Measuring Indonesian EFL Teachers' Digital Creativity: Validation of Hoffmann's Digital Creativity Scale

Gunawan Suryoputro, Aulia Rahmanda, Fathia Amalia Sulthonah, Herri Mulyono*, and Sri Kusuma Ningsih

***Abstract*—The current study was part of a larger project on Indonesian EFL teachers' digital creativity. Specifically, the aim of the current research was to validate the digital creativity proposed by Hoffmann *et al*. by assessing the reliability of the instrument, its unidimensionality, the effectiveness of the instrument rating scale, and the differential item functioning used to gather data related to the Indonesian teachers' digital creativity. Quantitative methods were employed throughout the research. A total of 422 Indonesian EFL teachers of different ages, genders, and educational backgrounds participated in an online survey, which was then filtered until a sample size of 132 EFL primary school, 162 EFL junior high school, and 104 EFL senior high school teachers remained. The findings of this study showed that first, statistical results indicated that the instrument used was reliable, obtaining a Cronbach's alpha value of 0.99. Second, the instruments have achieved their research objectives in that there is an aspect of digital creativity which is considered in the teaching activities of Indonesian teachers. The results also suggested that there are differences in gender and age in EFL teachers' digital creativity. This paper can be a useful reference for further research related to aspects which need to be fulfilled by teachers in the development of online teaching, considering the deficiencies found and offering solutions in subsequent research papers.**

***Index Terms*—Digital creativity, EFL teachers, Rasch model, validation**

I. Introduction

Creativity is defined as a term which refers to the psychological abilities of someone to produce ideas, insights, and solutions that are both innovative and valuable for future use [1]. In the context of foreign language learning, creativity encompasses the innovation of teaching and learning in order to promote a meaningful language learning process [2]. A creative teachers can be indicated from their own developed strategies which allow their students to express themselves freely and be accountable for their actions [3]. Many authors argue that teachers must use their own creative teaching approaches to enable their pupils to use their own expressions in order to achieve communication objectives, and enable them to take part in a communication experience that is close to reality [2, 4, 5]. As such, teachers should shape their creative abilities in order to select appropriate types of teaching and learning methods, tasks, materials, and activities that not only correspond to their intended learning objectives but also attract the interest of their students [6].

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G. Suryoputro, F. A. Sulthonah, H. Mulyono, and S. K. Ningsih are with Universitas Muhammadiyah Prof. DR. HAMKA, Jakarta, Indonesia.

A. Rahmanda was Universitas Muhammadiyah Prof. DR. HAMKA, Jakarta, Indonesia.

*Correspondence: hmulyono@uhamka.ac.id (H.M.)

During the online learning established amidst the COVID-19 pandemic, teachers are expected to promote students' creativity skills through the utilization of digital tools in the classroom. This is because such technologies can be used to better access creative ideas and serve as a platform to showcase creative works [7]. Such an act of technology utilization to drive creativity is often referred to as "digital creativity".

In reference to teaching language practice, possessing a greater ability of digital creativity is very important for teachers. This is because teachers who have creative thinking, particularly in choosing methods and activities, have the potential to enhance their classes. For example, in a study conducted by Cho and Kim [8], they observed how language play in EFL classrooms could affect students' creativity, which resulted in students' increased motivation in communicating their ideas and increased metalinguistic awareness.

Many instruments have been designed to explore the levels of digital creativity and teaching creativity. One of which is Hocever's work on the Creativity Behaviour Inventory [9], which obtained a Cronbach score of $\alpha = 0.81$ for fine arts, $\alpha = 0.84$ for performing arts, $\alpha = 0.63$ for math-science, $\alpha = 0.89$ for crafts, $\alpha = 0.80$ for literature, and $\alpha = 0.74$ for music. Additionally, Carson *et al*. [10] developed the Creative Achievement Questionnaire (CAQ) to assess creativity achievement in ten categories of creativity, including music, visual arts, dance, creative writing, architectural design, humor, innovation, scientific discovery, film, and theatre.

Similarly, the English Language Teacher Creativity Scale (ELT-CS) used in Khodabakhshzadeh *et al.*'s [11] study examined teachers' creativity with their teaching effectiveness and measured the differences between men and women teachers. The scale was designed to assess how teachers foster creativity in their EFL learners. The questionnaire instrument consisted of seven creativity determinants: Originality and Elaboration, Fluency and Flexibility, Person (Teacher), Press (Environment) and Materials, Motivation, Independent Learning (Autonomy), and Brainstorming. The overall reliability of the questionnaire was 0.83, indicating its high level or internal consistency. Moreover, the scale reliability for each dimension was found to be high: Originality and Elaboration ($\alpha = 0.80$), Fluency and Flexibility ($\alpha = 0.75$), Person (Teacher) ($\alpha = 0.79$), Press (Environment) and Materials ($\alpha = 0.81$), Motivation ($\alpha = 0.78$), Independent Learning (Autonomy) ($\alpha = 0.72$) and Brainstorming ($\alpha = 0.76$).

