A RASCH ANALYSIS OF A MEASURE OF STAKEHOLDERS INPUTS FOR THE SOUTH AFRICAN OCCUPATIONAL LEARNING CONTEXT

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Abstract

This study assesses the psychometric properties of the Stakeholders Inputs (SI) scale which is designed for the South African occupational learning context. A quantitative, non-experimental cross-sectional survey design was used and data were collected from a sample of 652 respondents. Data were analysed using SPSS and Winsteps software. The findings reveal that the SI scale is a psychometrically robust instrument suitable for application in the South African occupational learning context. The measure shows a good person and item separation indices and no evidence of item misfit. All items contribute to a single trait measurement.

Keywords: Stakeholders Inputs, Occupational Learning Context, South Africa

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1 Introduction

The current study seeks to assess the psychometric properties of the Stakeholder Inputs (SI) scale which is designed to measure the way organisations identify, relate to and manage key stakeholders who are part of the occupational learning programmes. The Skills Development act 97 of 1998 (as amended in 2008) provides for the development of learning programmes and further provides for regulations pertaining to the registration and management of such programmes (Republic of South Africa, 2008; DHET, 2012). An occupational learning programme includes a learnership, an apprenticeship, a skills programme or any other prescribed learning programme that includes a structured work experience component (Republic of South Africa, 2008). These programmes are inserted into a complex and increasingly bureaucratised qualification and quality assurance infrastructure.

The management and evaluation of an occupational learning programme is a complex task because of the nature of the programme itself and the diversity of stakeholders involved (Tshilongamulenzhe, 2012). Davies and Farquharson (2004) indicate that occupational learning programmes tend to be implemented in multiple stakeholder environments. Furthermore, De Jager et al. (2002) allude that these programmes are best managed as projects at various levels. These researchers make reference to the composition of diverse stakeholders with various roles and responsibilities, all of which have to be managed.

2 Occupational learning stakeholders in South Africa

According to Davies and Farquharson (2004), occupational learning programmes are “stakeholder-rich interventions”, which have to be implemented in a multidimensional environment consisting of multiple stakeholders and the often complex interactions between them (Davies and Farquharson, 2004). Such stakeholders include Sector Education and Training Authorities (SETAs), employers, managers, coaches, mentors, learners/apprentices, assessors and skills development providers. It is thus important to investigate the ways in which these parties interact to ensure that the theoretical courses and experiential learning align well with one another. Learning takes place in a socio-cultural context that influences interactions between all stakeholders (Kruss et al., 2012).

A wide range of individuals act as the support and liaison interfaces between the SETA and the skills development sector stakeholders, and between the training providers and employers - mentors, clinical facilitators, project managers and tutors. Mentors are particularly critical in ensuring that the transition between completing a learnership and entry into the labour market is optimal (Kruss et al., 2012). Thus, many stakeholders have now identified a need for mentoring and coaching to support this transition. A good relationship between all stakeholders in the process is critical to ensure responsiveness. The lack of clear cut roles and responsibilities, can lead to the difficulties for learners, as there is no specified champion for the rights of the learner. The complexity of managing a system in which a multitude of stakeholders is involved constantly evolves. This requires the constant re-alignment and adaptation from all parties for successful implementation (Davies and Farquharson, 2004; Bamber and O'Shea, 2009; Mummenthey, 2008).

However, skills development providers must integrate their activities in any organisation by working with the skills development facilitators, assessors, other skills development practitioners, managers and learners. They must employ project management skills in order to manage diverse roles and responsibilities of all key stakeholders and to evade crisis management situations (Bisschoff and Govender, 2004). Equally significant and from a training evaluation perspective, Kirkpatrick and Kirkpatrick (2006) suggest that along with the evaluation of learners, the programme coordinators, training managers and other qualified observers' reactions to the facilitator's presentation should also be evaluated. The success of learners during a training programme therefore also depends on the roles played by other stakeholders.

In order to provide guidance to the management of stakeholders and clarification of their roles and responsibilities in the occupational learning context, Tshilongamulenzhe (2012) developed the 16 items Stakeholders Inputs (SI) scale. The objective of this study is to assess the psychometric properties of the 16 items SI scale using Rasch analysis. The study seeks to assess the use of response categories, success in measuring a single trait (unidimensionality), ability to discriminate persons (precision), and targeting of the questions to person. It is therefore imperative that these issues are assessed comprehensively to gauge whether the SI scale measures what it purports to measure. There has been no evidence of research conducted which employed item response theory (IRT) to examine the psychometric properties of the SI scale in the South African occupational learning context, hence this study.

3 Trends from the Rasch analysis literature

Researchers and practitioners depend on reliable and psychometrically sound measurement instruments (Peter et al., 2013). The use of Rasch methodology involves a rigorous and extensive analysis of the data and provides additional psychometric information that cannot be obtained through other tests. The data are tested for fit into the Rasch model, allowing for a detailed examination of the internal construct validity of the scale, including properties such as reliability and ordering of categories (Van der Wal et al., 2012). It also determines whether a scale is unidimensional, which is required to justify summation of scores and can linearly transform raw scores from their original scale to an interval scale to allow application of parametric statistics.

As a probabilistic mathematical model, Rasch analysis provides estimates of person's ability and item difficulty along a common measurement continuum, expressed in log-odd units (logits). It focuses on constructing the measurement instrument with accurateness rather than fitting the data to suit a measurement model (Hamzah et al., 2009). A unique feature of the Rasch model is, however, that it provides measurement that is not dependent on the distribution of the persons, given that the data fit the model (Andrich, 1988). This also implies that no assumptions about the person distribution have to be made. The measurement requirements underpinning the Rasch model also connect to additive conjoint measurement, a concept with roots in mathematical psychology (Luce and Tukey, 1964; Perline et al., 1979). The Rasch model was useful in this study for overall consideration of response category ordering, reliability and separation indices analysis, person-item targeting, goodness of fit, and unidimensionality. At each step the data, response structure and targeting were checked for fit to the Rasch model. Applying the Rasch model started with calibration of items, and examined the overall estimates of the model parameters (Smith, 2001).

4 Perspectives on scale development

According to Peter (1979) a valid measurement is the *sine qua non* of science. Scholars such as DeVellis (2003; 2012), Netemeyer et al. (2003), and Crook et al. (2009), have argued that effective measurement is a cornerstone of scientific research. However, developing a measurement scale that leads to valid and reliable results is a challenging task (Slavec and Drnovsek, 2012). A number of scale development models have been suggested, used and reported in the literature (Anderson and Gerbing, 1988; Benson and Clark, 1982; Churchill, 1979; DeVellis, 2012; Gable and Wolf, 1993). