



Grit scale development and validation using rasch model: cross-cultural adaptation

Desarrollo y validación de la escala grit mediante el modelo rasch: adaptación transcultural

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Received: 28-12-24

Accepted: 08-09-25

How to cite in APA

Andrianie, S., Wiyono, B. B., Atmoko, A., Setiyowati, A. J., Hidayah, N., Ramli, M., Aren, M., & Putra, F. W. (2025). Grit scale development and validation using rasch model: cross-cultural adaptation. *Retos*, 73, 104-115. <https://doi.org/10.47197/retos.v73.112440>

Abstract

Introduction: Grit is a psychological trait that has received significant attention in various studies, particularly in an academic context. This trait is considered an important factor for student success in academic fields.

Objective: The purpose of this study was to develop and validate a Grit Scale adapted from Duckworth's Grit-O scale to measure the grit level of university students.

Methodology: The methodology used in this research is quantitative. The data collection instrument uses the Grit-O scale with a total of 12 items. The sample in this study amounted to 461 students spread across several regions of Indonesia. Data analysis used the Rasch Model, namely Winstep software.

Results: Data analysis showed the item reliability index was 0.99. The polarity angle of the items indicates that each item can contribute to student grit because the point-measure correlation value for each item is between 0.33 and 0.55. The item ideality test on the instrument shows that the item outline can be used.

Discussion: Overall, the Grit-O scale developed for students has good validity and reliability. Therefore, the Grit-O scale adapted for Indonesian society can measure the level of grit that exists in students in the construct of consistency of interest and persistence in trying.

Conclusions: The Indonesian version of the Grit-O scale items has high validity and reliability, so they can be used to measure student grit at university.

Keywords

Grit-O scale; grit; develop; validate.

Resumen

Introducción: La determinación es un rasgo psicológico que ha recibido mucha atención en diversos estudios, especialmente en el contexto académico. Este rasgo se considera un factor importante para el éxito de los estudiantes en el ámbito académico.

Objetivo: El propósito de este estudio fue desarrollar y validar una escala de determinación adaptada de la escala Grit-O de Duckworth para medir el nivel de determinación de los estudiantes universitarios.

Metodología: La metodología utilizada en esta investigación es cuantitativa. El instrumento de recopilación de datos utiliza la escala Grit-O con un total de 12 ítems. La muestra de este estudio ascendió a 461 estudiantes repartidos por varias regiones de Indonesia. El análisis de datos se realizó utilizando el modelo Rasch, concretamente el software Winstep.

Resultados: El análisis de datos mostró que el índice de fiabilidad de los ítems era de 0,99. El ángulo de polaridad de los ítems indica que cada uno de ellos puede contribuir a la determinación de los estudiantes, ya que el valor de correlación punto-medida de cada ítem se encuentra entre 0,33 y 0,55. La prueba de idealidad de los ítems del instrumento muestra que el esquema de los ítems puede utilizarse.

Discusión: En general, la escala Grit-O desarrollada para los estudiantes tiene una buena validez y fiabilidad. Por lo tanto, la escala Grit-O adaptada a la sociedad indonesia puede medir el nivel de determinación que existe en los estudiantes en el constructo de consistencia de interés y persistencia en el esfuerzo.

Conclusiones: Los ítems de la versión indonesia de la escala Grit-O tienen una alta validez y fiabilidad, por lo que pueden utilizarse para medir la determinación de los estudiantes universitarios.

Palabras clave

Escala Grit-o; grit; desarrollar; validar.

Introduction

Today the study of grit is broadly defined as persistence and passion for long-term goals (Howard et al., 2019; Lund et al., 2019). Grit is a psychological trait that has received significant attention in various studies, particularly in an academic context. This trait is considered an important factor for student success in academic fields (Paramitha et al., 2024). The study of grit has attracted a lot of attention from various researchers, especially administrators in universities. Not only that, the study of grit is a topic of concern in various fields of scientific study, especially in the field of psychology (Direito et al., 2021; Shafique et al., 2022). One of the beginnings of research on resilience was conducted by Angela Lee Duckworth in 2007 (Tang et al., 2019; Terry & Peck, 2020). Duckworth is an expert in the field of educational psychology who pursues resilience research by taking several research subjects from Ivy League students, the United States Military Academy, to national level spelling bee contestants. Duckworth (Duckworth & Gross, 2014; Duckworth et al., 2007) assumes that there are individual differences that can predict one's success. One of these important predictors is a non-cognitive trait called grit or tough in Indonesian.