With so many studies offering various instruments, Hoffmann *et al.*'s [12] study was reviewed as the most quantitative study that focused on an instrument for measuring creativity in digital environments. Their instrument, known as The Creative Behavior Questionnaire

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Digital (CBQD) scale, was used to measure the self-reported creative behavior in the digital domain, including activities such as creating or operating mobile apps, producing mash-ups of songs, or designing a website. The items were presented in the form of a rating, and participants were required to rate how often they had engaged in each of the thirty listed activities within a given timeframe. The scale used a 5-point response scale, with 1 representing "never" and 5 representing "4+times". Data analysis revealed that there were three factors present, along with their reliability results (α = 0.84, 0.73, and 0.77, respectively, for digital creativity achievement, school-related everyday creativity, and self-expressive digital creativity). These three factors were also found to be correlated with domains of the Creative Achievement Questionnaire (CAQ) ($r = 0.20$, $p = 0.003$; $r = 0.25$, $p < 0.001$; and $r = 0.31$, $p < 0.001$, respectively). However, the study did not focus on teachers, but instead utilized high school students as participants. While the current statistics have shown that many Indonesian teachers are from the millennial generation, the current study is necessary to provide an empirical evidence regarding the validity of the CBQD scales within a teachers' context.

The current study attempts to validate the internal reliability of the Indonesian version of Hoffmann *et al.*'s [12] instrument to measure teachers' teaching creativity. Previous studies mentioned have all been analyzed using SPSS, but the current study will use a different modelling to measure the validity and reliability of the instrument. Specifically, this study will employ Rasch analysis which has not been done previously. Rasch analysis is a psychometric model which can be used to monitor the quality of items in an instrument by assessing the items' difficulty levels and a person's ability level [13]. Thus, this study is important, as it contributes to the literature with an empirical illustration of the modern psychometric model—the Rasch technique—to observe the psychometric characteristics of the Indonesian version of Hoffmann *et al.*'s CBQD scale.

II. Methodology

A. Participants

The sample was gathered to observe teachers' digital creativity based on the Indonesian version of Hoffmann *et al.*'s [12] Creative Behaviour Questionnaire: Digital (CBQD). Data were collected online via a Google form that was shared on social media platforms, such as WhatsApp, Instagram, and Facebook, using a non-probability sampling method to survey a total of 422 willing participants between the beginning of January 2022 and the end of January 2022. Teachers from all school levels were invited, including 142 from primary schools, 170 from secondary schools, and 109 from senior high schools. The age range of participants varied from under 30 (N=222) to 30-40 (N=88) and above 40 (N=112). The gender majority consisted of female teachers (N=315) with males (N=107). All participants were filtered to meet the research criteria, resulting in 398 Indonesian EFL teachers meeting the determined criteria, with varying ages, genders, levels of teaching, and school statuses, as detailed in Table I.

TABLE I: Demography

Demography	Description (Code)	N_1	N_2
Gender	Male (M)	107	98
	Female (F)	315	300
Age	< 30 y.o (Y)	222	202
	30-40 y.o (A)	88	87
	> 40 y.o (O)	112	109
Level of teaching	Primary school (E)	143	132
	Junior high school (J)	170	162
	Senior high school (S)	109	104
School status	Private school (P)	220	207
	Public school (N)	202	191

Note: N_1 = initial sample, before screening (N = 422); N_2 = after screening (N = 398)

B. Instrument

The present study adapted Hoffmann *et al.*'s [12] questionnaire to measure the EFL teacher's digital creativity. This questionnaire, originally known as the Creative Behaviour Questionnaire Digital (CBQD), was initially developed to evaluate students' creativity, and consisted of three factors: Digital Creativity Achievement (DCA), School-based Everyday Creativity (SBEC), and Self-Expressive Creativity (SEC) as shown in Table II. The DCA construct consisted of 12 items, while the SBEC and SEC constructs each consisted of 10 items. These constructs referred to specific creative activities in 10 domains, such as visual arts, music, dance, architectural design, creative writing, humour, inventions, scientific discovery, theatre and film, and culinary arts. In the present study, the scale used the same 5-point response scale, with 1 representing "never," 2 = once, 3 = twice, 4 = three times, and 5 representing "4 or more times."

TABLE II: Digital Creativity Subscales

Subscales	**Number of items (N)**	**Item number in the scale**
Digital Creative Achievement (DCA)	Twelve items	Q2, Q8, Q11, Q12, Q13, Q14, Q17, Q25, Q26, Q27, Q28, Q30
School-based Everyday Creativity (SBEC)	Ten items	Q5, Q6, Q15, Q16, Q19, Q20, Q21, Q22, Q29, Q31
Self-Expressive Creativity (SEC)	Ten items	Q1, Q3, Q4, Q7, Q9, Q10, Q18, Q23, Q24, Q32

