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ABSTRACT

There are numerous studies that have found adventure-based program intervention has potentially linked towards the development of psychological aspects, including mental toughness. This study aims to validate Adventure-based Mental Toughness Inventory (AbMTI) through SEM analysis. A total of 371 degree's level students from several higher institutions were involved as respondents. The final valid data is 357 hence 14 respondents have been removed due to outliers in normality analysis. A total of 67-items representing 7 dimensions of AbMTI was analysed and purified. The data were analysed through confirmatory factor analysis (CFA) and Cronbach's Alpha reliability. Through CFA measurement, the modification indices (MI) examination was conducted. Overall, the final analysis results from CFA-SEM indicates AbMTI has achieved a significant validation value. Four (4) validation analysis was applied such as standard loading (≥.50), construct reliability (CR≥.60), Cronbach Alpha (α≥.70), and average variance extracted (AVE≥.50). The final AbMTI consisted of seven (7) constructs and 38-items were validated to tap adventure-based mental toughness. Findings from this study have confirmed AbMTI as valid instruments for assessing mental toughness. It is also considered as the new horizons in mental toughness measure.

Keywords: *Adventure-based program, Structural Equation Modelling (SEM), Confirmatory factor analysis, modification indices (MI), reliability, validity*

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INTRODUCTION

It should be noted, this study considerably as the first attempt to develop a specific adventure-based mental toughness inventory. Over the years, adventure-based program is believed effective in improving participant's psychological aspects, including mental toughness. However, these claims can be questioned hence several items from the establish instruments are considerably unrepresentative when it applies in adventure-based program setting. There is a gap, which is many items from the established instruments are considerably irrelevant, such as; 1) the influence of fans distraction (PPI: Loehr, 1982); 2) pressure from the opponent (PPI-A: Golby et. al., 2007), and 3) pressure of competition (CMTI: Gucciardi & Gordon, 2009; SMTQ: Sheard et. al., 2009) and 4) considerably too general (MTQ48; Clough, 2002). Despites the availability of these instruments, none estimates specifically in terms of environmental challenges (open weather condition, wilderness, discomforts zone) and risks, which are considerably as the nature in adventure-based program. Due to the problems, the accuracy of the tests can be questioned hence it was measured using sports context.

Assessing mental toughness

For over decades most of the study related to mental toughness was conducted with focus on sports and athletics performances. However, despite many progressive studies have been conducted several limitations are also revealed (Crust, 2008). The literature indicates that most of the issues regarded mental toughness are centered on the instrumentation's development and the concepts. The established instruments come out with different foundation and concept of development. Several common psychological factors were revealed as the most often to represent mental toughness such as, having unshakeable self-belief, coping effectively with pressure and adversity, being resilient, thriving on pressure, being committed, and having superior concentration skills (Crust, 2008; Sheard, 2010). This situation contributed to the debates on the best instrumentation to be used in assessing mental toughness.

There are several instrumentations was developed to assess mental toughness. On the basis, most of the instrument that been developed are based on the researcher investigation and thoughts with the lack of statistical evidence. The researcher found there are two (2) most applied instruments in assessing mental toughness are 1) Psychological Performance Inventory (PPI: Loehr, 1986) and 2) Mental Toughness Questionnaires (MTQ48; Clough, 2002).

Pioneering the instruments development for assessing mental toughness, Loehr (1986) was develop the Psychological Performance Inventory (PPI). PPI was stated as the most influential and utilized instrument (Tripathi & Singh, 2010; Mohamad et. al., 2009; Hogg, 2007; Kuan & Roy, 2007). Accordingly, PPI was developed and rooted based on the sport's coaching and athlete's performance perspective with the highlights of seven psychological factors, which are: (1) self-confidence; (2) negative energy control; (3) attention control; (4) visualization and imagery control, (5) motivation; (6) positive energy and; (7) attitude control. However, PPI reported lacking in providing the information on the conceptual underpinnings of its seven-factor model, no information on item development procedures and no psychometric data to support its reliability and validity (Crust & Azadi, 2010). Without this important information, the researcher considered PPI as an unstable instrument to assess mental toughness.