Grit is a personality factor that describes differences in individual abilities in achieving academic success (Credé, 2018; Sriram et al., 2018). Research conducted by Whipple & Dimitrova-Grajzl (2020), explains that grit is a counterproductive mechanism in research. Because research on grit always associates poor learning outcomes as a result of the impact of low economic status (Zisman & Ganzach, 2021). While grit in research conducted by Du et al. (2023); Ratnawati et al. (2018), grit is also associated with high academic achievement and good learning performance. Furthermore, Grit is a non-cognitive ability, so it can be influenced by external factors such as culture (Burhanuddin et al., 2023; Wong et al., 2018). In other words, grit does not have a positive relationship with Intelligence Quotient (IQ), but has a relationship with conscientiousness (Setiyowati et al., 2020; Sharma et al., 2018). So, grit is something that exceeds the capacity of a person's IQ. This can also be interpreted that a person can achieve success with continuous effort and focus or consistency on what is being done (Tang et al., 2019).

Until now, Duckworth still uses persistence and consistency of interest as components or dimensions of grit. The definition of each of these dimensions is the persistence dimension and the interest consistency dimension. An individual can be said to be diligent when he makes efforts continuously and is carried out with hard work. According to Duckworth and colleagues a person can be said to be diligent if he has a great effort in facing challenges. Meanwhile, consistency of interest can be interpreted as individuals who have interest and continue to be maintained even though they fail. However, the individual continues to have progress until he is successful. Maintaining interest does not only apply for a day, month, or even yearly, but individuals consistently maintain their interest even in the failure phase (Duckworth & Yeager, 2015). Duckworth also added that individuals are also expected to have a passion that is like running a marathon, not a sprinter. This means that individuals have an unyielding spirit so that goals can be achieved (Guelmami et al., 2022).

A grit scale has been created and developed to measure grit characteristics. The grit measurement tool consists of two scales, namely the Grit-O scale (long version) and the Grit-S scale (short version) (Fosnacht et al., 2019; Schimschal et al., 2022). The Grit-O scale consists of 12 items (Duckworth et al., 2007) and the Grit-S scale consists of 8 items (DUCKWORTH & QUINN, 2009). The Grit Scale has been adapted by several countries such as Russia (Tyumeneva et al., 2019), Philippines (Datu et al., 2017), Malaysia (Tan et al., 2019), Oman (Alhadabi & Karpinski, 2020), China (Li et al., 2023), and India (Kuruveettissery et al., 2023). Of the many countries that have adapted the grit scale, there are no researchers who have adapted the grit scale in Indonesia.

Indonesian society has uniqueness such as collectivistic and individualistic cultures, multicultural origins of society, as well as variations in educational models such as formal education and informal education which are predicted to influence the role of grit in the learning abilities and achievements of Indonesian students (Junaedi et al., 2022; Sucipto et al., 2021; Wiyono et al., 2023). In Indonesia, research on grit is only limited to descriptive and correlational research (Ratnawati et al., 2021). According to the researchers, it is important to develop and modify a grit measuring tool, considering that there are still rare studies using grit measuring tools in Indonesia. Not only that, the grit measurement tool is also not necessarily acceptable to the people in Indonesia because of the multi-culture. Therefore, this research

was designed to develop a grit measurement tool in accordance with the culture in Indonesia. It is possible for a new interpretation to arise in Indonesian society. So that this research has the aim of validating the grit scale that has been developed by Duckworth by adjusting aspects of the psychological dimensions that are appropriate to the culture or conditions of individual people in Indonesia.