C. Design and Procedure

The current study employed a quantitative survey design to collect data. The CBQD questionnaire was translated into Indonesian using a back-translation procedure. Initially, the second author translated the whole items into Indonesian and then it was refined and evaluated by the first author, a lecturer in the English department fluent in both Indonesian and English. To retain the essence of the items, some modifications were necessary. As suggested by Nielsen [14], the translated questionnaire was proofread and revised in order to prevent any items from attaining differential item functioning which may benefit certain groups. Consequently, the authors made adaptations from English to construct more meaningful items in the study context. For example, the first item of the DCA, "Flickr (or similar site)?", was changed to "online for others to see?" Moreover, the authors removed

more specified application examples, such as "Xtranormal, GoAnimate or other?", "such as wroth1000, deviantart.com or other", "(e.g. part of trip you went to or something similar)", "(e.g. three minute fiction on the National Public Radio, worth1000 or other website)?" and "(e.g. speculated about possible developments)?", from DCA, SBEC, and SEC items respectively. Furthermore, certain items were made more specific, such as "figured out a new way to raise money for an activity, group or organization?" which was changed to "Made money from endorsements, advertising, or other payments, for your YouTube Channel, Instagram account, or other social network". These changes were performed to provide specificity to the general items.

The data collected were downloaded and saved in an Excel file. Subsequently, the data responses were sorted and coded into the predetermined codes by the researchers. The data were then analysed using the WINSTEP application (Version 4.4.1). Prior to the data being tested in the WINSTEP, the Excel file had to be converted to a formatted text. The analysis process was conducted in two stages. In the first stage, the data underwent a screening process to eliminate misfit data. These misfits indicated misbehaving participants (i.e. participants who did not take the questionnaire seriously to complete it) and the data that did not meet the criteria for Mean Separation Scores (MNSQ) above 2.0. Out of the 422 English teachers who taught English subjects in elementary, junior high, and senior high schools, 24 samples were proven to be outliers. The 398 remaining samples were then reanalysed in the second stage. This stage sought to uncover information regarding (a) unidimensionality, (b) the reliability of items and person separation, (c) rating scale, (d) item difficulty (e) person ability, (f) item bias, and (g) item differential function (DIF).

D. Data Analyses

The Rasch analysis is used to evaluate the reliability of the data for evaluating digital and teaching creativity [15]. According to Colledani *et al*. [16], the Rasch model is considered a latent trait analysis, providing a response of an individual to an item based on the item and individual characteristics. Furthermore, the Rasch model is an objective measure of valid data, regardless of the construct or instrument employed, as reported by Boone and Noltemeyer [17] as cited in Program Committee of the Institute for Objective Measurement [18]. This model has also been employed to evaluate, promote, and enhance tests. For instance, some researchers have employed Rasch analysis to assess the reliability, validity, and responses of participants in assessing training needs [19–22].

III. Results

A. Item and Person Separation Reliability

The reliability of the questionnaire was ascertained using internal consistency assessments, which were reflected in the summary statistics of the Rasch analysis, presented in Attachment 1. The global scale Cronbach's alpha for digital creativity was excellent ($\alpha = 0.99$). Reliability was likewise found to be excellent for each subscale of DCA ($\alpha = 0.98$), SBEC ($\alpha = 0.99$) and SEC ($\alpha = 0.99$). The item separation reliability of the global scale and each subscale was also determined to be excellent, indicating that the questionnaire items had an impressive ability to accurately measure respondents' responses. The summary statistics further revealed that the person separation reliability was excellent for the global scale (0.91 logit). The person separation reliabilities for each subscale of digital creativity, however, were lower than the established 'good criteria': DCA ($\alpha = 0.47$), SBEC ($\alpha = 0.72$) and SEC ($\alpha = 0.69$), with the digital creativity scale yielding a value of $\alpha = 0.85$. These results suggested that respondents in each subscale exhibited excellent reliability in responding the instrument items, though the subscale of digital creativity was lower than its person separation reliability. In conclusion, the results from item and person separation indicated that the instruments for the data were highly good, excellent and reliable.

Additionally, Attachment 1 also presents the item and person separation reliability within a global and each subscale. The reliability of person separation was considered excellent for global of digital creativity ($\alpha = 0.85$). Besides, for the subscales were as follows DCA ($\alpha = 0.47$), SBEC ($\alpha = 0.72$) and SEC ($\alpha = 0.69$). In reference to item and person separation index, the global scale was found greater than 3 logits (item separation index > 3) as it scored (global scale = 16.05 logit for item separation index and 3.20 logit for person separation index). Moreover, the person separation index for global scale and all subscales have met the criteria (>2). The global scale is 3.53 logit. The data analysis then showed that the instrument had an excellent quality.

B. The Analysis of Unidimensionality of the Items

Rasch analysis was initially focussed on the unidimensionality of the items, which is used to evaluate whether the item instrument is able to measure what it is intended to measure, or to identify whether the item instrument is measuring one construct or another. The analysis of this journal for global scale and subscales were conducted by measuring Principal Component Analysis (PCA). As Fig. 1 presents, Rasch Principal Component Analysis (PCA) for global scale and all subscales exceeded the threshold value of 20% of the variance data; the global scale was 45.6%. Moreover, the digital creativity subscale showed that DCA was 41.4%, SBEC 55.7%, and SEC 44%.

