INSTRUMENT DEVELOPMENT AND VALIDATION TO MEASURE DIGITAL CITIZENSHIP OF SECONDARY SCHOOL STUDENTS IN MALAYSIA

By

NUR 'ATIKAH BINTI AHMAD

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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DEDICATION

To my dearest and gritty cheerleaders, Mak and Abah. Everything I have, whoever I am, I owe to both of you.

To Malaysia, my nation, herewith, my humble piece of benefaction.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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Chairman : Prof. Aminuddin Hassan, PhD
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The evolving digital landscape in education necessitates wellness and resilient practices among students to navigate online risks while maximizing the benefits of digital participation. The concept of digital citizenship, which promotes responsible behavior in the digital space, is pivotal in this context. However, the lack of a valid instrument tailored to secondary school students impedes comprehensive measurement and strategic intervention in evaluating, fostering, and promoting digital citizenship within this vulnerable group. The limited availability of instruments tailored to the Malaysian context, considering cultural nuances, hinders the understanding of the extent of digital citizenship initiatives in Malaysia. Consequently, the severity of digital issues experienced by secondary school students in Malaysia may remain untraced and unresolved. Furthermore, the evolving digital educational landscape presents new psychological-related online risks, underscoring the need for an adaptive instrument. Hence, this study aims to develop and validate an instrument (MyDCi) to measure digital citizenship among Malaysian secondary school students through three main phases: Development, Pre-validation, and Validation. Drawing on the Theory of Nine Elements of Digital Citizenship, psychological theories, and Malaysia's educational outcomes, 177 items were initially developed across nine constructs: digital access, digital commerce, digital communication, digital etiquette, digital health and wellness, digital law, digital literacy, digital rights and responsibilities, and digital security. MyDCi was pre-validated for its first 80 items using 347 responses from Form Four students obtained through purposive sampling. For its construct validation, involving 63 items, 232 responses from Selangor, Kuala Lumpur, and Putrajaya were obtained using a multistage sampling technique. CVI analysis was employed to validate MyDCi's content with input from five experts and students, while the Rasch model was used for its construct validation, and linear regression and correlation coefficients were used for criterion validation. MyDCi achieved a satisfactory CVI value (0.78) and aligned with Rasch's assumptions, with unidimensionality improving from 37.5% to 40.7% in MyDCi's final version. The final 56 items significantly predict holistic wellness with a 31% variance, demonstrating that MyDCi is a reliable and valid instrument aligned with national citizenship characteristics. The insights from this study contribute to enhancing educational strategies, policy formulation, and the overall development of digital

citizens, both globally and in the Malaysian context. It offers a new option for a valid and reliable instrument for future research, enriching the body of knowledge on digital citizenship.

Keyword: Digital Citizenship, Instrument Development, School Students, Rasch Model,and Malaysia Education.

SDG : GOAL 4: Quality Education, GOAL 3: Good Health and Wellbeing, and GOAL 9: Industry, Innovation, and Infrastructure.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PEMBINAAN DAN PENGESAHAN SKALA UNTUK MENGUKUR KEWARGANEGARAAN DIGITAL PELAJAR SEKOLAH MENENGAH DI MALAYSIA

