

## Measures of eHealth Literacy: Options for the Malaysian Population

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### ABSTRACT

Health literacy is an important component to the self-management of one's health decisions. As information on the Internet becomes more easily accessible, individuals need to be properly equipped to seek and evaluate the health information available to them. Digital health literacy, or eHealth literacy, refers to an array of skills required to properly seek, access, understand and apply health information on the Internet. To date, a number of different models and instruments have been developed to measure eHealth literacy, including the eHealth Literacy Scale (eHEALS), the eHealth Literacy Framework (eHLF), the Digital Health Literacy Instrument (DHLI), the eHealth Literacy Questionnaire (eHLQ), the eHealth Literacy Assessment Toolkit (eHLA) and the Transactional eHealth Literacy Instrument (TeHLI). While some of these instruments rely on the individual's self-assessment of eHealth literacy, others also test for functional information, communication and technological competencies. This paper presents these different eHealth literacy instruments and how they have been applied in current research. The similarities and differences between the instruments are examined. The discussion concludes with a summary of the measures and potential ways forward in developing an eHealth Literacy instrument for the Malaysian population. It is hoped that this paper may benefit researchers, health care providers, practitioners, ministries and governing bodies interested in understanding eHealth literacy and its measures.

**Keywords:** *Health information seeking, information and communication competencies, conceptual definitions, literature review, digital health literacy.*

### INTRODUCTION

As access to the Internet continues to increase across the world, online sources have become a primary reference for health information. It is becoming increasingly important to assess eHealth literacy - the skills, knowledge and experience of individuals in seeking, accessing and evaluating health information on the Internet. In countries such as the United Kingdom, the Netherlands and the United States of America, an array of health services are now being moved to online platforms. These services include consultations with general practitioners, access to medical records and acquisition of personalised health advice and information (Srivastava, Pant, Abraham & Agrawal, 2015). Although these services are not yet being implemented in Malaysia, an assessment of our eHealth literacy levels would inform the future development of such services.

The measurement of health literacy is only just gaining traction in Malaysia with the inclusion of health literacy measures in the National Health and Morbidity Survey since 2015. Although this is a step toward understanding the health literacy levels of our Malaysian society, the health literacy measures have yet to include measures for digital competencies needed to navigate the wealth of health-related information available online.

While measures for health literacy focus on the ability to access, understand, process and apply health information, eHealth literacy measures include the domains of access and capabilities in navigating digital spaces on the Internet. This is especially important today as digital technologies are rapidly evolving and may require people to obtain new competencies to navigate the changing landscape. These changes also enable misinformation about health, wellbeing and health products to run unchecked on the Internet, especially in regards to social media.

Working toward the investigation of Malaysian eHealth literacy, this paper aims to explore the competencies that comprise eHealth literacy by reviewing current models and instruments that have been used in recent years.

#### EHEALTH LITERACY IN AN ERA OF CONNECTIVITY

Health literacy is the ability to seek, understand and apply health information that influence an individual's health behaviour. A high level of health literacy indicates that a particular individual is capable of finding, processing and applying health-related information toward the betterment of their health (Suri, Majid, Chang & Foo, 2016). Those with lower levels of health literacy are at higher risk of developing or contracting health problems (Lam & Lam, 2012). Thus, not only is health literacy an indicator of one's capacity to take control over their health decisions, but it is also an asset for continuous healthcare. Extant literature has shown that individuals with higher health literacy are in better general health compared to those with low health literacy (Peterson et al., 2009).

Though general health literacy is an important aspect of public health, eHealth literacy is fast emerging as an area of concern, especially in this era of connectivity. With current developments in information communication technology, the Internet provides a wealth of health information resources. The reliance people once had on traditional sources (i.e. their general practitioner's office, newspapers and magazines) has been diffused by the abundance of health information available online. Studies have shown that patients use the Internet to search for information on general health and medicines (Peterson, Aslani, & Williams, 2003), to look up symptoms and conditions before heading to the emergency department (McCarthy et al., 2017), to learn about health and diagnoses (Fox & Duggan, 2013), improve the quality of doctor visits (Briones, 2015) and to solve medical problems (Chen, Li, Liang & Tsai, 2018).

Despite the advantages, the nature of the Internet also allows for the dissemination of false health information. This poses a threat to societies with low health literacy levels because they are unable to discern illegitimate health sources from legitimate sources, thus resulting in misinformation and generally undesirable health outcomes. A study by Eysenbach and Kohler (2002) indicated that proper appraisal of health information sources on the Internet were still lacking. Users often failed to check website credentials and could not recall specific sources for health information obtained. In a systematic review on indicators for trustworthy online information sources, Sun, Yang, Gwizdka and Trace (2019) found that consumers evaluation of health information online was very subjective. Their judgments varied across different contexts and were at times misinformed. Furthermore, those with low health literacy levels showed poor ability in evaluating online sources and low trust in health information found online (Diviani, van den Putte, Giani & van Weert, 2015).

The concept of eHealth literacy as defined by early advocates Norman and Skinner (2006a) is “the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem”. The authors proposed the Lily Model of eHealth literacy that encompasses six different literacy skills: 1) traditional literacy, 2) media literacy, 3) information literacy, 4) computer literacy, 5) science literacy; and 6) health literacy. Each of these skills are pertinent to competence in navigating health information on the Internet. The Lily Model outlines the fundamental competencies needed for eHealth literacy and is the basis of many current instruments formed to measure eHealth literacy. Norman (2011) proclaims that though different contexts may introduce new challenges to building eHealth literacy, the core skills that form eHealth literacy are unlikely to change.

