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Determining and Developing Teachers' Digital Skills Construct Instruments in the Context of Online Formative Assessment

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Abstract

The usage of digital tools and applications is a crucial component of delivering lesson content and evaluating students' learning, online formative assessments demand that teachers be tech-savvy. In this study, an instrument to measure teachers' digital skills was examined to analyze the implementation of the national primary school online formative assessment in Seremban. A survey method with quantitative approach was imply in this study. Nineteen ICT Skills items from previous studies have been adapted and modified and one question is constructed by the researchers themselves according to the context of the online formative assessment. Twenty of the items were verified by experts and a pilot study was then conducted with 100 teachers selected at random. The result revealed three dimensions i.e., component 1, Use of Digital Applications in Teaching Learning and Assessment, component 2 as Online Teaching and Learning Activities and component 3 as Digital Tool and Application Usage Skills have been formed using Exploration Factor Analysis (EFA), and internal reliability has been achieved for all three dimensions. The results offer a trustworthy source of information to researchers and professional practitioners of educational policies for the next study in the policy implementation of online formative assessment.

Keywords: Digital Skills, ICT Skills, Online Formative Assessment

Background

The 12th Malaysia Plan emphasizes the country's education leveraging technology to expand the process of teaching learning and assessment using digital technology (Economic Planning Unit, 2021). In line with this aspiration, Ministry of Education Malaysia has created a digital platform called Digital Educational Learning Initiative Malaysia (DELIMa). The platform was launched in July 2019 to enhance digital learning and continuous access in schools (Ministry of Education, 2019). Therefore, educators especially teachers from primary school level need to act to optimize their use and move together with this direction in order to achieve the formation of human capital balanced in terms of self-learning and digital skills in accordance with the educational needs of the 21st century.

Online formative assessments require teachers to be proficient in using technology as the use of digital devices and applications is a key asset to deliver the content of the lesson and assess the learning of the students. To connect online, teachers and students need devices such as computers, mobile phones and tablets through apps such as WhatsApp, Telegram, Google Meet, Zoom, Webex or using recorded videos (Çakiroğlu et al., 2020; Chien et al., 2019; Hashim & Shaari, 2020). Thus, these devices and applications will be able to help teachers to assess students and easily determine the level of mastery of students.

Digital skills are synonymous with ICT competencies, ICT skills, digital competencies, digital literacy and digital pedagogy as they all emphasize to teachers to use digital technology and integrate it into teaching and learning practices (Pettersson, 2018; Spante et al., 2018). Technology-era education requires a teacher's commitment to improve digital skills in the person (Sidin et al., 2020). Without these knowledge and skills, teachers will find it difficult to implement the online assessment process. Every provision of information, materials, communications or assessments is using internet access and technological equipment (Yusoff & Ali, 2018). The required skills are such as uploading and downloading teaching materials on portals, YouTube, mobile phones or computers, performing online lessons, providing written training in Google Form or Live worksheet and various applications that teachers can use to deliver teaching content so that assessment can be implemented (Abdullah et al., 2017; Mustafa et al., 2021). Therefore, digital skills are the main source of education today that teachers need to apply as an intermediary medium of the teaching, learning and assessment process (Curriculum Development Division, 2021). Hence, the objective of this study is to analyze and measure teachers' digital skills items in the context of online formative assessment of primary school teachers.

Methodology

The selection of the location of this study uses a purposive sampling strategy. The district of Seremban was chosen because its population is the most populous compared to other districts in Negeri Sembilan (Department of Education Negeri Sembilan, 2022). School selection and respondents using a simple random sampling strategy. The main criterion of respondents is that they have experience assessing students online. Spielberger and Gorsuch (1983) have suggested that a hundred respondents are needed for exploratory factor analysis (EFA) procedures. Therefore, 100 respondents were randomly selected to get the results. Questionnaires are distributed through Google Form. The use of a simple random sampling method gives each member of the population the opportunity to answer the study questionnaire. Therefore, the results can be generalized to the study chops.

Instruments

Twenty questionnaire items were equipped with a five-point Likert-type scale. Score 1 - "strongly disagree", while a score 5 - "strongly agree". Nineteen items were adapted from the Tondeur et al.'s study (2017) with permission and one item was developed by the researchers themselves. Respondents were also asked to provide demographic details such as gender, duration of teaching experience, duration of face-to-face teaching experience and level of internet access.

The items in the questionnaire were comprehensively validated by experts for reliability and validity. Reliability is the level at which measurements are not affected by random errors and

reliable instruments provide consistent results (Cooper and Schindler, 2003). Face validity, content validity, and criterion validity are three forms of validity assessment. The face validity is the extent to which the measurement indicates the content of a given concept. In addition, the face validity and the content validity are related which refer to the descriptive set of items to represent a concept. Criterion validity refers to the level of correlation of an item size built into a variable (Zikmund, 2000). The content validity and the criterion validity should also be carried out before performing an exploratory factor analysis (EFA) to verify the validity and reliability of the item (Awang et al., 2018).

