



Item Calibration for Computer Adaptive Mental Well-Being Scale for a non-illness Intervention using Graded Rating Model

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Abstract

Mental health is conceptualized as a state of well-being in which the individual realizes his or her abilities, can cope with the normal stresses of life, can work productively and fruitfully, and can contribute to his or her community. The purpose of the research was to calibrate an optimal item bank for a Mental Wellbeing Computer Adaptive Test (MWB-CAT) for use by university undergraduates in Nigeria which informed the study sample. The instrument for the study would be a Likert-scaled questionnaire with items based on indices of mental well-being. The scale would be face and content validated by medical, sociology and educational psychological experts while a trial test was carried out to determine the reliability of the test items. The scale parameters were analysed using Graded Rating Scale Model (GRM) for polytomously scored items and deployed through the Xcalibre 4.2 programme. This study yielded a calibrated item bank of 173 items with an alpha value of 0.8469, mean, and standard deviation of 0.0344(0.8658). This study is germane to the attainment of SDG goal 3 of ensuring healthy lives and promoting well-being for all.

Keywords: Mental health, Well-being, Item bank Calibration, Computer Adaptive Testing, Samejima's Graded Response Model

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INTRODUCTION

Mental health as an integral aspect of human wellbeing is more than just being ill. A person in a state of mental health is one in which they are aware of their abilities, are able to manage life's typical pressures, are able to work effectively and efficiently, and are able to meaningfully give back to their community. Health and Wellbeing (HWB) was described as an integral, multi-aspected, and functional notion premised on innate functions of nature and individual consideration of the good things of life and external functions, which are the extent to which potentials are realized and societal leverages to ascertain the quality of life. A paradigm shift has occurred in mental health management strategies of illness treatment to health promotion and illness prevention (Oladele et al., 2022).

Mental health and well-being are important aspects of university students' lives, with several facets that impact social, intellectual, and personal spheres. The initial measure to guarantee an individual's mental health is doing a mental health assessment. Overall health is critically dependent on mental well-being, especially for academically autonomous university undergraduates who are often subjected to high levels of stress and mental health challenges (Hernández-Torrano et al., 2020; Medlicott et al., 2021; Tandzegolskiene & Rutkienė, 2013). Universities that place a high priority on mental health create an environment that fosters holistic development and student achievement. The findings of 2020 World Health Organization (WHO) survey revealed that 89% of countries reported that mental health and psychosocial support is necessary for the attainment of SDG Goal 3 of ensuring healthy lives and promoting well-being for all. As such, universities that place a high priority on mental health create an environment that fosters holistic development and student achievement. Mental health is an essential component of overall well-being, encompassing emotional, psychological, and social aspects of an individual's life.

A report by WHO show that relatively few people around the world have access to quality mental health services. In low and middle-income countries, more than 75% of people with mental, neurological and substance use disorders receive no treatment for their condition at all (Cuijpers et al., 2023; WHO, 2020). This situation is compounded by stigma, discrimination, punitive legislation and human rights abuses that are still widespread. This report reveals that close to 1 billion people are living with a mental disorder, 3 million people die every year from the harmful use of alcohol and one person dies every 40 seconds by suicide. Moreover, billions of people around the world have been affected by the COVID-19 pandemic, which is having a further impact on people's mental health. Another report shows that approximately 700,000 suicide deaths occur yearly across the world making

the prevention of suicide is a critical public health priority (Ned et al., 2022). A call to action, the World Mental Health Report from the World Health Organisation serves to remind everyone of the enormous impact that mental diseases have, both on an individual level and on society as a whole. Also, the care models require a ‘whole of system’ change so that they are more effective, sensitive to the context, and structurally competent. ongoing depression monitoring. While much effort is put into research, the need for a trans-disciplinary approach to mental health research is becoming popular for sustainable innovation and problem-solving (Bergmann et al., 2021). Furthermore, considering the shift made with approaching mental health from a psychological disease to the therapeutics of affection, compassion, and forgiveness while emphasizing the contextual, metatheoretical and meta-disciplinary perspectives. It becomes necessary to drive mental wellbeing research in this light for wholistic problem-solving.