Furthermore, the Rasch analysis provided the eigenvalue of the Principal Component Analysis (PCA) for the first contrast, which was higher than two logits for the global scale and all of the subscales (Global Scale DC = 3.99 logits, DCA = 1.84 logits, SBEC = 1.94 logits, SEC= 2.04 logits). Thus, it was observed that the global scale and the digital creativity subscales had a dimensionality. On the other hand, Attachment 1 presented the result of unexplained variance in the 1st-5th contrast of the PCA of residuals, where the criteria for a good result was set at 5-10%; 3-5% for a very good result; and <3% for an excellent result. According to Attachment 1, the unexplained variance in the 1st-5th contrast of the global digital creativity scale (2.5% – 6.8%) was indicated as good, while the DCA (5.2% – 9.0%), SBEC (4.4% – 8.6%), and SEC (5.3% – 11.4%) were classified as good as well.

C. Effectiveness of the Rating Scale

This current study employed a five-point Likert scale to administer all questionnaire items, ranging from "Never" (1) to "4 or more times" (5). According to the Rasch criteria, the response category must have a value higher than 10; thus, the data shown in Table III from 1 to 3 (7311 (57%), 2057 (16%), 1421 (11%)) were all higher than 10. However, data from 4 and 5 (790 (6%), and 1157 (9%)) were below 10, suggesting that the scale was not suitable for the given criteria. Additionally, the adjacent thresholds distance across the rating scale ranged from −1.47 to 0.11 logits. The outfit MNSQ indicated that each rating scale was below the threshold of 2. The distinct curve across the response category and each peak also was not higher than 0.5 logits. Furthermore, the average calibration of the rating scale increased monotonically from −1.59 logits to 1.57 logits, and the Andrich threshold increased from nothing to negative (−0.19).

TABLE III: SUMMARY OF CATEGORY STRUCTURE OF 5-POINT RATING SCALES

Rating scale step number	Observed Person	Average Calibration	Outfit MNSQ	Threshold	Threshold Distance
1	7311 (57)	−1.47	0.91	NONE	(−1.59)
2	2057 (16)	−0.71	0.74	0.11	−0.57
3	1421 (11)	−0.28	0.76	−0.28	0.01
4	790 (6)	0.07	0.83	0.36	0.57
5	1157 (9)	0.11	1.63	−0.19	(1.57)

D. Item and Person Mapping

The Wright Map was developed to illustrate the distribution of person and item location on the same scale; this can also be utilized to understand person-and item-level difficulty on the same scale (see Fig. 1). The right side describes items that have been grouped based on Digital Creative Achievement (DCA) and the left side represents the number of respondents who filled the data. As indicated on Fig. 1, items Q14, Q28, Q13, Q11, Q30, and Q17 were revealed to be the most difficult, these were rarely selected by the respondents and found in the DCA construct. For example, the response to the item Q14, "how many times in the last year have you won an award for digital photography," suggested that most respondents had not won any award for digital photography in recent years. Similarly, the response to the item Q28, "won a contest for your digital art," illustrated that the participants rarely win contests of digital art. Moreover, the result for the item Q13, "sold something you've made on a website," showed that the respondents are seldom able to sell items made on a website.

Furthermore, items Q11 "Creating new content for video games (e.g., new levels or storylines)?", Q30 "Receiving payments from endorsement, advertising, or other sources via one's YouTube Channel, Instagram account, or other social networks", and Q17 "Creating something using a 3D printer" all suggest that most participants are unlikely to create content related to video games or even utilize a 3D printer while teaching.

The current findings revealed that most of the participants disagreed that they had ever earned money from social networks through endorsement, advertising, or other forms of payment from their YouTube Channel, Instagram account, or other social networks. Initially, the DCA subscales outlined by Hoffmannn *et al.* [12] were utilized to examine the participants' technical skills and knowledge through exploring their accomplishments with regard to digital technologies. As a result, the present study concluded that the instrument was successful in exploring Indonesian teachers' digital capabilities, such as utilizing websites, 3D printers, and/or video games. Additionally, difficult items pertaining to SBEC constructs were discovered, such as items Q31 "Raised money for a project using an online fundraising site", Q29 "Taken digital art classes such as Photoshop, 3D animation, computer graphics or other?", and Q20 "Created a podcast?". The result of Q31 was found to be correlated with item Q30, both of which asked participants if they had earned money through leveraging digital technology. Furthermore, the intensity of participants who chose to agree to Q29 may have explained why some of them have rarely won contests for digital art (Q28).

In Item Q1, which pertained to the SEC construct and Q5, pertaining to the SBEC, both were categorized as items which participants found easy to agree with. This indicates that most teachers agree with the behaviours of using PowerPoint, Prezi, KeyNote or other methods to deliver material in their class in order to increase digital creativity, as well as posting photographs online as a form of self-expression. The influence for individuals who post content and interact with others through social media to gain attention and followers has been identified as being driven by the need for validation and attention [23]. Additionally, Q39, "I provide opportunities for students to ask questions and express their ideas freely", indicates that English teachers or respondents are in agreement of allowing their students to ask questions and express their ideas. Likewise, Q40, "I accept suggestions and input from students, and listen to their questions seriously", indicates that many respondents are in agreement regarding the acceptance of suggestions and input from their students and listening to their questions seriously.