Exploration Factor Analysis (EFA) Procedure

The verified questionnaire was distributed to 100 randomly selected respondents to collect data for pilot study. EFA is carried out to explore and measure construct items. Awang (2012) and Hoque et al. (2018) assert that EFAs should be carried out for each construct to determine whether items will create a different dimension than previous studies. According to them, it is likely that a new dimension will exist due to the adaptation of the item to the new field of study, differences in background and population. Therefore, the current study will produce a new dimension from previous studies.

EFA for Digital Skills

The digital skills instrument consists of 20 items. Table 1 shows the descriptive statistics for each item that measures the construct. Scale from 1 (strongly disagree) to 5 (strongly agree) is used to provide various options. The standard of deviation is calculated to understand the distribution of data. The standard deviation defines the normal distribution of data based on error values and variance to identify the mean. Table 1 shows the mean and standard deviations for each item.

Table 1
Mean and Standard Deviation of Digital Skills Item Construct

Descriptive Statistics			
	Items	Min	Standard Deviation
KD1	I am adept at using digital tools to communicate with pupils (e.g., DIGITAL TOOLS: mobile phones, computers, laptops, tablets)	4.12	.755
KD2	I am adept at using digital applications to communicate with students (e.g., DIGITAL APPLICATIONS: Google Meet, Google Form, WhatsApp, Telegram)	4.09	.766
KD3	I can assess the students with the help of digital tools.	3.93	.855
KD4	I can assess students with the help of digital applications.	3.94	.885
KD5	I was able to track the progress of students' learning through digital gaming applications (e.g., GAME APPLICATIONS: Quizziz, Kahoot, Wordwall, Live worksheet)	3.81	.960
KD6	I give students exposure to search for information using digital tools.	4.04	.723
KD7	I provide teaching activities using various digital applications (example: Google Forms, Google Docs, Word, PowerPoint, Quizziz, Kahoot, Live Worksheet, Wordwall)	4.01	.758
KD8	I give students exposure to methods to communicate information with friends during online teaching and learning.	3.79	.832
KD9	I teach students on how to communicate in an ethical way during online teaching and learning.	4.10	.717
KD10	I gave the students exposure to the current method of working online teaching and learning.	3.95	.743
KD11	I give exposure to students using digital skills during online teaching and learning.	3.90	.771
KD12	I use a digital application that fits the objectives of teaching, learning or online assessment.	4.08	.747
KD13	I use digital skills to provide online teaching, learning or assessment activities.	4.04	.723
KD14	I can design digital applications based on online teaching, learning or assessment objectives.	3.50	1.039
KD15	I am adept at designing online learning environments with existing digital infrastructure.	3.53	.947
KD16	I can choose an effective digital application for online teaching and learning.	3.84	.800
KD17	I give students the opportunity to express ideas creatively through digital applications.	3.79	.844
KD18	I provide activities that use digital skills to implement teaching	3.77	.789
KD19	I stimulate students to use digital skills critically.	3.71	.844
KD20	I motivate students to use digital skills positively.	3.86	.791

Table 2 shows *Bartlett's Sphericity* Test is significant ($p < 0.05$). Furthermore, Kaiser–Meyer–Olkin (KMO) measures the adequacy of sampling above the value of 0.6 (Awang, 2012; Hoque et al., 2018). Therefore, the data is sufficient for the data reduction procedure.

Table 2
KMO Score and Bartlett Sphericity Test

KMO and Bartlett's test		
measure of sampling adequacy *Kaiser-Meyer-Olkin*		.925
Bartlett Sphericity Test	*Approx. Chi-Square*	1962.855
	df	190
	Sig.	.000

Figure 1 shows the components resulting from the scree plot in the EFA procedure. This procedure produces three components out of 20 items. Each component represents a set of measuring objects. According to Awang (2012); Hoque et al (2018), the components of the matrix will determine the dimensions for each item.