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On the record, PPI was generated based on sports coaching and athletic performances. Even though several researchers applied and claimed PPI as the best instrument in assessing mental toughness for general sports (Kuan & Roy, 2007) , but the researcher believed several psychological constructs in PPI are not relevant to be applied in adventure-based program context. In fact, the influence of competitive element in every part of PPI area are contradictory with the nature of adventure-based program.

Clough et al. (2002) advancing the study in mental toughness by developing the Mental Toughness Questionnaire (MTQ48). After the PPI, MTQ48 also claimed as the most utilized instrument in measuring mental toughness in sport (Gucciardi, Hanton, Mallett, & Temy 2015). The foundation and development of MTQ48 are based the on 4C's model of mental toughness that also created by Clough and colleagues. Accordingly, to the 4C's model, there are four (4) psychological constructs of mental toughness which are 1) confident, 2) commitment, 3) challenge; and 4) control. Crust and Azadi (2010) stated MTQ48 are adopting a psychological theory on hardiness and focusing on sport population such as athletes, coaches, and sport psychologists. However, MTQ48 also been criticized by many researchers. Based on the study, the MTQ48 was claimed may not be a valid measure of the model of mental toughness when in only tested using student athletes (Gucciardi et. al 2008 & Perry et al., 2003).

Acknowledging the previous studies there are also other instrument to assess mental toughness was developed such as Mental, Emotional, and Bodily Toughness Inventory (MeBTough; Mack & Ragan, 2008); Mental Toughness Inventory (MTI; Middleton, Marsh, Martin, Richards, & Perry, 2004); and Psychology Performance Inventory-A (Golby et al., 2007). However, there a lack of statistical evidence of the development. The researcher considered these instruments are unstable and need further testing to determine its psychometric properties.

In sum, the literature reviews shown most of the developed instrument in assessing mental toughness was developed based on sports contexts. Most of the focus in the development are oriented based on sports and athletics performance. Moreover, most of the respondents for these studies are among professional coaches, athletes, university athletes and schools' athletes. Most of the developed instruments are also included the influence on competition. In term of the application, the researcher claimed most of the developed instruments are not accurate and relevant to be applied in adventure-based program. On the other hand, there very limited studies in adventure-based program with focus to develop an instrument for assessing mental toughness in adventure-based program. According to this matter, the researcher stressed the importance to have an accurate instrumentation tool as to meet the study objectives. The validation of the process is important in ensuring the accuracy of the instruments. Each item must adequately measure and represent the content of the focuses that the researcher wishes to measure.

METHOD

In this study, final 38-items measurement model was developed and tested among 357 (N=357) respondents to examine the reliability and validity. This validation process was believed to foster accurate value of reliability of the items in each construct (Marzita, 2012). The values from the analysis assisted the researcher to further the analysis. Next, the researcher works on

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the modification indices (MI) until the measurement model achieve model fit.

In the last phase of the analysis, the researcher conducted a reliability and validity test. The study focused on several validation such as the Cronbach Alpha (interval consistency) (Ahmad, 2014), construct reliability (CR≥0.70) (Marzita, 2012), and Average variance extracted (AVE≥0.50) (Kline, 2005) that commonly to use to assess convergent validity. Several previous studies have shown that convergent validity is achieved when it is demonstrating a correlation between the two measures, and for this CR (≥.70) and AVE (≥.50) strongly adequate to convergent validity (Hair et al., 2018; Marzita, 2012, Henseler et. al., 2015). Convergent validity also indicates that the AbMTI scale is significantly related to other variables and constructs. The validation of the instrument considerably as the final output of the study.

RESULTS

Table 1 shown the final validation analysis. In details, all constructs achieved construct reliability (CR=>.70) with Self Confidence (.86) Motivation (.85), Coping Skill (.86), Focus (.86), Challenge (.86), Control (0.85), and Commitment (0.84).

Moreover, the Cronbach alpha analysis stated all constructs achieved high internal consistency (α=>.70). A measurement set of items per constructs stated Challenge is the highest (α=.90), followed by Self Confidence, Coping Skill, and Focus (α=.86), Motivation and Control (α=.85), and Commitment (α=.84). The analysis strongly suggested significant relationship a set of items as a group. It is also considered valid to be measured as a scale reliability.