Method

This study applied a quantitative approach to analyzing the Grit-O Scales, using the Rasch model to validate to students' grit in completing their studies. Rasch analysis offers more advantages over other methods, namely, it is capable of predicting missing data based on individual response patterns (Folastri et al., 2023; Sumintono, 2018). In instrument validation, the use of Rasch analysis provides more thorough information about the instrument and is more consistent with the instrument's definition (Bond & Fox, 2013).

Participants

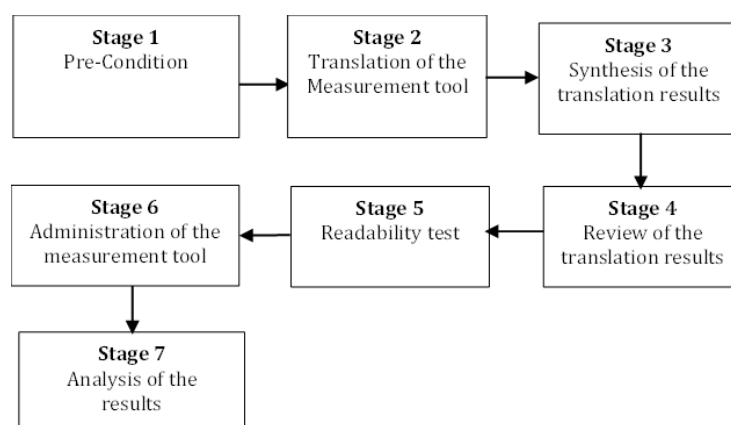
The total number of respondents in this study was 461 students from 15 universities located in western, central and eastern Indonesia. Respondents consisted of 127 male students and 337 female students with different educational and ethnic backgrounds. The number of male and female student samples was unbalanced because the researcher used random sampling techniques. The respondent's first language is Indonesian. All respondents participated voluntarily and received information about the research objectives that the researchers provided to the university where the data was collected and the names of the respondents were coded to maintain the confidentiality of the respondents.

Procedure

Instrument

The instrument used in this study is the Grit-O scale which consists of 12 statement items with alternative answers 1 to 4 (Duckworth et al., 2007). The Grit-O scale that has been developed by Angela L. Duckworth, Christopher Peterson, Michael D. Matthews, and Dennis R. Kelly in 2007 is adapted by continuing to use two measurement constructs by adjusting the statement items and alternative answers to the conditions of Indonesian society. The two measurement constructs used are consistency of interest and persistence in trying (Duckworth et al., 2007; DUCKWORTH & QUINN, 2009). The process of developing the Grit-O scale so that it is suitable for the conditions of Indonesian society involves three experts in the field of perseverance and interest in revising the adapted instrument. Several students were also invited to provide input and suggestions for the instrument being developed. The process of adaptation to the Grit-O scale follows the adaptation procedure of the measurement tool developed Commission (2019) and Erawati et al. (2025). The steps can be seen in the image below (Figure 1).

Figure 1. Measurement Tool Adaptation Stage



Stage 1: Pre-Condition. At this stage, the researcher sent an email to Angela Duckworth, creator of the Grit-O scale measurement tool, to obtain permission to adapt the Grit-O scale. On 5 February 2023, the researcher obtained written permission to modify and adapt the Grit-O scale for the Indonesian version. Stage 2: Translation of the measurement tool. The Grit-O scale was originally in English and was then translated into Indonesian by two translators certified by the Indonesian Ministry of Education. Stage 3: Synthesis of the translation results. The researchers synthesized the translation results from the second stage to identify differences between the two versions. After the synthesis process was completed, the items were translated back from Indonesian to English to ensure consistency between the adapted items and the original items. The results were then reviewed before the next phase began. Stage 4: Review of the translation results. The synthesis results from the third stage were presented for evaluation by experts. The selected experts were researchers with a focus on educational psychology or school counselling. Next, Stage 5: Readability test. A readability test was conducted on the items that had been translated from the Grit-O scale measurement tool, using an expert assessment approach. This assessment involves seven students from Universitas Nusantara PGRI Kediri. The test evaluates participants' understanding of the instructions and items provided. Based on the evaluation results, a detailed Likert scale specification is recommended for the Grit-O scale measurement tool. This description should explain that scores range from 1 to 4, indicating very positive responses to very negative responses. Then, Stage 6: Administration of the measurement tool. At this stage, the Grit-O scale was developed and distributed to participants who met the research criteria. Finally, Stage 7: Analysis of the results. The Indonesian version of the Grit-O scale was evaluated for psychometric quality using the Rasch model, first introduced by George Rasch in 1960 (Bond & Fox, 2013). This model is part of item response theory (IRT), which explores the relationship between item characteristics and the ability of individuals to respond to them (Cavanagh & Waugh, 2011). Rasch analysis not only provides fit statistics to assess how accurately items represent the overall subject population but also creates a hierarchical measurement framework for evaluating items and assessing subject fit within groups (Prieto et al., 2003). This approach addresses limitations that often arise when raw total scores are used (Ekstrand et al., 2022; Pendrill, 2019).