Oleh

NUR 'ATIKAH BINTI AHMAD

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Perkembangan pendidikan digital memerlukan amalan kesejahteraan dan ketahanan bagi pelajar untuk menghadapi risiko dalam talian serta memaksimumkan manfaat keterlibatan digital. Konsep kewarganegaraan digital penting dalam mempromosikan tingkah laku bertanggungjawab dalam ruang digital. Walau bagaimanapun, ketiadaan skala yang sah dan sesuai bagi pelajar sekolah menengah menghalang pengukuran yang komprehensif serta langkah strategik untuk memupuk dan mempromosikan amalan kewarganegaraan digital bagi kumpulan yang berisiko ini. Skala bersesuaian bagi konteks Malaysia dan budaya tempatan masih terhad, menyulitkan pengetahuan tentang tahap kejayaan inisiatif kewarganegaraan digital di Malaysia. Akibatnya, keparahan isu digital yang dihadapi pelajar sukar dikesan dan diselesaikan. Tambahan pula, kewujudan risiko baharu dalam pendidikan atas talian yang berkaitan psikologi, menekankan keperluan skala yang menyentuh isu ini. Justeru, kajian ini bertujuan membangunkan dan mengesahkan skala (MyDCi) untuk mengukur kewarganegaraan digital bagi pelajar sekolah menengah di Malaysia, dengan tiga fasa utama: Pembangunan, Pra-pengesahan, dan Pengesahan. Berasaskan Teori Sembilan Elemen Kewarganegaraan Digital, teori-teori psikologi, dan matlamat pendidikan Malaysia, 177 item awal dibangunkan bagi sembilan konstruk (akses digital, perdagangan digital, komunikasi digital, etika digital, kesihatan dan kesejahteraan digital, undang-undang digital, literasi digital, hak dan tanggungjawab digital, dan keselamatan digital). Pra-pengesahan konstruk 80 item melibatkan 347 maklumbalas daripada pelajar Tingkatan Empat, disampel melalui persampelan bertujuan. Kemudian, sebanyak 63 item melalui proses pengesahan konstruk yang melibatkan 232 pelajar dari Selangor, Kuala Lumpur, dan Putrajaya disampel menggunakan teknik persampelan berbilang peringkat. Analisis CVI digunakan dalam kesahan kandungan MyDCi yang diperoleh daripada lima pakar dan pelajar, manakala model Rasch digunakan untuk kesahan konstruk, dan regresi linear dan pekali korelasi untuk kesahan kriteria. MyDCi memperoleh nilai CVI yang memuaskan (0.78) dan sejajar dengan andaian Rasch, dengan nilai Unidimensionaliti meningkat dari 37.5% kepada 40.7% bagi versi akhir MyDCi. Sebanyak 56 item akhir adalah sah dan berkemampuan tinggi untuk meramalkan kesejahteraan holistik dengan jumlah varians 31%. MyDCi terbukti sebuah skala yang boleh dipercayai dan sah, yang turut mencakupi elemen kewarganegaraan negara. Kajian ini menyumbang

kepada peningkatan strategi pendidikan, penggubalan dasar, dan pembangunan keseluruhan warga digital, di peringkat global dan Malaysia. Ia turut menawarkan pilihan baharu untuk instrumen yang berkualiti untuk penyelidikan masa depan, menyumbang kepada badan pengetahuan tentang kewarganegaraan digital.

Kata Kunci: Kewarganegaraan Digital, Pembangunan Instrumen, Pelajar Sekolah, Model Rasch, dan Pendidikan Malaysia.

SDG : MATLAMAT 4: Pendidikan Berkualiti, MATLAMAT 3: Kesihatan yang Baik dan Kesejahteraan dan MATLAMAT 9: Industri, Inovasi dan Infrastruktur.

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LIST OF SYMBOLS

n_0	Sample size
t	Value for selected alpha level
s	Standard deviation
d	Margin of error
e	Exponent
%	Percentage
±	Positive-negative
N	Number of population
n	Number of samples
n	Total

LIST OF ABBREVIATIONS

AASL	American Association of School Librarians
AECT	Association for Educational Communication and Technology
AI	Artificial Intelligent
ANOVA	Analysis of Variance
ASK	Asas Sains Komputer (Basic of Computer Science)
BSTP	Bahagian Sumber dan Teknologi Pendidikan (Educational Technology and Resources Division)
CC	Creative Common
CFA	Confirmatory Factor Analysis
CTT	Classical Test Theory
CVI	Content Validation Index
CVR	Content Validation Ratio
DC	Digital Citizenship
DCQ	Digital Citizenship Questionnaire
DIF	Differential Item Functioning
EDA	Exploratory Data Analysis
EFA	Factor Analysis
EPRD	Educational Planning and Research Division, Ministry of Education Malaysia
ETD	Educational Technology Division (Bahagian Teknologi Pendidikan)
GUI	Graphical User Interface
HWA	Holistic Wellness Assessment
ICC	Item Characteristic Curve
iCGPA	Grading Point Average
ICT	Information and Communication Technology