E. Item Bias

Differential Item Functioning (DIF) analysis is employed to analyse whether or not the items on the instrument exhibit bias in favour of a particular group of participants. The Rasch-Welch tests are used to evaluate DIF. Item bias is ascertained when the DIF contrast value is greater than 0.5 logits and the probability value in the Rasch-Welch is lower than 0.05 logits. For the purposes of this study, DIF was investigated based on demographic data, such as gender, age, school level and school identity.

As evidenced by Table IV, the demographic data indicates a gender and age bias for digital creativity. Specifically, Q14 (DIF F = 1.34 logits, DIF M = 0.75 logits, DIF contrast > 0.5, $p < 0.05$) revealed that female English teachers were more likely to receive recognition for digital photography than male English teachers. Additionally, Q20 (DIF A = 0.79 logits, DIF O = 0.81 logits, DIF Y = 0.28 logits, DIF contrast > 0.5, $p < 0.05$) demonstrated that English teachers aged 30 to 40 and those under 30 were less likely to create a

podcast than those aged over 40. However, for Q1, a lower likelihood was noted for those over 40 compared to those under 30 to post photographs online.

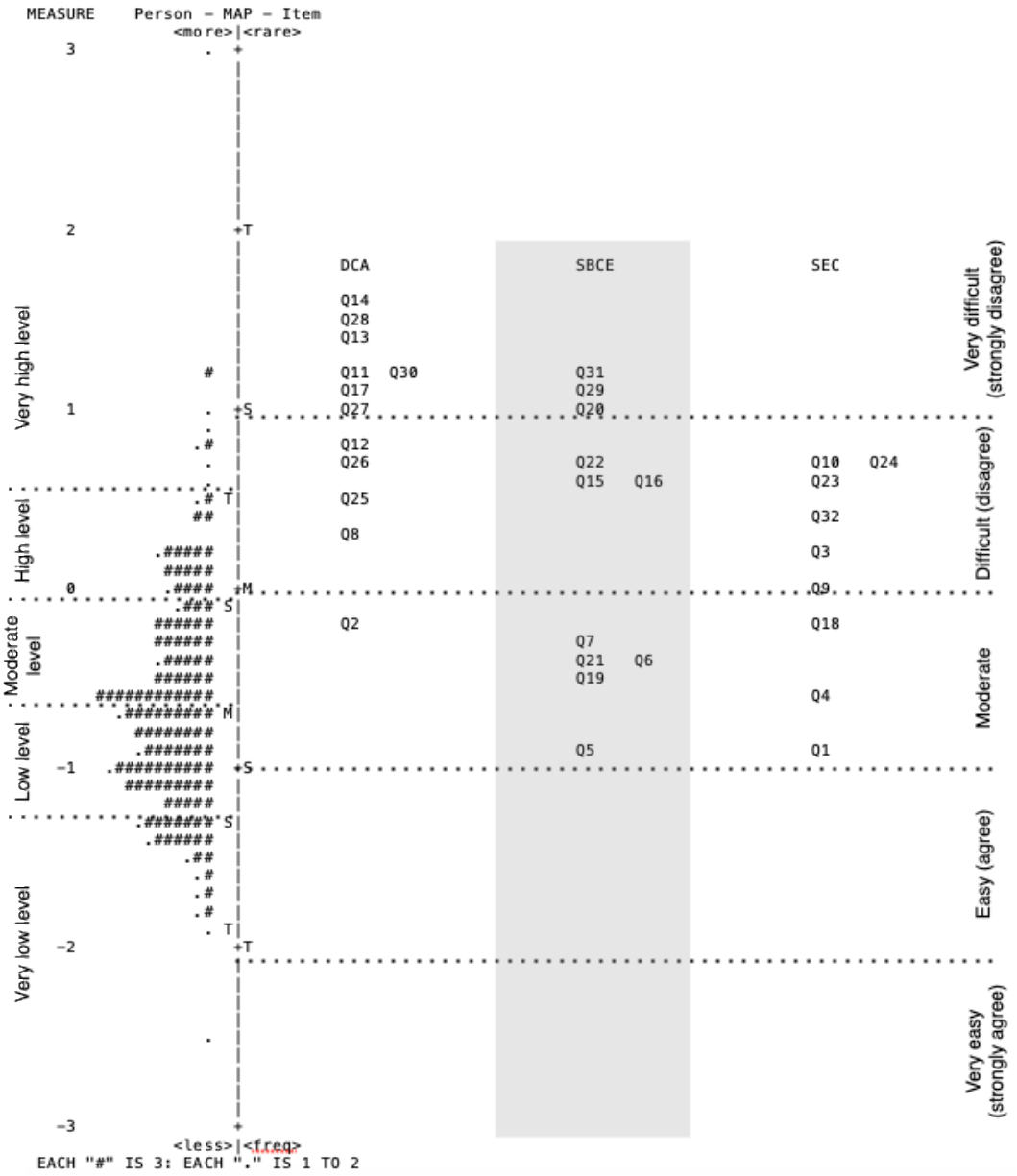

Fig. 1. Wright map.of the participants' responses to the instrument constructs

TABLE IV: DIF ANALYSIS BY GENDER AND AGE ON THE DIGITAL CREATIVITY SUBSCALE

Item	Gender	DIF Measure	DIF Contrast	T	Probability
Q14	F	1.34	0.58	2.90	0.00
	M	0.75			
Item	Age	DIF Measure	DIF Contrast	T	Probability
Q20	A	0.79	0.50	2.56	0.01
	Y	0.28			
	O	0.81	0.53	2.63	0.00
	Y	0.28			
Q29	O	1.00	0.59	2.61	0.00
	Y	0.41			
Q30	O	1.33	0.81	2.92	0.00
	Y	0.52			
Q31	O	1.57	0.78	2.20	0.02
	A	0.79			
	O	1.57	1.03	3.23	0.00
	Y	0.54			
Q1	Y	-1.05	0.63	6.13	0.00
	O	-1.68			

IV. DISCUSSION AND IMPLICATIONS FOR FURTHER VALIDATION STUDIES

The current study aimed to conduct a psychometric evaluation of the CBQD instrument from Hoffmann *et al.* [12], in order to provide users with practical knowledge about its properties and to suggest some potential opportunities for its future refinement and revision [24]. The results of Rasch measurement of the CBQD indicated that all subscales (i.e., Digital Creativity Achievement (DCA), School-based Everyday Creativity (SBEC), and Self-Expressive Creativity (SEC)) and the global scale were found to be reliable. As mentioned by the original developers of the scale, DCA requires the most technical skill and knowledge to complete tasks (such as creating a music video from a band and editing and posting a personal video to YouTube). The reliability of DCA was found to be different

to that previously reported by Hoffmann *et al.* [12] (α=0.84), while the current study found it higher (α=.98). Groening and Binnewies [25] suggested that digital achievement could be an effective method to improve students' performance. SBEC tasks in the CBQD involve the digital use of materials related to classroom activities, which may contribute to teachers' digital creativity in everyday practice. However, Pérez-Fuentes *et al.* [26], who also analyzed the academic performance of students using Hoffman's subscales, found SBEC to be relatively less reliable (α=0.625). Finally, SEC measures individuals' own creative efforts, with its reliability being corroborated by findings from Pérez-Fuentes *et al.* [27] (α=0.85).