Data analysis

To determine the quality of the research instrument, it is necessary to pay attention to the validity and reliability of the measuring instrument to determine the ability of the item (Bond et al., 2020). Data analysis for instrument testing using the Rasch model analysis software, "i.e." Winsteps version 5.1.5.1. Georg Rasch developed the item response theory (or Item Response Theory, IRT) analysis model in the 1960s, which was later figures such as Benjamin Wright. The Rasch model can see interactions between respondents and items at the same time. In the Rasch model, the value is not seen based on the raw score, but a logit value that reflects the probability of selecting an item in a group of respondents (Ifdil et al., 2024).

Item validity refers to the polarity of an item. In determining the polarity of an item, point size correlation coefficient (PTMEA CORR) is used. If the high PTMEA CORR value is more than 3.8 (Arifin et al., 2010) or has an index value between 0.20 and 0.79, then an item can differentiate abilities between respondents. A negative or zero value indicates a relationship between an item or respondent's response to the variable or construct (Linacre, 2009).

The measurement of the reliability of the Grit-O scale is seen based on the level of fit of the items (fit) with the Rasch measurement model. This means that the adapted scale is reliable and the number of items is sufficient to measure a construct. Accepted scale reliability index > 0.8 (Bond et al., 2020).

Ethics Approval

This study adheres to ethical principles by ensuring participant confidentiality. The participants consented to participate in this study and the publication of the results in accordance with ethical approval. Ethical approval Number: 15.5.6/UN32.14/PB/2024 was obtained from Lembaga Penelitian dan Pengabdian Kepada Masyarakat (LPPM) Universitas Negeri Malang, Indonesia.



Results

The results of data processing on the Grit-O scale developed or adapted according to the conditions of Indonesian society. The results of the overall analysis can be seen as follows.

Table 1. Summary of quality Grit-O Scale (n items = 12)

Estimation	Values
Item Reliabilities	0.99
Mean Item	0.00
Mean Outfit MNSQ	1.01
Raw variance explained by measures	37.8%
Cronbach Alpha (KR-20)	0.89

Note: Andrianie et al. (2025).

Table 1 above explains the results of the Grit-O scale reliability analysis for students of 0.99 which is at a very good level. In other words, reliability is close to a perfect score. Furthermore, unidimensional estimation through principal component analysis (PCA) identified a raw variance value explained at 37.8%, this means that the unidimensional instrument condition has been reached ($> 20\%$) (Linacre, 2009). This shows that the 12 instrument items can measure student persistence. Next, the second part regarding the classification of appropriate and inappropriate items on the instrument can be shown by comparing the MNSQ OUTFIT values of each instrument item. Outfit Mean Square (MNSQ) is a statistic used to evaluate model fit in data. An ideal Outfit MNSQ is close to 1, indicating that the data fits the model used. Values that are too far from 1, either too high or too low, indicate problems in the fit of the data to the model, such as inconsistent or overly predictable data. In the results of Table 1, the average MNSQ OUTFIT value is +1.01 logit. This means that the 12 items on the Grit-O scale indicate that the respondents' data fit the model used. Additionally, the results of the Cronbach Alpha analysis (KR-20) show a score of 0.89 (> 0.8), indicating that the interaction between the items and the respondents is at a very good level.