Since the seminal work of Norman and Skinner (2006a), there have been numerous different models and tools developed for understanding eHealth literacy. The following sections will present and discuss six of the current tools and models available in conceptualising and measuring eHealth literacy. These include the eHealth Literacy Scale (eHEALS), the eHealth Literacy Framework (eHLF), the Digital Health Literacy Instrument (DHLI), the eHealth Literacy Questionnaire (eHLQ), the eHealth Literacy Assessment Toolkit (eHLA) and the Transactional eHealth Literacy Instrument (TeHLI). Each of these models are presented in chronological order.

#### THE EHEALTH LITERACY SCALE (eHEALS)

Based on their Lily Model, Norman and Skinner (2006b) developed a tool for the measurement of the six different competencies in eHealth literacy. The instrument contains 8 items under a single domain measuring eHealth literacy, focusing on the individual’s self-assessment of their own eHealth literacy levels. The authors define each of the literacy skills as follows:

##### *a. Traditional Literacy*

Traditional literacy refers to basic reading and comprehension skills as well as the ability to speak and write. Traditional literacy is deemed important in accessing health information online as much of the information available on the Internet is in text form.

##### *b. Media Literacy*

Media literacy skills are defined as the ability to critically assess media content and its sources. Individuals encounter various types of messages via the media and must be able to consider the different influences and meanings these messages can carry in interpreting them.

##### *c. Information Literacy*

Norman and Skinner (2006a) state that “an information literate person knows what potential resources to consult to find information on a specific topic, can develop appropriate search strategies, and can filter results to extract relevant knowledge”. Thus it is a skill related to one’s search, interaction with and use of information.

*d. Computer Literacy*

Online information is commonly accessed through devices such as the computer. Computer literacy encompasses basic skills on how to operate and use a computer to higher-level skills like utilising it to solve specific problems.

*e. Science Literacy*

The definition of scientific literacy is drawn from Laugksch (2000). Science-literate individuals have a basic understanding and exposure to science-based information, the scientific method as well as the underlying concepts and limitations of conducting research in a systematic manner.

*f. Health Literacy*

A central component of eHealth literacy, Norman and Skinner (2006a) define health literacy as “skills required to interact with the health system and engage in appropriate self-care”. This broad definition includes performing tasks in the healthcare environment and being able to make decisions when participating in healthcare activities.

The six types of literacy mentioned above are assessed by asking the individual to rate their own competencies on a 5-point Likert scale ranging from “strongly agree” to “strongly disagree”. Due to its ability to gauge eHealth literacy through a short and relatively easy questionnaire, eHEALS is one of the most widely used instruments for eHealth literacy. The instrument has been translated into different languages such as Dutch (van der Vaart et al., 2011), Japanese (Mitsutake, Shibata, Ishii, Okazaki & Oka, 2011), German (Soellner, Huber & Reder, 2014), and Swedish and Arabic (Wangdahl, Dahlberg, Jaensson & Nilsson, 2019). The instrument has also been tested and validated on various populations including older adults (Chung & Nahm, 2015), school children (Koo, Norman & Chang, 2012) as well as those with specific conditions such as high cardiovascular disease risk (Richtering et al., 2017) and chronic disease patients (Paige, Kreiger, Stellefson & Alber, 2017).

The popularity of the eHEALS is not without criticism. Though the original instrument showed high correlations with related concepts, more recent studies have indicated a weaker correlation between the eHEALS and Internet use (van der Vaart et al., 2011) and traditional health literacy (Quinn, Bond & Nugent, 2017). Paige et al. (2018) also point out that the eHEALS is intended to reflect the Lily Model but the items in the instrument are not reflective of the model’s competencies. In addition to this, Zrubka et al. (2019) describe eHEALS as a “self-efficacy-related measure” because of the focus on self-assessment. The authors argue that this subjective measurement is different from objective, functional measurement of eHealth literacy skills. Similarly, Nguyen et al. (2016) suggest that a drawback to the eHEALS is that it does not measure the full range of eHealth literacy. eHEALS is able to measure perceived knowledge, skills, and confidence in locating, evaluating, and using electronic health information to make health decisions. Even so, factors such as information, operational and strategic Internet competencies are not included in this instrument (van der Vaart et al., 2011) and neither are situational factors such as cultural and contextual experiences in using knowledge to solve a health problem (Gilstad, 2014).

### THE EHEALTH LITERACY FRAMEWORK (eHLF)

In order to address the gaps toward a comprehensive model for eHealth literacy, Norgaard et al. (2015) developed the eHealth Literacy Framework (eHLF). The eHLF intended to account for individual and system factors that contribute toward one's eHealth literacy. In developing the eHLF, a series of workshops were held to garner input as to what constitutes digital health literacy. The participants, consisting of patients, healthcare providers as well as IT experts and managers were asked to think about a person's experiences in looking after their health and the skills a person needs to navigate digital health information or services. An analysis of the statements gathered resulted in the identification of seven domains of eHealth literacy. These domains are succinctly presented below.

#### *a. Ability to Process Information*

Similar to Norman and Skinner's (2006b) traditional literacy skill, this domain includes the ability to read and understand information. Even so, it also includes several other competencies such as the ability to recognise the need for information, and finding, appraising and applying health information. Many statements that were gathered under this domain were related to issues in understanding medical information, filtering the information as well as being able to discuss the information with other people.

#### *b. Engagement in One's Own Health*

This domain is defined as the "knowledge about one's own health conditions, how to approach the healthcare system, as well as the approach to health in terms of will and responsibility" (Norgaard et al., 2015 p. 531). It provides an indication of an individual's interest in understanding and taking control of their health within the available healthcare systems.

