usable_eHealth	<---	METRICS	***	Significant	YES

These results confirm that the common metrics significantly contribute to the usability of eHealth systems only when combined with specific metrics. Additionally, the power of contextual issues is revealed when both common and specific metrics are joined in evaluating the eHealth systems' usability. Thus, this study argues that, in order to evaluate the usability of eHealth systems, one should combine common metrics, specific metrics, and contextual issues, as revealed in this study.

CONCLUSION

This study has proven that contextual issues are influencing the usability metrics for evaluating the usability of eHealth systems. However, the context and physical environment have been found to have less influence on usability metrics. Additionally, the study has also found that the contribution of common usability metrics in evaluating eHealth systems is significant only when they are combined with the specific eHealth usability metrics. Based on the results of this research, we recommend further studies be conducted in the field of the usability of the eHealth system and develop a context-specific framework for evaluating the usability of the eHealth systems that will fit Tanzania and other countries with similar contexts.

REFERENCES

[1] F. Ranzani and O. Parlangeli, "Digital Technology and Usability and Ergonomics of Medical Devices," in *Textbook of Patient Safety and Clinical Risk Management [Internet].*, Italy, Springer, 2020, pp. 455-464.

[2] F. Alanezi, "Factors affecting the adoption of e-health system in the Kingdom of Saudi Arabia," *International Health*, vol. 13, p. 456–470, 2020.

[3] ISO, "ISO-9241-11: Usability: Definitions and concepts," ISO, Geneva, 2018.

[4] M. Niranjanamurthy, N. Archikam, G. Himaja and P. K. Shetty, "Research Study on Importance of Usability Testing/ User Experience (UX) Testing," *International Journal of Computer Science*, vol. 3, no. 10, pp. 78 - 85, 2014.

[5] M. Broekhuis, L. Velsen and H. Hermens, "Assessing usability of eHealth technology: A comparison of usability benchmarking instruments," *International Journal of Medical Informatics*, vol. 128, pp. 24-32, 2019.

[6] M. C. Trivedi and M. A. Khanum, "Role of context in usability evaluations: A review," *Advanced Computing: An International Journal (ACIJ)*, vol. 3, no. 2, pp. 69-78, 2012.

[7] F. Nayebi, J.-M. Desharnais and A. Abran, "The State of the Art of Mobile Application Usability Evaluation," in *25th IEEE Canadian Conference on Electrical and Computer Engineering*, Montreal, 2012.

[8] N. Bevan, J. Carter, J. Earthy, T. Geis and S. Harker, "New ISO Standards for Usability, Usability Reports and Usability Measures," in *International Conference on Human-Computer Interaction*, Switzerland, 2016.

Article DOI: https://doi.org/10.37284/eajit.6.1.1442

[9] J. S. Mtebe and R. Nakaka, "Assessing Electronic Medical Record System Implementation at Kilimanjaro Christian Medical Center, Tanzania," *Journal of Health Informatics in Developing Countries*, pp. 1-16, 2018.

[10 T. Tiihonen, M. Vesisenaho and E. Sutinen, "Concept on Context: IS Meeting Context in Developing Countries," in *Technology for Innovation and Education in Developing Countries*, 2008.

[11 M. Maguire, "Context of Use within usability activities," *International Journal of Human-Computer Studies,* vol. 55, pp. 453-483, 2001.

[12 M. Chandra and M. A. Khanum, "The role of Context in Usability Evaluation: A Review," 2012. [Online]. Available: https://arxiv.org/ftp/arxiv/papers/1204/1204.2138.pdf. [Accessed 23 February 2020].

[13 A. Kaikkonen, T. Kallio, A. Kekäläinen, A. Kankainen and A. Cankar, "Usability Testing of Mobile Applications: A Comparison between Laboratory and Field Testing," *Journal of Usability studies,* vol. 1, no. 1, pp. 4-16, 2005.

[14] M. Prgomet, A. Georgiou, J. Callen and J. Westbrook, "Fit Between Individuals, Tasks, Technology, and Environment (FITTE) Framework: A Proposed Extension of FITT to Evaluate and Optimise Health Information Technology Use," *International Medical Informatics Association (IMIA),* pp. 744-748, 2019.

[15] M. Broekhuis, L. v. Velsen, L. Peute, M. Halim and H. Hermens, "Conceptualizing usability for the eHealth context: A content analysis of usability problems of eHealth applications," *Journal of Medical Internet Research (JIMR),* vol. 5, no. 7, p. e18198, 2021.

[16 H. Hyppönen, J. Kaipio, T. Heponiemi, T. Lääveri, A.-M. Aalto, J. Vänskäi and M. Elovainio, "Developing the National Usability-Focused Health Information System Scale for Physicians: Validation Study," *Journal of Internet Medical Research (JIMR),* vol. 21, no. 5, p. e12875, 2019.

[17 B. M. Byrne, Structural Equation Modeling With AMOS: Basic Concepts, Applications, and Programming, 2nd ed., New York: Routledge, 2013.