The next analysis carried out is to analyze the score of each item contained on the scale. The results of this analysis aim to ascertain whether there are items that need to be discarded or not. In the original output, the outputs have been sorted by Winstep by difficulty. But the researcher edited and rearranged the items sequentially. the order of difficulty levels can be seen on the wight map. The size score indicates the difficulty level of our item. The MNSQ infit-outfit shows whether the scale developed is in accordance with the Rasch model. PTMEA CORR stands for Point Measure Correlation, or almost the same as point-biserial correlation in classical test theory (Nur et al., 2025). This parameter indicates the item's discrimination power. For further details, see the table below.

Table 2. Validity Item and Ideality Model (Fit) Item

Construct	Item	Score Measure	Model S.E	Infit MNSQ	Outfit MNSQ	PTME CORR
Interest Consistency	Item1	-0.88	0.07	0.74	0.75	0.42
	Item2	1.18	0.06	0.93	0.99	0.33
	Item3	0.44	0.06	1.18	1.18	0.48
	Item4	-0.71	0.06	1.21	1.24	0.47
	Item5	0.94	0.06	0.98	0.97	0.51
	Item6	0.90	0.07	0.76	0.76	0.50
Perseverance in Endeavor	Item7	0.32	0.06	0.95	0.96	0.55
	Item8	0.65	0.06	0.96	0.97	0.51
	Item9	-1.03	0.07	0.89	0.85	0.46
	Item10	-0.04	0.06	1.06	1.17	0.36
	Item11	0.73	0.06	1.44	1.43	0.37
	Item12	-0.69	0.06	0.75	0.76	0.44
Mean		0.00			1.01	
S.D		0.77			0.23	

Note: Andrianie et al. (2025).

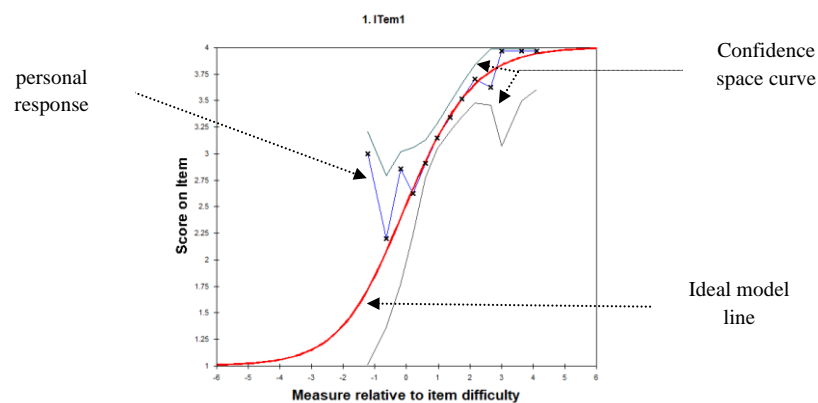
Item validity refers to the polarity of an item. In determining the polarity of an item, the PTMEA CORR point-size correlation coefficient is used. The results showed that item polarity in the interest con-

sistency construct was 0.42 to 0.51, and the persistence construct was 0.37 to 0.55. Following the criteria recommended by Linacre (2009). Furthermore, to find out which items are inappropriate and the accuracy of the items can be seen from the ideal items through the Oufit MNSQ value. Following the criteria recommended by Bond et al.(2020) and Ramdani et al. (2020) the results show that the MNSQ Outfit value ($0.5 < \text{MNSQ} < 1.5$) all items fit the Rasch model.

As seen in Table 2, the average logit value of the items is 0.0 logit. If the average logit is 0.0, this indicates that the Grit-O scale is relatively balanced in predicting both possible outcomes. In other words, the measuring instrument can be used as a measuring instrument overall. The average value of a logit item of 0.0 is a random value assigned to express a probability of 50:50 which is nothing but the same measure of the ability level of the respondent and the level of difficulty of the item (Bond & Fox, 2013). If it turns out that the average logit item is not 0.0, then the overall instrument is not good.

Another option to see if an item from the adapted Grit-O scale has a misfit or not can be seen in the image below (Figure 2).