#### *c. Ability to Actively Engage with Digital Services*

The third domain pertains to basic information technology and navigation skills as well as the competency to evaluate digital sources and understand the risks related to information found on the Internet. Different from the first domain on the ability to process information, this domain has a specific focus on digital competencies.

#### *d. Feel Safe and in Control*

Feeling safe and in control is the fourth domain in the eHLF. This domain refers to the ability of the individual to gain a sense of trust and security in dealing with health information sources. This includes trust in both the information available on the Internet and the information a patient provides when using an eHealth service.

#### *e. Motivated to Engage with Digital Services*

This domain is related to the need and willingness to use eHealth services on the Internet. Norgaard et al. (2015) found that the statements collected under this domain referred to the "curiosity, courage, enjoyment and feeling of closeness and comfort" in using digital services. This implies that in order to build eHealth literacy, not only do individuals need to possess the ability to engage in digital health services, they also need to be ready and willing to participate.

*f. Access to Digital Services That Work*

In addition to the ability and the willingness to engage with digital health services, the sixth domain of the eHLF stresses the importance of access to functional hardware and software needed to access health information and health services available in digital format. This would indicate lower eHealth literacy levels in populations with low Internet penetration and poor access to devices used to access health information on the Internet.

*g. Digital Services That Suit Individual Needs*

The last domain of the eHLF pertains to accessible information and services. Different from access related to hardware and software, this domain focuses specifically on the content of digital health services including the language, interface, relevance of information, its quality and simplicity of language.

Together, the seven domains in the eHLF form an eHealth literacy framework that accounts for individual and system factors as well as internal and external factors (observable vs internalised concepts) that comprise eHealth literacy in the digital age. The core contribution of this model is in the interaction between the individual and systems. Norgaard et al. (2015) outline the uniqueness of the eHLF as follows:

How a person might engage with information in the context of a system is dominated by more than just technical skills. Experiencing safety and control, benefit and comfort, and having the right attitude in approaching technology become just as relevant as knowing the inner workings of the systems and having the skills to navigate it (p. 533).

One of the drawbacks of the work by Norgaard et al. (2015) is that despite providing a comprehensive definition and conceptualisation of eHealth literacy, the authors did not provide an operationalisation of the model in the form of a questionnaire. They emphasised its utility in guiding the development and implementation of effective eHealth systems. Even so, the results of their study have garnered attention and has been acknowledged in various studies examining models and developing measures for eHealth literacy. The most significant use of the eHLF in current research is its use in the development and validation of the eHealth Literacy Questionnaire (eHLQ). Kayser et al. (2018) produced and validated the eHLQ based on the seven domains of the eHLF. This instrument will be discussed in the coming sections.

#### THE DIGITAL HEALTH LITERACY INSTRUMENT (DHLI)

Having previously critiqued the eHEALS, van der Vaart and Drossaert (2017) developed a set of items in response to the need for objective measures on eHealth literacy. The Digital Health Literacy Instrument (DHLI) was constructed based on seven separate skills derived from a qualitative study on the eHealth literacy of rheumatic disease patients (van der Vaart, Drossaert, de Heus, Taal & van de Laar, 2013). Van der Vaart and Drossaert (2017) posit that the instrument provides a comprehensive assessment of skills in health-related use of the Internet. The seven skills covered in the DHLI are operational skills, navigation skills,

information searching, evaluating reliability, determining relevance, adding self-generated content and protecting privacy. Each of these are presented below.

*a. Operational Skills*

Operational skills refer to the ability of an individual to use a device to access information on the Internet. The questions constructed by van der Vaart and Drossaert (2017) specifically refer to competencies related to the use of a desktop computer and Internet browser (e.g. use of a keyboard and mouse).

*b. Navigation SKILLS*

Navigation skills are related to the ability for one to effectively navigate websites with an awareness of what they are doing. Items in this skill set refer to the knowledge of where one is situated on the Internet and how to navigate to where they want to be.

*c. Information Searching*

Information searching pertains to the ease or difficulty a person feels in finding the information that they intend to find. This includes skills such as entering the proper keywords as well as being able to make choices among the information found.

*d. Evaluating Reliability*

The next set of skills that van der Vaart and Drossaert (2017) present is the ability to evaluate the reliability of information found on the Internet. This is operationalised by asking respondents questions regarding their ability to decide if the information is reliable, their awareness of any commercial interests in the information provided and if they perform checks to make sure other Internet sources provide similar information.

*e. Determining Relevance*

Another element to eHealth literacy in the DHLI is determining relevance. This skill refers to the individual's capacity to ascertain if the health information that they find is relevant to their own situation and the ability to use that information in a practical manner.

*f. Adding Self-Generated Content*

Van der Vaart and Drossaert (2017) also find that adding self-generated content is an important part of eHealth literacy. Skills under this competency set include being able to write questions and inquire about their health conditions in a way that is easy for others to understand.

*g. Protecting Privacy*

Protecting privacy is the last skill set tested in the DHLI. It refers to behaviours related to sharing personal private information or other people's private information through online forums or social media.

The seven skill sets are measured through a set of 21 self-report items and 7 performance-based items. The self-report items are measured on a 4-point scale indicating ease/difficulty and frequency. The performance-based items contain correct and incorrect answers and are scored according to the number of correct answers the respondents are able to obtain. In testing for the validity and reliability of the DHLI, van der Vaart and Drossaert (2017) found that six of their eHealth literacy domains obtained high internal consistencies. The items under 'protecting privacy' had low reliability and requires further testing to determine the reliability of this set of questions.