Among young people all over the world, suicide is the top cause of mortality, and students attending higher educational institutions are a vulnerable demographic that is particularly susceptible to this phenomenon (Alabi, 2022). There are re-occurring incidences of university undergraduate who committed suicide due to depression from academic challenges in Nigeria, among many others (Healthwise, 2023; Oloniniran & Bamigbola, 2023; Sahara Reporters, 2022; Sulaimon, 2023). Similar, a rising suicide rate is reported in South Africa as a direct result of the country's substantial burden of mental health problems (Edeh & Eseadi, 2023). This is not surprising as studies show that as many as 31% of students in South Africa report a common mental disorder such as depression, anxiety and attention difficulties (Bantjes, 2020). These incidences show an urgent for mental health interventions that can pick red flags at the earliest stages as these individuals led normal lives like their peers until their sudden death. Alabi (2022) stressed the urgent need for campus-based interventions and prevention strategies aimed at addressing the suicidal associated factors.

Mental health assessment is the starting point of ensuring mental well-being. There is an array of standardised mental health assessment tools some of which are Minnesota Multiphasic Personality Inventory (MMPI-2); first published in 1989, and the world’s most widely used psychometric test for measuring mental health ailments that features 567 true–false statements, which assess 10 clinical subscales (Butcher et al., 1989); the Beck Anxiety and Depression Inventory is a brief self-report test used to assess the severity of symptoms of anxiety with 21 common symptoms of anxiety and depression respectively (Beck et al., 1993). Also, one of the mental health screening tools used commercially by

Annabelle Psychology in Singapore is the General Health Questionnaire (GHQ). GHQ is a self-report screening tool for identifying short-term, non-psychotic, and minor mental health problems in the general or non-clinical population (Annabelle Psychology, 2022). Furthermore, the ICANotes Behavioral Health EHR, clinicians employ behavioral health assessments electronic rating scales for adults and children which are integrated with the patient's mental health chart and treatment plans to ensure all patient records are easily accessible and secure (ICANotes Behavioral Health HER, 2021). On the global scene, the World Health Organization developed an Assessment Instrument for Mental Health Systems for collecting essential information on the mental health system regionally aimed at providing a baseline for monitoring change (WHO, 2005). Furthermore, the Global Mental Health Assessment Tool-primary care version (GMHAT/PC) is a linear computerised clinical assessment tool developed to assess and identify a wide range of mental health problems (Sharma et al., 2004). While these instruments could be quite useful, behavioural psychologist in Africa must be careful with using existing mental health assessment tools, which may not capture the African context. This research is focused on developing a computerised adaptive test (CAT) for evaluating students' mental health in the post-COVID era while considering implications on stakeholders' roles and policy-making in sub-Saharan Africa. This study aims to report Item Calibration for Computer Adaptive Mental Well-Being Scale for a non-illness Intervention using Graded Rating Model for use within the African context.

Methodology

Study Measurement Model

The CAT mental well-being assessment programme would be developed and administered based on the Graded Response Model (GRM), also known as the Ordered Categorical Responses Model; a unidimensional polytomous item response theory models (Al-A'ali, 2006; Han & Hambleton, 2014). The graded response model represents a family of mathematical models that deals with ordered polytomous categories. The graded response model would be adopted to handle polytomous responses to attitudinal statements (such as a Likert scale such as strongly disagree, disagree, agree, and strongly agree), used in attitude surveys (32, 33). GRM is expressed as:

$$P_{ix}^*(\theta) = \frac{\exp(Da_i(\theta - b_{ix}))}{1 + \exp(Da_i(\theta - b_{ik}))}$$

Equation 1

where $P_{ix}^*(\theta)$ is the probability of a randomly chosen examinee with proficiency of θ scoring x or above on item i . This function is called the cumulative category response function (CCRF).

Probability of each score category can be given by

$$P_{ix}(\theta) = P_{ix}^*(\theta) - P_{ix+1}^*(\theta) \quad \text{Equation 2}$$

Thus, the score category response function (SCRF) of the GRM can be expressed as:

$$P_{ix}(\theta) = \frac{\exp[-Da_i(\theta - b_{ix+1})] - \exp[-Da_i(\theta - b_{ix})]}{[1 + \exp[-Da_i(\theta - b_{ix})]] [1 + \exp[-Da_i(\theta - b_{ix+1})]]} \quad \text{Equation 3}$$

Where:

θ represents the latent ability or trait, and its actual level in the test subject.

ix represents the grade given.

b_{ix} is a constant specific to the test item; the location parameter, or category boundary for score x ; the point on the ability scale where $P = 0.5$.

a_{ix} is an another constant specific to the test item, the discrimination parameter, and is constant over response categories for a given item.