Figure 2. Measure relative to item difficulty

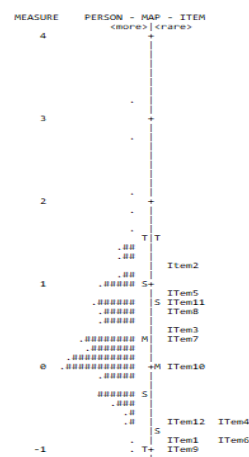


Source: Andrianie et al. (2025).

Figure 2 above shows that overall, the person's response in working on the items contained on the adapted Grit-O scale is almost on the ideal model line and there is no response that crosses the confidence space curve. This means that the adapted scale can measure the level of grit possessed by Indonesian students.

Furthermore, to see the distribution of subject abilities and the distribution of item difficulty levels can be seen on the wright map. For more details as follows (Figure 3).

Figure 3. Person Map Item



Source: Andrianie et al. (2025).

Figure 3 represents an Item-person map of the data (part of the map is shown due to length). The number on the right indicates an item and the “#” on the left indicates a person. Items and people located at the top of the scale are more difficult and more proficient respectively. On the other hand, items at the bottom of the scale are items that are easier to answer, while items at the top of the scale are items that are difficult to answer. The lowest threshold is -1.03 logit (item1) and the highest is 1.18 logit (item2). Theoretically, each subject has the opportunity to answer each question in the instrument correctly because they have abilities that tend to be equivalent to the difficulty level of each of these questions.

Discussion

Overall, the Grit-O scale developed for students has good validity and reliability. Therefore, the Grit-O scale adapted for Indonesian society can measure the level of grit that exists in students in the construct of consistency of interest and persistence in trying. The reliability index of the interest consistency construct is 0.99 and the reliability value for the persistence construct is 0.99 . This shows that the questionnaire has very good reliability. In the unidimensional item section (raw variance explanation) it shows a score of 37.8% ($> 20\%$) this means that the Grit-O scale can measure what you want to measure. As found by Alhadabi (2022) states that to adapt a scale, the score of the unidimensional item also determines the quality of the scale. Accordingly, Linacre (2009) supports that item reliability values from 0.67 to 0.80 are categorized as simple, 0.81 to 0.90 are categorized as good, and >0.91 are very good. While the reliability index of items and respondents received was >0.91 (T. Bond et al., 2020).

The results showed that the item polarity of all constructs was in the range of 0.33 to 0.55 . Following the criteria recommended by Linacre (2009), that the PTMEA CORR value must be higher than 3.8 or have an index value of 0.20 to 0.79 , it can be seen that all items have been in accordance. This means that the items contained in the construct or in other words the items on the Grit-O scale can be used to measure the persistence construct and the consistency of student interest in Indonesia.

The data processing above also shows that all the items analyzed meet the range of values received. but further testing is needed to find out which items are not appropriate. Table 2 shows that the Outfit MSQ average score meets the criteria related to item quality. This is in accordance with the recommendation of Sumintono & Widhiarso (2015) that an item is said to be appropriate if the MNSQ Outfit value obtained is in accordance with a predetermined value threshold.

Further evidence supporting the appropriate use of the adapted Grit-O scale is shown in Figure 2. In this figure it can be seen that almost all people's responses to the Grit-O scale are on the ideal line. This shows that the items on the Grit-O scale in their adaptation process match the conditions of respondents in Indonesia. Furthermore, from Figure 2, information is also obtained that there are no misfit Grit-O scale items, this can be seen from the response from the person who does not cross the existing confidence space curve.

In line with the results of the item quality analysis, Figure 3 shows how difficult the item is to be answered by the respondent. Figure 3 shows that items with code item2 (Logit score = $+1.18$) are in the top position, which are items that are difficult for respondents to work on. Furthermore, the figure also shows that the item coded item9 (Logit score = -1.08) is at the bottom, the item that is the easiest for the respondent to answer. Nonetheless, as a whole the Grit-O scale can be used to reveal the level of persistence and consistency of interest in the Indonesian region.

Overall, the results of the research data analysis are supported by the findings of Li et. al (2023) which states that an adapted scale must meet certain criteria, one of which is validity and reliability. The validity that can be done is construct validity and item validity (Kuruveettissery et. al, 2023). So, if the Grit-O scale meets several requirements for adaptation, then the scale is suitable for measuring grit.