The main difference between the eHEALS and the DHLI is that the DHLI includes a set of performance-based items that requires the respondent to apply the seven skills required for eHealth literacy. By introducing objective measures in their instrument, the authors hope to reduce bias that comes from respondents over- or underestimating their eHealth literacy skills. Van der Vaart and Drossaert (2017) also suggest that the DHLI has an advantage over the eHEALS as it addresses both Health 1.0 and Health 2.0 skills encompassing skills related to obtaining information and use of the Internet.

The developers of the DHLI claim that it is a valid tool for quick evaluation of patient eHealth literacy in a clinical setting. By using the DHLI, health practitioners may be able to determine if eHealth tools will be of benefit to the patient. Even so, the application of this instrument is still in its infancy. To date, the DHLI has gained some attention in the field of public health but further studies testing its validity in different settings are limited (see van der Vaart et al., 2019).

#### THE EHEALTH LITERACY QUESTIONNAIRE (eHLQ)

Not long after the DHLI was published, Kayser et al. (2018) presented their own eHealth literacy instrument that was constructed based on the eHLF by Norgaard et al. (2015). Kayser et al. (2018) began with the statements gathered in the workshops conducted by Norgaard et al. (2015) and performed various consultations with international communities to ensure that the items would be applicable in different settings. The researchers were also careful to simultaneously construct the instrument in Danish and English to ensure that it would be easy to translate into different languages.

The initial version of the eHLQ contained 57 items with a 4-point response scale. After reliability and validation testing through confirmatory factor analysis, Kayser et al. (2018) successfully produced a 37 item questionnaire to measure the seven dimensions in the eHLF: 1) using technology to process health information, 2) understanding of health concepts and language, 3) ability to actively engage with digital services, 4) feel safe and in control, 5) motivated to engage with digital services, 6) access to digital services that work; and 7) digital services that suit individual needs. Each of the dimensions contained four to six items.

The results showed that the dimensions "using technology to process information" and "motivated to engage with digital services" were highly correlated, as were "access to digital services that work" and "digital services that suit individual needs". The authors chose to retain the dimensions as they were conceptually different and could potentially display causal relationships between them. Kayser et al. (2018) propose that the instrument is ready for application in different contexts including gauging the effectiveness of intervention



programmes, implementation of digital health services, and descriptive surveys describing eHealth literacy levels of different populations.

Thus far, the eHLQ has gained international attention with studies being conducted to translate the measures into different languages (Kayser et al., 2018). Additionally, Holt et al. (2019) have utilised the questionnaire to study eHealth literacy levels and use of digital health services among Danish patients. Kayser et al. (2019) have also utilised the eHLQ in combination with two other health literacy instruments to form a comprehensive tool for the measurement of one's health technology readiness: the Readiness and Enablement Index for Health Technology (READHY). The eHLQ has also been used to study health literacy in France under the World Health Organisation National Health Literacy Demonstration Projects (NHLDPs) in the European Region (Bakker et al., 2019).

At the same time that the eHLQ was being developed, another eHealth literacy instrument was also being produced by Karnoe et al. (2018) - the eHealth Literacy Assessment toolkit (eHLA). This instrument is discussed in the next section.

#### THE EHEALTH LITERACY ASSESSMENT TOOLKIT (eHLA)

The eHealth Literacy Assessment Toolkit (eHLA) by Karnoe et al. (2018) was published only a short while after the eHLQ by Kayser et al. (2018). Although both instruments are intended to measure eHealth literacy and therefore share similar domains, the development of the eHLA began before the eHLF was introduced and before the eHLQ was initiated (see Furstrand & Kayser, 2015; Karnoe & Kayser, 2016).

The main objective of the eHLA is to measure eHealth literacy levels for the purpose of improving eHealth services. The researchers wanted to ensure that eHealth projects that are being developed are well suited to the health and digital literacy levels of their audiences. When eHealth services are accessible, the patient is empowered to take control of their health decisions and health care. Karnoe et al. (2018) set out to develop and validate an instrument that is able to gauge an individual's eHealth literacy by combining pre-existing and newly developed measures.

The development of the eHLA involved the continuous testing of different health literacy and digital competency tools over a span of five to six years (2011 to 2016). There were 10 tools that underwent several development stages. After rigorous testing, seven of these tools were selected for validation testing. Four of the tools were related to health literacy while three of them assessed digital literacy. All seven tools are summarised below.

##### *a. Functional Health Literacy*

The purpose of the functional health literacy tool is to gauge the respondents' reading comprehension and numeracy skills in a health context. Karnoe et al. (2018) draw from the Test of Functional Health Literacy in Adults (TOFHLA) from Parker, Baker, Williams, & Nurss (1995) to develop performance-based items measuring functional literacy skills. Items are scored according to the number of correct answers the respondent obtains with higher scores indicating higher functional health literacy.

*b. Health Literacy Self-Assessment*

Karnoe et al. (2018) developed a shortened version of the HLS-EU-Q47, a tool measuring self-reported health literacy, to be included in the eHLA. This tool measures the respondent's ability to find, understand, appraise and apply health information in three different domains: health care, disease prevention and health promotion.

*c. Familiarity with Health and Health Care*

Items under this tool were newly developed for the eHLA. The authors tested familiarity with health and health care by presenting common terms and terminology in health care, asking respondents to indicate whether the concepts were familiar to them.

*d. Knowledge of Health and Health Care*

The tool for knowledge of health and health care was also developed specifically for the eHLA. This is a performance-based test that indicates the level of knowledge a person has regarding health and health care. The questions are formatted in the form of multiple-choice questions with 4 responses: a correct answer, 2 incorrect answers and an option to "consult someone else" answer.

*e. Familiarity with Technology*

The purpose of this tool was to measure a person's proficiency and knowledge in using technology. Karnoe et al. (2018) based this tool on Hargittai's (2008) measures of digital literacy. Respondents answer by indicating how familiar they are with concepts in and the use of technology.