D is a scale factor.

GRM is based on the CCRF where the value of b -parameter for each response category indicates where a probability that a randomly chosen examinee, whose proficiency level (θ) is exactly same as the value of b -parameter, scores x or higher is 50% on the CCRF. The GRM adopted for this study would allow the researcher to evaluate, or at least estimate:

1. the probability a particular test subject will receive a specific grade or score for each item;
2. the participants level of mental well-being; and
3. how well the scale measure mental well-being.

Population

The population of the study consists of 407 university undergraduates for the purpose of pilot-testing the developed CAT mental well-being assessment programme (scale). A students' information sheet

clearly stating the purpose of the study was provided to recruited students while an informed consent forms were dully signed by students who consent to participate in the study. The student participants accessed the instrument through FastTest which is an online assessment platform (Oladele, 2022); while providing data access (for those who indicated a need for data support). Providing access to data was deemed important as a way of alleviating some of the challenges with online testing (Martin, 2008).

Data Analysis

The items were subjected to psychometric analysis using the Graded item response model deployed using x-calibre (licensed version) for determining the psychometric properties of the scale.

Ethics

A dual-site ethical approval was obtained for the study. The obtained ethical certificates are available on request. The authors ensured that participants were fully informed of the purpose of the research.

RESULTS

The mental health assessment scale parameters were analysed with eight sub-constructs using Samejima's Graded Rating Scale Model (SGRM) for polytomously scored items and deployed through the Xcalibre 4.2 programme. The full parameter table is available at <https://osf.io/24czv/>.

Table 1: Item per sub-constructs

Sub-constructs	Number of Items
Belief system	15
Coping with the normal stresses of life	15
Emotional stability	14
Healthy living	12
Realise potentials	26
Social interaction	27
School-life balance	36
Studying productively and fruitfully	31
Total	173

As shown in Table 1, the item calibration yielded an assessment scale with 173 psychometrically certified items to be deployed on Concerto (an open-source platform for administering adaptive

testing) which will be named as Mental Wellbeing Computer Adaptive Test (MWB-CAT). The model fit statistics ascertained through the chi-square/p value statistics yielded a value of 6067.7362(1). The calibration yielded the Eta, Alpha w/o, Max Info, Theta at Max, a, and boundary (b1 to b3) values obtained for the MWB-CAT deployment. The calibrated item bank was scaled at a theta value of -4 to +4, Maximum information of 25.478, and CSEM of 0.198.

DISCUSSION

The MWB-CAT as a non-illness interventions offer a multifaceted approach to mental health promotion, emphasizing prevention, resilience, and well-being enhancement. By addressing various aspects of life, individuals can cultivate resilience, emotional balance, and flourishing. Integrating these interventions into daily life fosters a holistic approach to mental health, empowering individuals to thrive and lead fulfilling lives. Also, universities should be aware of the students' changing emotional responses to crisis and ensure visibility and accessibility of student support.

While mental illness interventions are crucial, focusing solely on treating disorders neglects the broader spectrum of mental health. Non-illness interventions offer a holistic approach that promotes mental well-being, resilience, and flourishing. Moving away from huge institutions and instead focussing on the creation of community services that allow people to remain in their own environment is an essential component of the improvement of mental health care is an important feature of providing mental health services (Cuijpers et al., 2023). One of such interventions is the designed computerized adaptive mental well-being scale (MWB-CAT) based on an extensive review of literature and guided by the World Health Organization's conception of mental well-being as a relevant mental health supportive service within the African context (Oladele et al., 2022).

The National Mental Health Act 2021 which provides for the establishment and regulation of mental health and related matters can be regarded as an action which can be carefully explored for meaningful implementation (Oduote, 2023). A call to action, the World Mental Health Report from the World Health Organisation serves to remind everyone of the enormous impact that mental diseases have, both on an individual level and on society as a whole. The designed MWB-CAT can be regarded as a response and a research-based implementation effort in this direction. Also, it is hoped that it will

meet the need for improving the mental health care models to be more effective, sensitive to the context, and structurally competent has been stressed.

CONCLUSION

An accurate mental wellbeing assessment scale (MWB-CAT) that aids early detection of red flags of mental illness which will be accessible at users' convenience and driven by a robust cloud infrastructure, which guaranteed security and affordance, is now available for use at no cost to the institution or students.

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