Table 2 also recorded 7-constructs of AbMTI achieved minimum AVE (>.50) with Self Confidence (.51), Motivation (.55), Coping Skill (.51), Focus (.55), Challenge (.54), Control (.54), and Commitment (.52). The convergent validity is achieved and supporting the previous analysis for construct validity. Given that the model fits to the data adequately and all items loading represented constructs are above 0.50.

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Table 1: AbMTI validation

Structural Equation Modelling analyses			Validation		
Constructs	**Items**	**Std. Loading**	**CR** (>.60)	**CA (α)** (>.70)	**AVE** (>.50)
Self Confidence (6-items)	SC4	.70			
	SC1	.72			
	SC7	.69	.86	.86	.51
	SC6	.80			
	SC8	.65			
	SC11	.74			
Motivation (5-items)	M6	.84			
	M1	.80			
	M11	.77	.85	.85	.55
	M5	.77			
	M8	.54			
Coping Skill (6-items)	CS6	.79			
	CS2	.70			
	CS7	.77	.86	.86	.51
	CS3	.71			
	CS1	.64			
	CS6	.66			
Focus (5-items)	F3	.76			
	F7	.67			
	F1	.82	.86	.86	.55
	F2	.75			
	F6	.72			
Challenge (6-items)	C3	.87			
	C2	.80			
	C1	.85	.86	.90	.54
	C7	.78			
	C6	.74			
	C5	.62			
Control (5-items)	CN1	.81			
	CN18	.81			
	CN14	.79	.85	.85	.54
	CN11	.67			
	CN5	.59			
Commitment (5-items)	CM6	.62			
	CM12	.74			
	CM8	.61	.84	.83	.52
	CM10	.75			
	CM5	.85			

DISCUSSION

Table1 indicates AbMTI have reached significant values of validity. AbMTI were recorded achieved all validity tests. Four (4) validation analysis was applied such as standard loading (>.50), construct reliability (CR>.60), Cronbach Alpha (α>.70), and average variance extracted (AVE>.50). The final AbMTI consisted of seven (7) constructs and 38-items were validated to tap adventure-based mental toughness.

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The validity was determined based on three (3) main analyses namely Cronbach Alpha coefficient (α), construct reliability (CR), and average variance extracted (AVE). This is based on several recommendations from previous studies that stipulate that at least convergent validity must be achieved to strengthen the instrument reliability (Marzita, 2012, Henseler et. Al., 2015; Yahaya, Idris, Suandi, & Ismail, 2018). However, the researcher is also aware of several studies that state that instrument reliability is adequately measured by Cronbach alpha analysis (Peterson & Kim, 2013; Omar, 2021; Ahmad, 2014).

A reliability test conducted as to refine the proposed items and constructs with the main purpose to measure of internal consistency a set of items as a group (unidimensional constructs). Cronbach's Alpha coefficient considerably as the most familiar method that to measure the reliability of test (Sekaran & Bougie, 2013). They also stated the general rule of thumb is that a Cronbach's alpha of. 70 and above is good, 80 and above is better, and .90 and above is excellent. Even though several studies claim greater .60 is good (Cresswell, 2014; Pallant, 2001), but in this study the researcher decided the scale is solid when the Cronbach alpha coefficient is above 0.7 (Ahmad, 2014). AbMTI recorded high internal consistency values.

CONCLUSION

To conclude, the data obtained from the analysis series using SEM and Analysis of a Moment Structures (AMOS) are highly significant. The validation of AbMTI significantly assists adventure-based training practitioners and professional to be more focused on creating programs and techniques in improving individual or group mental toughness.

Therefore, the findings of this study provide a space for industry players to design and measure adventure-based programs with a focus on the development of mental toughness. AbMTI has the potential to be used as a guide for designing this program. This obviously further expand research in this field, as well as improve the quality of life of communities from all walks of life.