*f. Technology Confidence*

Drawing from the work of Cho et al. (2010), a tool was developed to ascertain the level of confidence a person has in using technology. Respondents are asked to rate how confident they feel when performing technology-related tasks.

*g. Incentives for Engaging with Technology*

The last tool in the eHLA is a measure to assess the motivation an individual has in using technology. This tool was also newly developed by Karnoe et al. (2018) for the eHLA. The authors based this tool on the motivation domain of the eHLF, asking questions related to willingness to use and interact with technology.

The seven tools in the eHLA use a combination of performance-based tests and self-reported measures to determine eHealth literacy levels. Karnoe et al. (2018) posit that the tools can be used as a set or individually to assess the different competencies in eHealth literacy. The authors put in significant efforts to develop the eHLA as most of the tools needed to be reconstructed and rigorously tested for reliability and validity. As a result, the eHLA is a robust set of questionnaires suitable for use screening eHealth literacy levels.

Karnoe et al. (2018) differentiate the eHLA from eHEALS by emphasising that the eHLA subsumes all literacy skills in the eHEALS. Additionally, the eHLA also contains digital components essential for the assessment of eHealth literacy which are not in the eHEALS. An

interesting component to the eHLA is that health literacy and digital literacy are measured separately. The tools on health literacy do not include an assessment of skills in a digital setting and the tools on digital literacy are not written to reflect the health context.

As a newly developed instrument, extant literature utilising the eHLA is sparse. Studies to further test the dimensionality of the eHLA are needed to strengthen the measurement tools and explore if the tools can be combined to fall under a single eHealth literacy construct.

#### THE TRANSACTIONAL EHEALTH LITERACY INSTRUMENT (TeHLI)

Introduced by Paige et al. (2019), the Transactional eHealth Literacy Instrument (TeHLI) is one of the most recent measures of eHealth literacy. The researchers examine eHealth literacy from a communication perspective and emphasise the importance of the transactional component to eHealth literacy. Paige et al. (2018) began with a systematic review of literature on eHealth literacy models. As a result of the systematic review of literature, the researchers redefined eHealth literacy as “the ability to locate, understand, exchange, and evaluate health information from the Internet in the presence of dynamic contextual factors, and to apply the knowledge gained across ecological levels for the purposes of maintaining or improving health”. With this definition, they then produced the Transactional Model of eHealth Literacy (TMeHL).

Paige et al. (2018) suggest that competencies in technology alone do not translate into eHealth literacy. Instead, it is one’s ability to use technology and navigate the complexities of health information transactions in order to achieve their health goals. The key difference between the TMeHL and previous models of eHealth literacy is that the TMeHL focuses on the individual’s ability to communicate and exchange information with others in the process of solving a health problem. Paige et al. (2018) posit that there is noise that inhibits this communicative process in the form of personal, relational, social and cultural factors. These noise factors affect the individual’s ability to participate in health-related communication.

The researchers referred to the four health literacies in the Nutbeam (2000) health literacy model to form their dimensions of eHealth literacy: 1) functional eHealth literacy, 2) communicative eHealth literacy, 3) critical eHealth literacy; and 4) translational eHealth literacy. Each of these dimensions were carefully defined in Paige et al. (2018) and are presented below:

##### *a. Functional eHealth Literacy*

Nutbeam’s (2000) concept of functional health literacy formed the basis of this dimension. Paige et al. (2018) defined functional eHealth literacy as “Basic skills in reading and writing (typing) about health to effectively function on the internet” (Proposed Model section, para. 10).

##### *b. Communicative eHealth Literacy*

This dimension was adapted to fit within the contexts of interpersonal communication skills and the digital environment. Communicative eHealth literacy is defined as “The ability to collaborate, adapt, and control communication about health with users on social online environments with multimedia” (Paige et al., 2018, Proposed Model section, para. 11).

*c. Critical eHealth Literacy*

Also drawn from the health literacy model, critical eHealth literacy was defined as “The ability to evaluate the credibility, relevance, and risks of sharing and receiving health information on the internet” (Paige et al., 2018, Proposed Model section, para. 12).

*d. Translational eHealth Literacy*

This dimension elaborates the capacity for a person to turn the knowledge they gain from their interactions into real-life actions. Paige et al. (2018) defined translational eHealth literacy as “The ability to apply health knowledge gained from the internet across diverse ecological contexts. Translational literacy is the highest cognitive level of eHealth literacy, meaning it is informed and built upon from all lower-level eHealth literacy dimensions (ie, critical, communicative, and functional)” (Proposed Model section, para. 13).

The dimensions of eHealth literacy in the TMeHL are organised hierarchically, extending beyond the basic use of technology to more advanced information and communication skills. Paige et al. (2019) developed a questionnaire based on this model and performed rigorous testing procedures to produce the TeHLI. The TeHLI is made up of 18 items and is intended for use in the evaluation of a patient’s eHealth literacy skills in terms of strength and weakness in the functional, communicative, critical and translational components. The authors suggest that this knowledge would be helpful in guiding patients to resources that match their eHealth literacy levels and preferences.

A limitation of the TeHLI is that it is a self-reported measure. This means that assessment is not objective as only the respondent’s perceptions toward their own eHealth literacy competencies are measured. Even so, the TeHLI is an instrument built on a robust theoretical foundation and serves as a useful tool for the quick assessment of eHealth literacy levels.