ICTL	Information and Communication Technology Literacy
IIUM	International Islamic University Malaysia
Ins.	Institute
IoT	Internet-of-Things
IRT	Item Response Theory
ISTE	International Society for Technology in Education
JKEUPM	Jawatankuasa Etika Universiti Untuk Penyelidikan Melibatkan Manusia (Ethic Committee For Research Involving Human Subject)
JPN	Jabatan Pendidikan Negeri (State Education Department)
K-12	Kindergarten till 12th grade (primary school students till secondary school students)
KBSM	Kurikulum Bersepadu Sekolah Menengah
KDB	Klik Dengan Bijak programme
KR20	Cronbach Alpha
KSSM	Kurikulum Standard Sekolah Menengah
KTV	Kolej Teknik dan Vokasional (Technic and vocational college)
MCERT	Malaysian Computer Emergency Response Team
MCMC	Malaysian Communications and Multimedia Commision
MDEC	Multimedia Development Corporation
MJIIT	Malaysia Japan International Institute of Technology, Universiti Teknologi Malaysia
MNSQ	Mean square
MOE	Ministry of Education Malaysia
MOSTI	Ministry of Science, Technology and Innovation
NCPO	National Cyber Policy Office of New Zealand
NET.S	National Educational Technology Standards in USA

Netsafe	New Zealand's independent, non-profit online safety organisation
P-20	Education grade of Pre-school to graduate degree
PCA	Principal Component Analysis of Residual
PPSi	Psychometric Personality School Index
PT3	Pentaksiran Tingkatan 3(School Based Form Three Assessment)
PTMEA	Point Measure Correlation
SB	Sekolah Bimbingan (Schools for street children age 4-19)
SBPi	Sekolah Menengah Kebangsaan Berasrama Penuh Integrasi (National fully residential integration secondary school)
SD	Standard Deviations
SE	Standard Error
SNS	Social Networking System
SMK	Sekolah Menengah Kebangsaan (National regular secondary school)
SMKA	Sekolah Menengah Kebangsaan Agama (National religious secondary school)
SMBP	Sekolah Menengah Berasrama Penuh (National fully residential secondary school)
SPM	Sijil Pelajaran Malaysia
SSQS	Smart Schools Qualification Standards
STPM	Sijil Pelajaran Tinggi Malaysia
TMK	Teknologi Maklumat dan Komunikasi (Information and Communication Technology)
UCSNS	User Content Social Networking System
UKM	Universiti Kebangsaan Malaysia
UNESCO	The United Nations Educational, Scientific and Cultural Organization
UPM	Universiti Putra Malaysia

UPSI	Universiti Pendidikan Sultan Idris
USM	Universiti Sains Malaysia
USA	United State of America
VLE	Virtual Learning Environment
WINSTEPS	Rasch measurement computer software
z-std	Z-Standardized

CHAPTER 1

INTRODUCTION

This chapter introduces the study purpose, its significance in filling the knowledge gap on digital citizenship, and its limitations. Research objectives and questions are also formulated to guide the entire study process.

1.1 Introduction

Sophisticated online technologies and smart Information and Communication Technologies (ICT) equipment have been highly immersive in the present society. Tremendous efforts have been made in diffusing various new online-based technologies in education to prepare the youngster to learn, live, and cope with a future complex hi-tech society.

Learning in these online-based environments leads to unique and increasing challenges for today's adolescents, which expose them to seamless online threats and a tendency to be negatively affected (Livingstone & Helsper, 2010). Statistics also reported the increment of unwelcomed digital issues, such as online misconduct, inappropriate production of online content or footprint, identity theft, plagiarism, digital criminals, cyberbullying, addiction, and sexting (Crimmins & Seigfried-Spellar, 2014; Livingstone & Haddon, 2014; Waldo, 2014).