From the results of the data analysis above, it also shows that Grit will bring out a strong working power towards the challenges faced, maintaining effort and interest from year to year despite failures, misfortunes and obstacles in the process (Muslihata et al., 2022; Rachmawati et al., 2021). When the grit character in students is higher, it will further reduce the level of student academic procrastination. The grit

character as a positive character will have a significant impact on the negative behavior of student academic procrastination (Lestari et al., 2024). Furthermore, the ability to maintain consistency of interest and perseverance in the context of final year students, means being able to remain consistent and diligent in doing the final project, despite many obstacles and temptations. Saturation in working on the final project, revision, difficulty consulting with the supervisor, are some of the many things that are considered to hinder the process of completing the final project (Multisari et al., 2022). So, it can be concluded that individuals with good grit not only complete current work but try to achieve greater goals over a long period of time, as well as self-control in maintaining consistency of goals and interests.

Conversely, culture plays a significant role in the development of the Grit-O scale. Cultural factors require the careful adaptation and validation of measurement tools to ensure their reliability and suitability when used with diverse populations (Birr et al., 2023; Cui et al., 2023; Fekih-Romdhane et al., 2022; Ibrahim et al., 2023). This study shows that, while country-specific differences may affect pooled data, adjustments such as separating Fit Items and MNSQ Outfit Items can maintain the validity of the measurement tool for cross-cultural comparisons. The results of the data analysis show that the two-dimensional structure of Grit-O (perseverance of effort and consistency of interest) is not entirely stable across cultures. In the Indonesian context, some items have different factor loadings compared to studies in other cultures. This suggests that Indonesian students may interpret perseverance differently to students from the culture of origin of the instrument. Furthermore, culture can influence how individuals view perseverance and consistency of interest. In Indonesia, environmental factors, cultural values and social expectations may cause perseverance to be viewed as more important than consistency of interest, or vice versa.

Conclusions

After going through the procedures for adapting and developing the instrument, it can be concluded that the adapted Grit-O scale is very feasible to use to measure the level of consistency of interest and persistence in students in Indonesia. This is evidenced by the item reliability value of 0.99 (> 0.94) which indicates that the quality of the item is very special. The data is also supported by Cronbach's alpha value (KR-20) of 0.89 (> 0.8), which means that the interaction between items and people is very good. Then for an undimensional value of 37.8% ($> 20\%$), this means that the Grit-O scale can measure what it should measure. The quality of the Grit-O scale can also be seen from the Outfit MNSQ and PTMEA CORR values that meet the requirements for Rasch analysis. The adapted Grit-O scale can be said to be ideal because it can be seen that the response from the person does not come out of the curve of the trust space and spreads around the ideal line. And for the level of difficulty of item items is almost even.

Culture influences the development of the Grit-O scale because the concept of grit is not understood in the same way in all countries. In the Indonesian context, language adaptation, differences in factor structure, and the way athletes interpret perseverance and consistency demonstrate the importance of cultural adaptation for the scale to be validly used.

The implications of the results of this study can be used by other parties such as other researchers, school counselors or policy makers who wish to use the Grit-O scale to measure the level of consistency of interest and persistence of students in Indonesia. Because the adapted Grit-O scale has gone through a standard adaptation stage. As for the limitations of this study, it only developed the Grit-O scale (12 items), so it is necessary to develop the Grit-S scale (8 items) to measure the level of consistency of student interest and persistence.

Acknowledgements

This article was written as one of the requirements to complete a dissertation at the Guidance and Counseling Department, Universitas Negeri Malang, Indonesia.

Funding

The authors gratefully acknowledge the support provided by Indonesian Education Scholarship (Beasiswa Pendidikan Indonesia-BPI), with ID Number: 202209091751, funded and managed by Center for Higher Education Funding and Assessment (Pusat Pendanaan dan Penilaian Pendidikan Tinggi-PPAPT) and Ministry of Higher Education, Science, and Technology of the Republic Indonesia (Lembaga Pengelola Dana Pendidikan-LPDP).

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