## CONCLUSION

Six models for the measurement of eHealth literacy have been presented in this paper. A summary of the skills measured in each of the models are listed in Table 1. The focus of this paper was to review the competencies that comprise eHealth literacy. To do this, dominant eHealth literacy models and measures were examined to understand how scholars have defined and operationalised eHealth literacy in extant literature. Several other eHealth literacy tools and conceptual models have been developed in the fields of communication and sociology but were not discussed in this study. These eHealth literacy conceptualisations have more focus on situational, cultural and/ or contextual factors that influence eHealth literacy (see; Gilstad, 2014; Seçkin, Yeatts, Hughes, Hudson & Bell, 2016).

Table 1: Models of eHealth literacy and their domains

No.	Model	Domains/ Skills
1.	eHealth Literacy Scale (eHEALS) Norman & Skinner (2006b)	Traditional literacy Media literacy Information literacy Computer literacy Science literacy Health literacy
2.	eHealth Literacy Framework (eHLF) Norgaard et al. (2015)	Ability to process information Engagement in one's own health Ability to actively engage with digital services Feel safe and in control Motivated to engage with digital services Access to digital services that work Digital services that suit individual needs
3.	Digital Health Literacy Instrument (DHLI) van der Vaart and Drossaert (2017)	Operational skills Navigation skills Information searching Evaluating reliability Determining relevance Adding self-generated content Protecting privacy
4.	eHealth Literacy Questionnaire (eHLQ) Kayser et al. (2018)	Based on the seven domains of the eHLF
5.	eHealth Literacy Assessment Toolkit (eHLA) Karnoe et al. (2018)	Health literacy self-assessment Familiarity with health and health care Knowledge of health and health care Familiarity with technology Technology confidence Incentives for engaging with technology
6.	The Transactional Model of eHealth Literacy (TMeHL) Paige et al. (2018)	Functional eHealth literacy Communicative eHealth literacy Critical eHealth literacy Translational eHealth literacy

The development of eHealth literacy tools has undergone various improvements since the initial eHEALS instrument was introduced by Norman and Skinner (2006b). While the eHEALS focuses on different types of literacies associated with health literacy in a digital environment, it does not account for the range of skills required in light of newer developments in information and communication technology. Subsequent models and/ or instruments attempt to address this gap by including digital skills such as familiarity, confidence and access to digital health services. While some models focus on the functional use of technology, others emphasise the importance of information or source evaluation.

The different models also used either self-reported measures, performance-based measures or a combination of both. Self-reported measures have been criticised as relatively subjective measures compared to performance-based measures because they do not measure actual competence but perceived competence of the respondent. Some researchers (Karnoe et al., 2018; van der Vaart & Drossaert, 2017) have acknowledged the importance of including objective measures of eHealth literacy to gauge actual skill/ competence levels.

In a review of developments in eHealth literacy, Griebel et al. (2017) criticised existing models as being constructed in isolation of one another. Paige et al. (2018) disagrees with this opinion, suggesting that newer models of eHealth literacy have been building on older measures and making improvements in line with the changing digital environment. Many of the models and instruments mentioned in this paper were being developed concurrently (ie. the eHLQ, eHLA and TeHLI) and though there were no collaborative efforts to merge the separate studies, the researchers did take the time to acknowledge and compare their measures in the presentation of their work.

To determine the model most appropriate for the measurement of eHealth literacy in Malaysia, the local digital health landscape must be considered. Developed nations are focusing on eHealth literacy as part of the evaluation of digital health services such as online interactions between doctor and patient as well as electronic health records (Srivastava et al., 2015). Developing nations have different eHealth literacy needs as their health systems may not be as advanced and approaches/ solutions applied in the developed world may not be effective. Osborne (2016, p. 27) posits that health literacy and eHealth literacy are “deeply linked to the concept of equity” and that the problems and solutions of one nation may not apply to all.

All eHealth literacy models mentioned in this paper were developed in countries such as the United States of America, Denmark and Australia. Would a model constructed for developed nations in the West be applicable in the Malaysian context?

#### ACKNOWLEDGEMENT

This paper was written as part of a research project funded by Universiti Kebangsaan Malaysia under Geran Galakan Penyelidik Muda (GGPM-2019-044).