Excessive online device consumption and online media overload catalyse this vulnerable group to fall into addiction with severe effects similar to substance addiction, which lead to poor academic achievement and wellbeing (Hawi & Samaha, 2016; Kühn & Gallinat, 2015). Moreover, this situation raises wellness issues involving poor health and posture, vision issues, obesity, and psychological wellbeing, such as technostress, depression, social withdrawal, and online suicidal trend (Judi, Ashaari, Zin, & Yusof, 2013; Lee et al., 2014; Tsitsika et al., 2014). Harmful online activities form online misbehaviours, which may shape one's identity negatively and turn to culture itself (Helsper & Eynon, 2016; Hollandsworth, Donovan, & Welch, 2017). Thus demand new set of positive online practices to leverage the opportunities of online environment while remaining resilient to its risks.

1.2 Background of Study

Digital citizenship, defined as acknowledging the rights, responsibilities, and opportunities in the digital world and engaging in safe, legal, and ethical behaviours (ISTE, 2018), emerged in educational technology a decade ago. This concept aimed to address digital issues by promoting appropriate, safe, ethical, respectful, and responsible technology use. The widely introduced Nine Elements Digital Citizenship theory encompasses digital access, digital commerce, digital communication, digital

etiquette, digital health and wellness, digital law, digital literacy, digital rights and responsibilities, and digital security (Ribble, 2011).

Efforts to promote digital citizenship in education are on the rise globally. Australia implemented a digital citizenship program alongside the 1-to-1 laptop initiative in national secondary schools (O'Brien & Stavert, 2011). While US, New Zealand, and Singapore, digital citizenship is a curriculum learning outcome, while Hong Kong integrated it as an elective course at the tertiary level, covering the Nine Elements of Digital Citizenship (Cheng & Chau, 2016; Ministry of Education Singapore, 2014; NetSafe, 2016).

The significance of digital citizenship is also distinct in Malaysia education aiming to foster positive internet usage, safety, vigilance, and responsibility among school students. National initiatives like CyberSAFE and Klik Dengan Bijak ("Click Wisely") emphasise internet safety for secondary school students. Malaysia's commitment to digital citizenship is notably high compared to other countries, evident in its robust cyber safety and privacy policies (UNESCO, 2016).

Although digital citizenship integration in education has gained global attention, its measurement is overlooked (Chen, Mirpuri, Rao, & Law, 2021; Pérez-Sanagustín et al., 2017). There is a scarcity of studies measuring the extent of digital citizenship initiatives on positive online practices of the young generation, especially among school students (ITU, 2014; UNESCO, 2016). This gap may be attributed to the overall limited research on digital citizenship in the educational technology domain, tailored for studying this age group (Atif & Chou, 2018; Kamaruddin & Jalil, 2019) (refer to Appendix A1).

Even so, a few digital citizenship studies and instruments have been found in Malaysia, including works by Nordin et al. (2016) and Mahadir, Baharudin, and Ibrahim (2021), both of which focused on higher education contexts. Hence, the instruments' adaptation to measure the digital citizenship of school students may not capture the specific challenges within the Malaysian secondary education realm and limit their effectiveness in the context of secondary school students.

Therefore, comprehension of this group's present digital citizenship practices remains ambiguous, further complicated by divergent findings from a limited number of earlier digital citizenship-related studies. The National Cybersecurity Awareness Survey (NCSAS, 2016) assessed digital citizenship levels of 4,099 secondary school students regarding risk-taking behaviours, finding that students demonstrated awareness of online do's and don'ts. The 2015 National Survey Study CyberSAFE (NSSC) involving 18,000 students aged 13 to 15 reported that students were somehow resilient in encountering online challenges. Similarly, Saharrudin et al.'s (2019) study of 400 Selangor youths showed low cyberbullying engagement. Another study (Ming, Shi & Taha, 2020) involving 562 respondents aged 16 revealed high awareness of online risks and minimal exposure to online risks and cyberbullying.