In reference to item dimensionality, the results of the probability curve graph do not fit the curve on the response category, with each peak not exceeding the criteria of 0.5. Accordingly, the probability curve graph fails to meet the criteria. Moreover, the findings revealed that the global scale and digital creativity subscales indicate the presence of another construct, which is categorized as dimensional. These dimensionality findings, observed through the global scale and the digital creativity subscales, are consistent with the findings of past works using Rasch analysis from Silvia *et al.*'s [24] study exploring common creative activities related to the visual and performing arts. Their study concluded that the instrument tested showed solid dimensionality, as there was another presence of constructs that could be classified into levels (classes varied in intensity).

The Wright map item distribution revealed how the study participants responded to each item in the scale. Unfortunately, many Indonesian EFL teachers responded negatively to several items related to the achievement of digital photography (Q14), digital art (Q28), and money-making from their website (Q13). This is unfortunate, given that the participation in digital photography competitions can foster creativity, critical thinking, and the generation of ideas [28]. The present study also determined that such participation promotes the awareness of Education for Sustainability (EFS) in both the curriculum and co-curricular activities. According to Province [29], teachers and students who usually participate in digital art design contests tend to demonstrate an open-minded approach towards new ideas and resources, which can have a beneficial impact on their capacity for innovation. Additionally, taking part in digital art contests encourages students to tackle novel challenges and contests [30].

Furthermore, the study by Devedžić [31] suggested that if teachers intend to engage in entrepreneurial activities, such as selling products or services, they may encounter difficulty in calculating the cost of their product and setting a sales target. Similarly, Pushpanadham and Acharya [32] explored how teachers can improve the quality of education in schools by engaging in entrepreneurship. Accordingly, the findings of this study indicated that teachers are rarely venturing into selling goods produced with 3D printing technology or pursuing entrepreneurship while teaching. Additionally, the results of the research conducted by Törhönen *et al.* [33] uncovered that certain individuals create video gaming content and distribute it live or pre-recorded via platforms such as YouTube and Twitch. The purpose of this activity is to promote the game, assess its content, and demonstrate their experience in tournaments or events, for example, in creating Esports video content. In contrast, Putra *et al.* [34] determined that making video game content is commonly conducted by YouTubers as a way to share their enjoyable gaming moments as well as hobbies when they have a free moment. However, the current study found that Indonesian EFL teachers did not support the development of video game content. This could possibly be because most EFL teachers in Indonesia are not engaged in YouTubing or content production.