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REFERENCES

- Bakker, M. M., Putrik, P., Aaby, A., Debussche, X., Morrissey, J., Borge, C. R. ... Maindal, H. T. (2019). Acting together - WHO National Health Literacy Demonstration Projects (NHJDPs) address health literacy needs in the European Region. *Public Health Panorama*, 5(2-3), 123–329.
- Briones, R. (2015). Harnessing the web: how e-Health and e-Health literacy impact young adults' perceptions of online health information. *Medicine 2.0*, 4(2), e5. doi: 10.2196/med20.4327
- Chen, Y. Y., Li, C. M., Liang, J. C., & Tsai, C. C. (2018). Health information obtained from the Internet and changes in medical decision making: Questionnaire development and cross-sectional survey. *Journal of Medical Internet Research*, 20(2), e47. doi: 10.2196/jmir.9370
- Cho, A. H., Arar, N. H., Edelman, D. E., Hartwell, P. H., Oddone, E. Z., & Yancy, W. S. (2010). Do diabetic veterans use the Internet? Self-reported usage, skills, and interest in using My HealthVet Web portal. *Telemedicine Journal and E-Health*, 16(5), 595-602. doi: 10.1089/tmj.2009.0164
- Chung, S. Y., & Nahm, E. S. (2015). Testing reliability and validity of the eHealth Literacy Scale (eHEALS) for older adults recruited online. *Computers, Informatics, Nursing: CIN*, 33(4), 150-156.
- Diviani, N., van den Putte, B., Giani, S., & van Weert, J. C. (2015). Low health literacy and evaluation of online health information: A systematic review of the literature. *Journal of Medical Internet Research*, 17(5), e112. doi: 10.2196/jmir.4018
- Eysenbach, G., & Köhler, C. (2002). How do consumers search for and appraise health information on the world wide web? Qualitative study using focus groups, usability tests, and in-depth interviews. *BMJ (Clinical Research ed.)*, 324(7337), 573–577. doi: 10.1136/bmj.324.7337.573
- Fox, S., & Duggan, M. (2013). Health online 2013. *Pewinternet.org*. Retrieved on June 8, 2019, from <http://www.pewinternet.org/2013/01/15/health-online-2013/>
- Furstrand, D., & Kayser, L. (2015). Development of the eHealth Literacy Assessment Toolkit, eHLA. *Studies in Health Technology and Informatics*, 216, 971.
- Gilstad, H. (2014). Toward a comprehensive model of eHealth literacy. *Proceedings of the 2nd European Workshop on Practical Aspects of Health Information* (pp.19-20). Trondheim, Norway: 2nd European Workshop on Practical Aspects of Health Information. Retrieved from <http://ceur-ws.org/Vol-1251/paper7.pdf>
- Griebel, L., Enwald, H., Gilstad, H., Pohl, A-L., Moreland, J., & Sedlmayr, M. (2017). eHealth literacy research - Que voids?. *Informatics for Health and Social Care*, 1-16. doi: 10.1080/17538157.2017.1364247
- Hargittai, E. (2008). An update on survey measures of web-oriented digital literacy. *Social Science Computer Review*, 27(1), 130-137.
- Holt, K. A., Karnoe, A., Overgaard, D., Nielsen, S. E., Kayser, L., & Røder, M. E. (2019). Differences in the level of electronic health literacy between users and nonusers of digital health services: An exploratory survey of a group of medical outpatients. *Interactive Journal of Medical Research*, 8(2), e8423. doi: 10.2196/ijmr.8423

- Karnoe, K. A., & Kayser, L. (2016). Validation of the eHealth Literacy Assessment tool (eHLA). *International Journal of Integrated Care*, 16(6), a349. doi: 10.5334/ijic.2897
- Karnoe, A., Furstrand, D., Christensen, K. B., Norgaard, O., & Kayser, L. (2018). Assessing competencies needed to engage with digital health service: Development of the eHealth Literacy Assessment Toolkit. *Journal of Medical Internet Research*, 20(5), e178. doi: 10.2196/jmir.8347
- Kayser, L., Karnoe, A., Furstrand, D., Batterham, R., Christensen, K. B., Elsworth, G., & Osborne, R. H. (2018). A multidimensional tool based on the eHealth Literacy Framework: development and initial validity testing of the eHealth Literacy Questionnaire (eHLQ). *Journal of Medical Internet Research*, 20(2), e36. doi: 10.2196/jmir.8371
- Kayser, L., Rossen, S., Karnoe, A., Elsworth, G., Vibe-Petersen, J., Christensen, J. F., Ried-Larsen, M., & Osborne, R. H. (2019). Development of the multidimensional Readiness and Enablement Index for Health Technology (READY) tool to measure individuals' health technology readiness: Initial testing in a cancer rehabilitation setting. *Journal of Medical Internet Research*, 21(2), e10377. doi: 10.2196/10377
- Koo, M., Norman, C., & Chang, H. M. (2012). Psychometric evaluation of a Chinese version of the eHealth Literacy Scale (eHEALS) in school age children. *International Electronic Journal of Health Education*, 15, 29-36.
- Lam, M. K., & Lam, L.T. (2012). Health information-seeking behaviour on the Internet and health literacy among older Australians. *Electronic Journal of Health Informatics*, 7(2), e15.
- Laugksch, R. C. (2000). Scientific literacy: A conceptual overview. *Science Education*, 84, 71-94.
- McCarthy, D. M., Scott, G. N., Courtney, D. M., Czerniak, A., Aldeen, A. Z., Gravenor, S., & Dresden, S. M. (2017). What did you Google? Describing online health information search patterns of ED patients and their relationship with final diagnoses. *The Western Journal of Emergency Medicine*, 18(5), 928-936. doi: 10.5811/westjem.2017.5.34108
- Mitsutake, S., Shibata, A., Ishii, K., Okazaki, K., & Oka, K. (2011). Developing Japanese version of the eHealth Literacy Scale (eHEALS). *Nihon Koshu Eisei Zasshi*, 58(5), 361-371.
- Nguyen, J., Moorhouse, M., Curbow, B., Cristie, J., Walsh-Childers, K. & Islam, S. (2016). Construct validity of the eHealth Literacy Scale (eHEALS) among two adult populations: A Rasch analysis. *JMIR Public Health Surveillance*, 2(1), e24.
- Norgaard, O., Furstrand, D., Klokke, L., Karnoe, A., Batterham, R. W., Kayser, L., & Osborne, R. H. (2015). The e-health literacy framework: A conceptual framework for characterizing e-health users and their interaction with e-health systems. *Knowledge Management & E-Learning*, 7(4), 522-540.
- Norman, C. D., & Skinner, H. A. (2006a). eHealth Literacy: Essential skills for consumer health in a networked world. *Journal of Medical Internet Research*, 8(2), e9. doi: 10.2196/jmir.8.2.e9
- Norman, C. D., & Skinner, H. A. (2006b). eHEALS: The eHealth literacy scale. *Journal of Medical Internet Research*, 8(4), e27. doi: 10.2196/jmir.8.4.e27
- Nutbeam, D. (2000). Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promotion International*, 15(3), 259-267.