Conversely, other findings revealed that Malaysian adolescents' cybercrimes awareness remains low (Zain et al., 2015). Despite ranking second in reported cyberbullying cases in Asia, recent research on 430 urban adolescents (ages 13 to 18) in Klang Valley revealed a significant number involved in cyber victimisation and cyberbullying (Ipsos, 2018; The Star, 2022; Waheed, 2019; Yusuf et al., 2021). Statistics underscore that three in 10 young Malaysians experienced cyberbullying, and many struggled to protect themselves online (Digi Telecommunications, 2014; UNICEF, 2018).

Insufficient information about the present state of digital citizenship practices might impede a precise understanding of the prevalent digital issues among Malaysian students. A meticulously designed, comprehensive, valid, and reliable instrument tailored for this group could facilitate a continuous and up-to-date examination of digital citizenship practices. Such an instrument would play a crucial role in identifying areas for improvement, paving the way for future Malaysia's digital citizenship initiatives.

1.3 Problem Statements

The escalating impact of digital issues on secondary school students in Malaysia raises concerns about the country's future. The prevalence of psychological-related online challenges, including a 17.1% rate of suicidal behavior among Malaysian teenagers linked to cyberbullying, underscores the urgent need to fortify current digital citizenship practices in this vulnerable age group (Basyir & Perimbanayagam, 2020; Mohd Fadhli, Liew, Ab Halim, Ab Razak, & Ab Rahman, 2022; Selvam, 2022). However, addressing these digital issues is hindered by the challenge of identifying suitable constructs and practises to enhance their online wellness and resilience. Limited research on digital citizenship in this group may contribute to the undetected severity of the rising digital issues (Fernández-Prados, Lozano-Díaz & Ainz-Galende, 2021; Kim & Choi, 2018).

Moreover, the limited availabe instruments (e.g., Choi, Glassman, & Cristol, 2017; Jones & Mitchell, 2015), may inadequately align with the mission of Malaysia's citizenship chracteristics and educational realm, which aims to foster the development of value-driven citizens (Ahmad, Rahim, Pawanteh, & Ahmad, 2012). This stands in contrast to Western education-based instruments that emphasise political literacy and activism—activities prohibited for Malaysian students under the Malaysian University and University College Act 1971. This mismatch potentially results in inaccurate and threatens the validity of the measurement of digital citizenship (Mackenzie, Podsakoff, & Podsakoff, 2011). Necessitating the development of a new, locally tailored instrument to effectively address the specific online challenges, policies and national standards, norms, and cultural sensitivity in the Malaysian educational landscape.

In addition, the insufficient definition of certain constructs in The Nine Elements theory (Ribble, 2011), such as digital law, digital commerce, and digital health and wellness, particularly in psychological aspects, creates ambiguity in understanding the underlying digital citizenship constructs for secondary school students (Choi, Cristol, & Gimbert, 2018; Kuş et al., 2017) (Appendix A2). The Theory of Wellness and the

Theory of Resilience emphasise the importance of incorporating aspects like spirituality for a holistically balanced individual (Hattie, Myers, & Sweeney, 2004). This resilience factor is linked to positive adolescent outcomes, including mental health (Dutta & Singh, 2017; Shabani, Hassan, Ahmad, & Baba, 2010; Shek, 2012; Yahaya et al., 2012). However, it remains underexplored in previous literature or instruments, with only one study linking spirituality with digital citizenship found (i.e., Lucey & Lin, 2020). This gap may hinder digital citizenship initiatives from effectively addressing emerging online psychological-related risks, such as addiction and suicidal ideation, faced by secondary school students (Doumas & Midgett, 2023). This underscores the need for a more nuanced conceptualisation.