Contribution of Main author and Co - authors

Mohd Shariman Shafie – Conceived and designed the analysis, Collected data, contributed data or analysis tools, performed the analysis, main author as well as corresponding author

Md Amin Md Taff – Conceived dan designed the analysis. Co - author of it

Nik Jazwiri Johanis – Collected data and performed the analysis

Omar Firdaus Mohd Said – Collected data and contributed data or analysis tools

Hisyam Che Mat – Performed the analysis

Mustakim Hashim - Collected data and performed the analysis

Mohd Noorazlan Ab Aziz- Collected data and performed the analysis

Mohamed Azizul Bin Mohamed Afandi- Collected data

Conflict of Interest

This statement is to certify that all authors have seen and approved the manuscript being submitted. We warrant that the article is the Authors' original work. We warrant that the article has not received prior publication and is not under consideration for publication elsewhere.

On behalf of all Co-Authors, the corresponding Author shall bear full responsibility for the submission. This research has not been submitted for publication nor has it been published in whole or in part elsewhere. We attest to the fact that all authors listed on the title page have contributed significantly to the work, have read the manuscript, attest to the validity and legitimacy of the data and its interpretation, and agree to its submission to the MJSSR: Malaysia Journal of Sports Science and Recreation.

All authors agree that the author's list is correct in its content and order and that no modification to the author list can be made without the formal approval of the Editor-in-Chief, and all authors accept that the Editor-in-Chief's decisions over acceptance or rejection or in the event of any breach of the Principles of Ethical Publishing in the MJSSR: Malaysia Journal of Sports Science and Recreation being discovered of retraction are final.

No additional authors will be added post-submission unless editors receive agreement from all authors and detailed information is supplied as to why the author list should be amended. All authors given final approval – Yes, all the author and agreed to be accountable for all aspects. All authors declared that there is no Conflict interest. Co - authors responsible for specific or other parts of manuscripts

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REFERENCES

Ahmad H., (2014). Panduan Analisis Data Secara Efisien: Panduan lengkap berajah untuk menganalisa data. Dubook Press. ISBN 9798-967-0723-08-2.

Bull, S., Shambrook, C, James, W., & Brooks, E. (2005). *Towards an understanding of mental toughness in elite English cricketers.* Journal of Applied Sport Psychology, 17, 209-227.

Butt, J., Weinberg, R., & Cuip, B. (2010). *Exploring Mental Toughness in NCAA Athletes.* Journal of Intercollegiate Sport, 3, 316-332.

Clough P., Mackenzie S., Mallabon E., and Brymer, E., (2016). *Adventurous physical activity environments: a mainstream intervention for mental health.* Sports Medicine, 46 (7). pp. 963-968.

Connole, I. (2009) *Towards an understanding of mental toughness in high School boys' basketball.* California State University, Fullerton: ProQuest LLC.

Creswell, R. (2014), Research design: qualitative, quantitative, and mixed methods approaches, Sage Publications, USA.

Crust, L. (2008). *A review and conceptual re-examination of mental toughness: Implications for future researchers*. Personality and Individual Differences, 45, 576-583.

Crust, L. & Azadi, K. (2010). Mental toughness and athletes' use of psychological strategies. European Journal of Sport Science, 10(1), 43-51.

Gucciardi, D. F., Gordon, S., & Dimmock, J. A. (2009). *Evaluation of a mental toughness training program for youth-aged Australian footballers*: *I. A Quantitative Analysis*. Journal of Applied Sport Psychology, 21, 307-323.

Gucciardi D. F., Hanton S., Gordon S., Mallett C. J. &, Temby P., *(2015). The Concept of Mental Toughness: Tests of Dimensionality, Nomological Network, and Traitness.* Journal of Personality. 83 (1), 24-44.

Gucciardi, D. F., Gordon, S., & Dimmock, J. A. (2008). *Towards an understanding of mental toughness in Australian football.* Journal of Applied Sport Psychology, *20,* 261-281.

Hair, J.F., Celsi M., Money A., & Page M. J. (2015). *The Essentials of Business Research Methods.* 3rd Ed. Routledge: Taylor dan Francis.

Hair, J., Black, W., Babin, B., Anderson, R., & Tatham, R. (2014). *Multivariate data analysis (7th ed.).* Uppersaddle River, N.J.: Pearson Education Limited.

Henseler, J., C. M. Ringle, and M. Sarstedt (2015). *A New Criterion for Assessing Discriminant Validity in Variance-based Structural Equation Modeling*. Journal of the Academy of Marketing Science, 43 (1), 115-135.