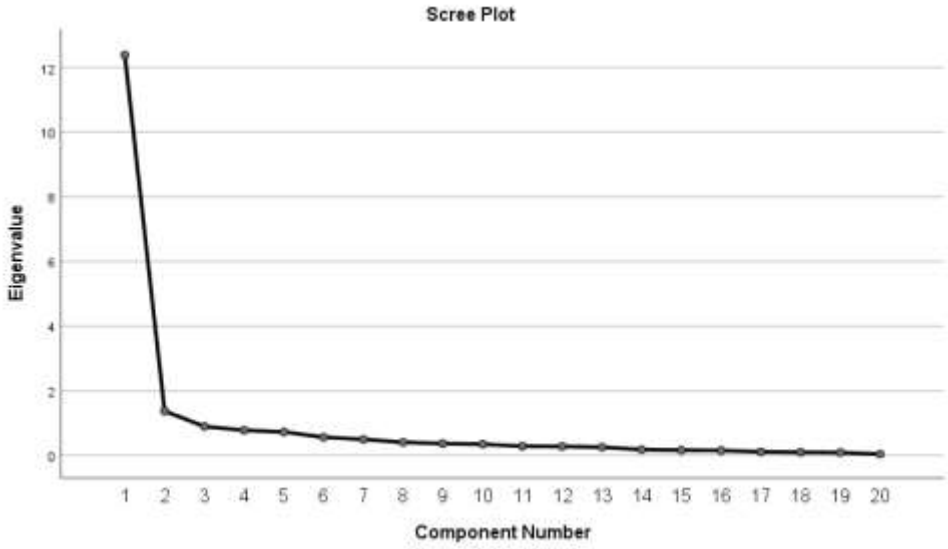

Fig. 1 Three components of the EFA procedure

Dimensions and Total Variance

The results presented in Table 3 show three components greater than the eigen value (>1.0). The extended value is between 4.614 and 5.074. Meanwhile, the variance for the first component is 25.371%, 24.821% for the second component and 23.071% for the third component. The total variance that measures this construct is 73.263%. This amount of variance is acceptable because it exceeds 60% (Awang, 2012; Bahkia et al., 2019; Hoque et al., 2018).

Table 3
Total variance of Digital Skills Construct

Total Variance Explained			
	Rotation Sums of Squared Loadings		
Component	*Total*	*% of Variance*	*Cumulative %*
1	**5.074**	**25.371**	25.371
2	4.964	**24.821**	50.191
3	**4.614**	**23.071**	**73.263**

The Principal Component Analysis (PCA) extraction method with VariMax (Variation Maximization) is implemented on 20 items. The three components derived from the EFA procedure are presented in Table 4. Factor loadings that exceed 0.6 are retained while items less than 0.6 will be dropped (Awang, 2012; Bahkia et al., 2019). Therefore, KD6, KD11, KD13 and KD20 items were dropped. This means that the total number of digital skill items is 26 items.

Table 4
Digital Skills Components and Items

Rotated Component Matrix[a]			
	Component		
	1	2	3
KD1			.688
KD2			.718
KD3			.851
KD4			.832
KD5			.754
KD6	Dropped		
KD7		.643	
KD8		.626	
KD9		.707	
KD10		.766	
KD11	Dropped		
KD12		.625	
KD13	Dropped		
KD14	.845		
KD15	.802		
KD16	.637		
KD17	.632		
KD18	.649		
KD19	.714		
KD20	Dropped		

The three components formed are component 1 as the Use of Digital Applications in Teaching Learning and Assessment, component 2 as Online Teaching and Learning Activities and component 3 as Digital Tool and Application Usage Skills.

Internal Reliability of Instruments

Internal Reliability of an item is calculated through the value of Cronbach's alpha. Internal reliability determines the degree of effectiveness of the set of items in measuring constructs. The value of Cronbach's alpha for items achieving internal reliability is above 0.7 (Awang, 2012). Table 5 shows the Cronbach's alpha score for each component.

Table 5
Internal Reliability of Each Component

Reliability Statistics		
Components	Number of Items	α
1	6	0.921
2	5	0.894
3	5	0.928

All items have achieved reliability as the Cronbach alpha score exceeds 0.7.

Conclusion

This study contributed to the measurement of digital skills construct, especially in the context of the online formative assessment of national primary school teachers in Seremban. The three dimensions of digital skills formed are component 1 as the Use of Digital Applications in Teaching Learning and Assessment, component 2 as Online Teaching and Learning Activities and component 3 as Digital Tool and Application Usage Skills. Measurement of reliability for three digital skill components items resulted in a high Cronbach's alpha value, with Bartlett test analysis (significant) and satisfactory KMO score (> 0.6). Thus, the factor loadings of each item are more than the minimum value of 0.6. The results showed that the items under consideration were applicable to this study.

Contributions

This study contributes to the field of online formative assessment by evaluating and testing suitable items to test the construct of teachers' digital skills. This construct item has been developed and verified. Items have been customized from various fields and modified to suit the field of study. The instrument has been verified through face validity, content validity and reliability. Researchers in the field of teaching, learning and online assessment can use these surveys in different locations.

Recommendations

This instrument is recommended for use in the field of educational technologies, in particular online assessment. In addition, it is recommended for future studies to measure more items that can explain the constructive component of digital skills. In addition, the output of this investigation can be adapted to the population of Chinese national school teachers, Tamil national schools, and secondary school teachers to compare the different outputs by using this instrument.

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