The current study found that the EFL teacher disagreed with the use of a 3D printer to present their teaching materials during teaching practice. However, Ford and Minshall [35] posited that a 3D printer can be used as a tool to deliver material to students during teaching practice [35]. A 3D printer in special education has been demonstrated to potentially serve a role as a tool for learning and creating educational aids for students [36]. The results also revealed that most participants disagreed with making financial gain from social networks through endorsement, advertising, or other forms of payments from their YouTube channels, Instagram accounts, or other social networks. In a study, Fay and Matias [37] reported that some teachers make video learning and teaching content for their classrooms or students; yet, it was not stated if teachers ever received payment from producing videos on YouTube. While few discussions have been made regarding making money from endorsements, advertising, or YouTube channels, Bhatnagar [38] found that YouTube itself can be a platform to acquire monetary profit and fame when the content is captivating and well-received. Moreover, people who are usually compensated for endorsements, advertising, YouTube channels, Instagram accounts, or other social networks are vloggers, though there is no specified sum of money they receive [39, 40].

Furthermore, difficult items were also found on the School-Based Everyday Creativity (SBEC) constructs, concerning raising money for a project (Q31), taking digital art classes (Q29), and creating a Podcast (Q20). Unfortunately, the study of Ford and Minshall [35] which utilized Hoffmann *et al.*'s [12] School-Based Everyday Activity Questionnaire yielded a different result. This discrepancy is likely due to the fact that their study focused on measuring the relationship between digital creativity, parenting style, and academic performance, unlike the present study which aimed to identify difficult items. Alpay and Gulati's [41] study, on the other hand, found that their students easily created podcasts in order to raise their motivation and develop their skills in podcasting technology. Conversely, creating a podcast affords a unique opportunity to be a creative individual in designing audio stories, thereby becoming a knowledgeable creator (see R. Armstrong *et al.* [42]). In reference to R. Armstrong *et al.*'s [42] study, students were given the task of creating a podcast with their group and sharing it with another group. Consequently, they can obtain insight into the other group's work and learn from it, thereby inspiring and introducing new techniques and ideas. Furthermore, teachers agreed that they rarely complete such activities in their classroom practice since the SBEC is the only scale that captures individuals' behaviour in

school-based activities and can have an effect on their digital creativity [12].

The findings of the study also showed that most teachers agree with using PowerPoint, Prezi KeyNote, and other media in the classroom to increase digital creativity, as well as posting photographs online as a form of self-expression [43]. Additionally, many teachers are driven by the need for attention and validation [23], which is consistent with Q1 of the study. Q39 of the study indicated that the respondents agreed to giving their students the opportunity to ask questions and express their ideas freely. This move is beneficial, as providing a creative media allows students to express their emotions more freely, particularly if they have difficulty expressing their ideas [44]. This is in line with the study from McBain *et al.* [45], which suggested that participants agree that expressing ideas and feelings is important and may influence the creative process in making their work more metaphorical.

Moreover, with regard to the Q40 "I accept suggestions and input from students, and listen to their questions seriously", many respondents agreed that they would accept suggestions and input from their students, and listen to their questions seriously. According to Wang [46], this behaviour relates to the psychological concept of suggestibility, or an individual's propensity to accept judgement or feedback from external sources. The current findings concur with those of Wang [46], as when applied in English teaching by lecturers, this concept may become beneficial in helping to build confidence, and realize an individual's full potential, based on the feedback given.

The current study also found that there was a difference in response probabilities between members of different participant groups, with similar levels of trait, suggesting the presence of item differential functioning (DIF) [24]. For instance, when an item is presented to participants from different groups and only one group is favoured in the responses, the item is classified as DIF. In this study, DIF items were found in two participant groups: gender and age. The findings concerning gender correspond to those of Shao *et al.* [47], which found that there was a significant difference between women and men, with exploitative use of digital technology advantaging women more than men and explorative use advantaging men more than women in terms of developing digital creativity. This, they argued, may be because female employees tend to be more conservative when using digital technologies and be more thorough in processing information.

In regards to DIF, Item 14 of the DCA subscale, "Winning an Award for Digital Photography," exhibited distinct behaviour for both genders; specifically, female English teachers were more likely to have won an award for digital photography than male English teachers. This finding contrasts with Hoffmann *et al.*'s [12] earlier research, which revealed that female English students had a lower score than male English students. This discrepancy could be attributed to the fact that English teachers in Indonesia are mainly female rather than male. Furthermore, this finding diverges from Conradty and Bogner's [48] previous study, which found no gender differences in measuring creativity. Additionally, there were age-related differences in five items (items 20, 29, 30, 31, and 1) of the DSC scale. It can thus be concluded that there are differences in gender and age between EFL teachers' digital creativity.

The present study identified several drawbacks. It had an imbalanced gender ratio, with 75.4% female and 24.6% male teachers. In terms of teaching levels, the sample was dominated by secondary school teachers (40.7%), followed by primary school (33.16%) and high school teachers (26.13%). Additionally, 50.75% of the participants were from teachers aged below 30 years old. The current study did not include interviews, as the researchers only conducted the measurement at a single time point. Therefore, it is recommended that further studies be designed to explore the topic in greater depth, using a qualitative approach. It is also suggested that a more varied sample, for the purposes of time-wise invariance (i.e. longitudinal DIF) and to assess the generalizability of the subscales, be included in the study [14].