Furthermore, the lack of well-established instrument specifically designed for K-12 students poses challenges in determining and measuring their digital citizenship practices (Kamaruddin & Ab Jalil, 2019). While tertiary students have been preferentially studied, leaving K-12 students less explored (Appendix A2)(Chen et al., 2021). Additionally, the adaptation of instruments is incompatible by the ambiguity and diversity of digital citizenship conceptualisation. For instance, Jones and Mitchell (2016) define digital citizenship based on two constructs, while others use four (e.g., Elçi & Sarı, 2016) and five constructs (e.g., Kim & Choi, 2018; Nordin et al., 2016). Furthermore, some instruments lack theoretical underpinning, leading to erroneous data and flaws conclusions (e.g., Alharbi & Alturki, 2018) (DeVellis, 2003) (see Appendix A2). Thus, hinder the effectiveness in addressing digital citizenship needs and its promotion, particularly within K-12 in the Malaysian context.

Additionally, the existing instruments face challenges in establishing reliable psychometric properties due to inadequate development techniques and validation procedures. These instruments lack a clear developmental model, leading to potential validity issues (e.g., Martin et al., 2020)(Appendix A2). Some instruments exhibit limited validation, lacking face and criterion validity (e.g., Isman & Gungoren, 2014). Moreover, certain developed items fall below psychometric quality standards, such as the double-barreled item in Al-Zahrani (2015) (e.g., "I place my keyboard properly and make sure my forearms are horizontal and my wrists are straight") and developed in languages other than English and Malay (e.g., Phornprasert et al., 2020). This may compromise validity if without a proper back-to-back translation and revalidation. Moreover, the reliance on convenient sampling limits the instruments' generalizability (e.g., Choi et al., 2017) and existing instruments predominantly adhere to the Classical Test Theory (CTT) potentially contributing to psychometric biases (e.g., Kim & Choi, 2018)(Furr, 2011). In contrast, a modern analytical approach, such as the Item Response Theory (IRT), specifically the Rasch model, has the potential to address psychometric issues and inaccuracies, providing more comprehensive evidence of psychometric properties than CTT (Bond & Fox, 2015). Surprisingly, this analysis method remains unexplored in the realm of digital citizenship studies, highlighting a significant gap in the current understanding and application of measurement methodologies.

In summary, the rapidly evolving digital landscape introduces new risks that existing instruments may not effectively address, leading to concerns about prediction precision and potential inefficiencies in interventions. The risk of faulty inferences heightens

when adapting items to different contexts, highlighting the imperative for a new, specifically tailored instrument for secondary school students in Malaysia. This instrument should be both valid and reliable, encompassing the necessary practices to effectively address contemporary risks. Accurate predictions of digital citizenship practice levels are crucial to equip students against Internet challenges, fostering a positive online culture, ensuring a safer digital society, and optimising the benefits of online learning and technology.

1.4 Objectives

The main objective of this study is to develop a valid and reliable instrument to measure digital citizenship practices of secondary school students in Malaysia. Specifically, the objective includes:

1. Develop a Digital Citizenship Instrument of Secondary School Students in Malaysia (MyDCi).
2. Examine the psychometric properties of the Digital Citizenship Instrument of Secondary School Students in Malaysia (MyDCi).
3. Evaluate the criterion validations of the Digital Citizenship Instrument of Secondary School Students in Malaysia (MyDCi).

1.5 Research Questions

Research questions were formed as below, based on this study's objectives:-

To fulfil the first objective:

RQ1. What are the items that reflect the constructs of the Digital Citizenship Instrument of Secondary School Students in Malaysia (MyDCi) ?

RQ2. What is the extent of content validation of the Digital Citizenship Instrument of Secondary School Students in Malaysia (MyDCi) ?

To fulfil the second objective:

RQ3. What is the extent of psychometric properties of the Digital Citizenship Instrument of Secondary School Students in Malaysia (MyDCi) based on the Rasch model (Indices of Reliability, Fit, Item Polarity, Unidimensionality, Local Independence, Item Difficulty Level, Separation, Different Item Functioning (DIF), and Scale Calibration) ?