Hogg, C. (2007). *An assessment of mental toughness in rugby union.* Unpublished master's thesis, Gloucester Academy, England.

Jones, G., Hanton, S., & Connaughton, D. (2002). *What is this called mental toughness? An investigation of elite sport performers.* Journal of Applied Sport Psychology, *14,* 205-218.

Kline, R. B. (2005). *Principles and Practice of Structural Equation Modeling* (2nd ed.). New York: Guilford.

Kuan, G. & Roy, J. (2007). *Goal profiles, mental toughness and its influence on performance outcomes among Wushu athletes.* Journal of Sports Sciences and Medicine, 6, 28-33.

Kumar A., (2017). *A comparative study of mental toughness between team sports and individual sports.* International Journal of Physical Education, Sports and Health 2017; 4(5): 182-184.

Loehr, J. E. (1982). *Athletic excellence: Mental toughness training for sports.* New York: Forum Publishing Company.

Mack, M. G., & Ragan B. G. (2008). *Development of the mental, emotional, and bodily toughness inventory in collegiate athletes and non-athletes. Journal of Athletic Training, 43*(2), 125-132.

Malhotra, N. K., & Dash, S. (2011). Marketing Research an Applied Orientation. London: Pearson Publishing.

Marzita I. S. (2012). Moral disengagement in manufacturing a Malaysian study of antecedents and outcomes. Unpublished doctoral dissertation, Curtin University, Australia.

Md Taff, M. A., Shafie, M. S., Zakaria J., Mohd Yasim, M. & Abdul Rahman W. M., (2012). *Effects of mental toughness in outdoor adventure program among Malaysian intervarsity athletes.* The Journal of Sports Medicine and Physical Fitness, 52(1), p. 5.

Middleton, S. C., Marsh, H. M., Martin, A. J., Richards, G. E., & Perry, C. (2004). *Mental Toughness: Is the mental toughness test tough enough?* International Journal of Sport & Exercise Science, 35, 19-108.

Mohamad M. (2019). *Budaya Sukan di Malaysia: Dimanakah Kita?* Institute for Youth Research Malaysia (IYRES). ISBN 2180-4044.

Mohamad N. A., Omar F. M. S., & Abu S. B. (2009). *The affect of higher score of mental toughness in the early stage of the leagues towards winning Malaysian football players.* Research Journal of International Studies, 12, 68-78.

Norlidah A., (2010). *Pembangunan Modul Pedagogi Berasaskan Teknologi dan Gaya Pembelajaran Felder Silverman-Kurikuluym Fizik Sekolah Menengah*. Unpublished PhD thesis of University of Malaysa: Kuala Lumpur.

Pallant, J. (2001), SPSS survival manual - a step by step guide to data analysis using SPSS for windows (version10), Buckingham Open University Press.

Saedah S., Muhammad R. T. L. A., & Rozaine M. R., (2020). Pendekatan Penyelidikan Rekabentuk dan Pembangunan: Aplikasi kepada Penyelidikan Pendidikan. Universiti Pendidikan Sultan Idris. ISBN: 978-967-2908-15-9.

Saedah S., Norlidah A., Dorothy D., & Zaharah H., (2013). *Design and developmental research: Emergent trends in educational research.* Pearson: Malaysia ISBN: 978-967-

Sekaran, U. and Bougie, R. (2013). *Research Methods for Business: A Skill-Building Approach*. 6th Edition, Wiley, New York.

Shariman M. S., & Hisyam C. M., (2014). *Advancing Recreational Studies: An Analysis of Mental Toughness in Outdoor Adventure Program.* Proceedings of the International Colloquium on Sports Science, Exercise, Engineering and Technology, p. 267-276.

Sheard, M., & Golby, J. (2006). *The efficacy of an outdoor adventure education curriculum on selected aspects of selected positive psychological development.* The Journal of Experiential Education, 29(2), 187-209.

Tripathi, R., & Singh, T. (2009). *Relationship of perceived motivational climate to goal orientation and mental toughness of male and female student athletes.* Human Kinetics: Journal of Physical Education. 10(2), 5-13.