V. Conclusion

The Hoffmann *et al*. Digital Creativity Scale was employed to measure Indonesian English as a Foreign Language (EFL) teachers' digital creativity in this paper. Results revealed acceptable levels of reliability, suggesting that the instrument is suitable for assessing Indonesian EFL teachers' Digital Creative Achievement (DCA), School-Based Everyday Creativity (SBEC), and Self-Expression Creativity (SEC). However, some questions were found to be incompatible and too general for the target participants and, as such, six items of DCA and two items of SEC were modified in order to ensure their applicability and specificity. Moreover, demographic factors such as gender and age were also reported as having an effect on the digital creativity scores, as presented in Table IV.

Therefore, the current study validated the internal reliability of the Indonesian version of the Hoffmann *et al.*'s instrument, which had not previously been done. The study findings further suggest that the translated instrument is appropriate for measuring teaching creativity among Indonesian teachers. It could be concluded that the study has enrichened empirical literature by presenting a psychometric illustration of the Rasch technique, as applied to the Indonesian version of Hoffmann *et al.*'s instrument termed Creative Behavior Questionnaire: Digital (CBQD).

Appendix

Attachment 1. Summary of Statistics

Parameter (with quality criteria)	Global Scale	Digital Creative Achievement	School-based Everyday	Self-Expressive Creativity (SEC)

		(DCA)	Creativity (SBEC)	
Model fit: Summary of items				
Item mean in logits (criteria: 0.0 logits)	0.00, SD = .65	0.00, SD = 0.53	0.00, SD = 0.80	0.00, SD = 0.52
Item reliability	0.99	0.98	0.99	0.99
Item separation reliability (criteria: good, 0.81 – 0.90; very good, 0.91 – 0.94; excellent, >0.94)	0.99	0.98	0.99	0.99
Item model fit MNSQ range extremes (criteria: good, 0.5 – 1.5; very good, 0.71-1.4; excellent, 0.77-1.3)	Infit 0.76 – 1.54 Outfit 0.58 – 1.80	Infit 0.76 – 1.44 Outfit 0.46 – 1.53	Infit 0.93 – 1.27 Outfit 0.81 – 1.21	Infit 0.79 – 1.45 Outfit 0.75 – 1.52
Item separation index (criteria > 3)	10.22	6.91	12.31	9.9
Separate item strata = [(4 x separation index) + 1]/3 (criteria: fair, 2-3; good, 3 – 4; very good, 4 – 5; excellent, >5)	13.96 ≈ 14 level	9.55 ≈ 10 level	16.75 ≈ 17 level	13.53 ≈ 14 level
Model fit: Summary of persons				
Person mean in logits (criteria: 0.0 logits)	−0.99, SD = .73	−1.75, SD = 0.80	−1.03, SD = .86	−0.65, SD = 0.66
Person reliability	0.85	0.47	0.72	0.69
Person separation reliability (criteria: good, 0.81-0.90; very good, 0.91 – 0.94; excellent, >0.94)	0.85	0.47	0.72	0.69
Person separation index (criteria > 2)	2.4	0.94	1.59	1.49
Separate Person strata = [(4 x separation index) + 1]/3 (criteria: fair, 2 – 3; good, 3 – 4; very good, 4 – 5; excellent, >5)	3.53 ≈ 4 level	1.58 ≈ 2 level	2.45 ≈ 2 level	2.32 ≈ 2 level
Rating Scale Analysis				
Responses per category (criteria: ≥ 10)	NA	NA	NA	NA
Adjacent threshold distance (criteria: 1.4 – 5 logits)				
Outfit MNSQ (criteria: < 2 logits)	NA	NA	NA	NA
Probability curve graph (criteria: distinct curve on each response category and each peak is higher than 0.5 logits)	NA	NA	NA	NA
Average measure (criteria: increases monotonically across rating scale)	NA	NA	NA	NA
Dimensionality				
Raw variance in data explained by measure (criteria: > 20%)	45.60%	41.40%	55.70%	44%
PCA eigenvalue for first contrast (criteria: > 2.0 indicates presence of another dimension; ≤ 2 supports unidimensional scale)	3.99	1.84	1.94	2.04
Unexplained variance in 1st-5th contrast of PCA of residuals (criteria: good, 5-10%; very good, 3-5%; excellent, <3%)	2.5% – 6.8%	5.2% – 9.0%	4.4% – 8.6%	5.3% – 11.4%

(Table adapted from Ling Lee, W., Chinna, K., & Sumintono, B. (2021). Psychometrics assessment of HeartQoL questionnaire: A Rasch analysis. European journal of preventive cardiology, 28(12), e1-e5.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

G. Suryoputro conceptualized the study, acquired the funding, supervised the research activity, wrote and reviewed the article. A. Rahmanda did the study investigation, applied the study methodology into the practice, curated the data, performed the formal analysis and visualization, wrote the first draft. F. A. Sulthonah did conceptualization, helped applied the study methodology and resources, curated the data, did the formal analysis, supervised the study, wrote the draft. H. Mulyono did the investigation, curated the data curation, carried out formal analysis, validated the study findings, wrote, edited and revised the manuscript. S. K. Ningsih supervised the study, validated the findings, wrote, reviewed and edited the manuscript, managed the project administration.

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