To fulfil the third objective:

RQ4. What is the extent of criterion validations (predictive validation and concurrent validation) of the Digital Citizenship Instrument of Secondary School Students in Malaysia (MyDCi) ?

1.6 Significance of Research

Assessing and fostering digital citizenship practices is essential for the comprehensive development, well-being, and success of students in the current digital learning era. This study introduces a new instrument crafted specifically for the Malaysian context, considering the cultural nuances and distinct challenges experienced by secondary school students in Malaysia. Aligned with the educational expectations set by Malaysia and reflecting the insights gained from the country's digital citizenship initiatives, this instrument acts as a reliable and valid means to uncover the extent of digital educational outcomes and initiatives in Malaysia. This understanding is derived from an examination of the digital citizenship practices exhibited by secondary school students.

This study initiates discussions on a proposed digital citizenship concept, contributing to the advancement of the existing digital citizenship theory (Ribble, 2011). Through refining construct definitions and extending subconstructs, the research enhances the accuracy of assessment items. It also delves into the cross-cultural reliability of Ribble's theory, evaluating its applicability in the Malaysian context.

This study adds to the body of knowledge in educational research, specifically in the realm of digital citizenship measurement. It provides insights that set the stage for future studies and enhancements in evaluating the level of digital citizenship practices. With the potential to offer a comprehensive understanding, the study incorporates overlooked psychological perspectives. By integrating concepts like digital wellness, digital resilience, and digital spiritual development, it introduces novel insights and dimensions for a holistic measurement of digital citizenship. Furthermore, it enriches the literature on digital citizenship and contributes to emerging fields such as cyberpsychology, technogogy, and cybergogy.

This study plays a crucial role in empowering stakeholders to provide insightful information for informed decision-making. It contributes to the body of knowledge, offering a solid foundation and references with a reliable instrument to enhance and design targeted interventions, addressing specific needs among secondary school students and ensuring alignment with local requirements. This new instrument serves as a catalyst, informing the development of digital citizenship promotion and supporting a structured, effective approach to digital education in Malaysia. It fosters a more accurate understanding of students' digital citizenship practices and guides the crafting plans for integrating digital citizenship in formal educational settings. This may influence educational policies related to digital citizenship in Malaysia.

This includes enhancing current digital curricula to address digital issues and preparing future school leavers with the essential digital citizenship practices and living skills for the future, which entails highly advanced technology-dependent professions and society. Moreover, this study provides insights that enhance psychometric quality and enrich the understanding of digital citizenship indicators through the application of modern analysis techniques, specifically, the Rasch model. The potential of this instrument extends to enhancing future research findings, assisting researchers in

interpreting their results for more valid and fair judgments and drawing precise conclusions.

Consequently, these findings contribute to enhanced knowledge and understanding of the elements of digital citizenship, shaping its conceptualisation in secondary education in Malaysia. This study also encourages further research in the digital citizenship domain in Malaysia, particularly involving secondary school students. In conclusion, this study holds substantial significance by addressing the distinctive needs of the Malaysian context. It contributes valuable insights to the global conversation on digital citizenship education, especially in the area of measurement. Its significance lies on its potential impact on local educational practices and its role as a valid and valuable tool for future endeavors.

1.7 Scope and limitation

This study had a geographical focus to the school-based system in Malaysia without specific consideration for varying age ranges of secondary school students. Consequently, the indicators may not fully capture the digital citizenship levels of other educational levels of different ages or those outside the national educational system. Moreover, the instrument may be less suitable in other countries with distinct digital learning outcomes and national educational missions.

This study encompassing nine constructs of digital citizenship, focuses on the educational technology perspective rather than others such as political sciences. As a result, the findings may have limited generalizability to other digital citizenship perspectives and may provide a less reliable measurement for different research fields.