- Osborne, R. (2016). Digital health literacy for 23 million: A breakthrough in systems design to ensure no one is left behind?. *Hisa.org.au*. Retrieved from <https://www.hisa.org.au/wp-content/uploads/hic2016/tuesday/Richard-Osborne.pdf>
- Paige, S. R., Krieger, J. L., Stellefson, M., & Alber, J. M. (2017). eHealth literacy in chronic disease patients: An item response theory analysis of the eHealth literacy scale (eHEALS). *Patient Education and Counseling*, 100(2), 320–326. doi: 10.1016/j.pec.2016.09.008
- Paige, S. R., Stellefson, M., Krieger, J. L., Anderson-Lewis, C., Cheong, J., & Stopka, C. (2018). Proposing a transactional model of eHealth Literacy: concept analysis. *Journal of Medical Internet Research*, 20(10), e10175. doi: 10.2196/10175
- Paige, S. R., Stellefson, M., Krieger, J. L., Miller, M. D., Cheong, J., & Anderson-Lewis, C. (2019). Transactional eHealth literacy: Developing and testing a multi-dimensional instrument. *Journal of Health Communication*, 24(10), 737-748. doi: 10.1080/10810730.2019.1666940
- Parker, R. M., Baker, D. W., Williams, M. V., & Nurss, J. R. (1995). The test of functional health literacy in adults: A new instrument for measuring patients' literacy skills. *Journal of General Internal Medicine*, 10(10), 537-541.
- Peterson, G., Aslani, P., & Williams, K. A. (2003). How do consumers search for and appraise information on medicines on the Internet? A qualitative study using focus groups. *Journal of Medical Internet Research*, 5(4), e33. doi: 10.2196/jmir.5.4.e33
- Peterson, P. N., Shetterly, S. M., Clarke, C. L., Allen, L. A., Matlock, D. D., Magid, D. J., & Masoudi, F. A. (2009). Low health literacy is associated with increased risk of mortality in patients with heart failure. *Circulation*, 120(18), S749-S749.
- Quinn, S., Bond, R., & Nugent, C. (2017). Quantifying health literacy and eHealth literacy using existing instruments and browser-based software for tracking online health information seeking behavior. *Computers in Human Behavior*, 69, 256–267. doi: 10.1016/j.chb.2016.12.032
- Richtering, S. S., Morris, R., Soh, S. E., Barker, A., Bampi, F., Neubeck, L., ... Redfern, J. (2017). Examination of an eHealth literacy scale and a health literacy scale in a population with moderate to high cardiovascular risk: Rasch analyses. *PLoS ONE*, 12(4), e0175372. doi: 10.1371/journal.pone.0175372
- Seçkin, G., Yeatts, D., Hughes, S., Hudson, C., & Bell, V. (2016). Being an informed consumer of health information and assessment of electronic health literacy in a national sample of Internet users: validity and reliability of the e-HLS instrument. *Journal of Medical Internet Research*, 18(7), e161. doi: 10.2196/jmir.5496
- Soellner, R., Huber, S., & Reder, M. (2014). The concept of eHealth literacy and its measurement: German translation of the eHEALS. *Journal of Media Psychology: Theories, Methods, and Applications*, 26(1), 29–38. doi: 10.1027/1864-1105/a000104
- Srivastava, S., Pant, M., Abraham, A., & Agrawal, N. (2015). The technological growth in eHealth services. *Computational and Mathematical Methods in Medicine*, 894171.
- Sun, Y., Zhang, Y., Gwizdka, J., & Trace, C. B. (2019). Consumer evaluation of the quality of online health information: Systematic literature review of relevant criteria and indicators. *Journal of Medical Internet Research*, 21(5), e12522. doi: 10.2196/12522

- Suri, V. R., Majid, S., Chang, Y. K., & Foo, S. (2016). Assessing the influence of health literacy on health information behaviors: A multi-domain skills-based approach. *Patient Education Counselling*, 99(6), 1038-1045.
- van der Vaart, R., van Deursen, A. J., Drossaert, C. H., Taal, E., van Dijk, J. A., & van de Laar, M. A. (2011). Does the eHealth Literacy Scale (eHEALS) measure what it intends to measure? Validation of a Dutch version of the eHEALS in two adult populations. *Journal of Medical Internet Research*, 13(4), e86. doi: 10.2196/jmir.1840
- van der Vaart, R., Drossaert, C. H., de Heus, H. M., Taal, E., van de Laar, M. A. (2013). Measuring actual eHealth literacy among patients with rheumatic diseases: A qualitative analysis of problems encountered using Health 1.0 and Health 2.0 applications. *Journal of Medical Internet Research*, 15(2), e27. doi: 10.2196/jmir.2428
- van der Vaart, R., van Driel, D., Pronk, K., Paulussen, S., te Boekhorst, S., Rosmalen, J. G. M., Evers, A. W. M. (2019). The role of age, education, and digital health literacy in the usability of Internet-based cognitive behavioral therapy for chronic pain: Mixed methods study. *JMIR Formative Research*, 3(4), e12883. doi: 10.2196/12883
- Wangdahl, J. M., Dahlberg, K., Jaensson, M., & Nilsson, U. (2019). Psychometric validation of Swedish and Arabic versions of two health literacy questionnaires, eHEALS and HLS-EU-Q16, for use in a Swedish context: A study protocol. *BMJ Open*, 9, e029668. doi: 10.1136/bmjopen-2019-029668
- Zrubka, Z., Hajdu, O., Rencz, F., Baji, P., Gulacsi, L. & Pentek, M. (2019). Psychometric properties of the Hungarian version of the eHealth Literacy Scale. *European Journal of Health Economics*, 20(Suppl 1), 57. doi: 10.1007/s10198-019-01062-1