The specifically designed instrument in this study aligning with the current Malaysian curriculum, philosophy, policy, norms, ethics, beliefs, societal values, and culture. Thus, instrument needs to revalidated in other contexts of studies. Additionally, the proposed conceptualisation or measurement of digital citizenship might be limited for students in special needs education, such as learning disabilities, emotional or behavioral disorders, mental retardation, autism, giftedness, and physical or health disabilities. This study assumes the digital citizenship level based on students' willingness and ability, preventing identification of whether the practices result from other circumstances, such as unwillingness and inability, unwillingness but ability, or willingness but inability to practice.

This study relies on cross-sectional analysis may limit this study's ability to draw longitudinal conclusions, and the developed instrument that may not account for potential changes in technology, practices, or students' behaviours in the future. Another limitation stems from the use of self-assessed questionnaires (paper-pencil) with mail distribution, complicating the tracking and measuring students' actual digital citizenship practices. As self-reporting may not always reflect the complexity of behaviors.

1.8 Definition of terms

This subsection provides the meaning and definition of digital citizenship used and discussed throughout this study.

Digital Citizenship

Digital Citizenship is defined as "norms of appropriate, responsible behaviour with regard to technology use" comprising nine constructs: digital access, digital commerce, digital etiquette, digital health and wellness, digital law, digital literacy, digital rights and responsibilities, and digital security (Ribble, 2011). Digital citizenship was conceptualised in the context of secondary school students in Malaysia by aligning the mission and vision and the characteristics of digital citizens outlined in Malaysian educational outcomes. Thus, digital citizenship was operationalised as the practice of meaningful use of technology in empowering individual and society wellness by enabling digital resiliency in active online participation. Consequently, a positive digital culture could be normalised and manifested.

Digital Access

Digital access is defined as "full electronic participation in society" (Ribble, 2011). This study conceptualised digital access in terms of active electronic participation in society rather than passive participation. Active participation in society would contribute to self-development and community development, specifically participation in the matter of civic, lifelong learning and technological accessibility. Therefore, digital access defined as the practice of actively enabling online opportunities and expanding knowledge that benefits oneself and others.

Digital Commerce

Digital commerce is defined as "the electronic buying and selling of goods" (Ribble, 2011). This study conceptualised digital commerce not only from buying and selling practices, also online safe transaction practises. operationalised digital commerce as the practise of wise, safe, and trustworthiness of online financial-related matters to achieve financial wellness for oneself and others.

Digital Communication

Digital Communication is defined as "the electronic exchange of information" (Ribble, 2011). This study operationalised digital communication as the practise of effectively expressing opinions online to be comprehended well and positively understand others across cultural diversity.

Digital Etiquette

Digital etiquette implies "the electronic standards of conduct or procedure" (Ribble, 2011). This study operationalised digital etiquette as the practise of respect, manners, and courtesy by being sensitive or considerate of others when using digital technology.

Digital Health and Wellness

Digital Health and wellness is defined as "physical and psychological wellbeing in a digital technology world" (Ribble, 2011). This study operationalised digital health and wellness as the practise of actively achieving an optimum state of holistic wellness for oneself and others with the use of digital technology.

Digital Law

Digital law denotes "the electronic responsibility for actions and deeds" (Ribble, 2011). This study operationalised digital law as the practise of using digital technology legally while being aware of the national digital law, the consequences of law violation, and digital rights offered by the law..

Digital Literacy

Digital literacy is the "process of teaching and learning about technology and the use of technology" (Ribble, 2011). This study operationalised digital literacy as the practise of using digital technology competently to sufficiently gather information, critically evaluate information, and creatively process the information to produce new or positive meaningful digital information

Digital Rights and Responsibilities

Digital rights and responsibilities is defined as "those requirements and freedoms extended to everyone in a digital world" (Ribble, 2011). This study operationalised digital rights and responsibilities as the practise of using digital technology safe, fairly and responsibly to protect, maintain and expressing own rights (personal responsibility) and others rights (social responsibility) in online environment.

Digital Security

Digital security is defined as "the electronic precautions to guarantee safety" (Ribble, 2011). This study operationalised digital security as the practise of using digital technology securely and safely to protect personal information, identity, data assets, and online devices.

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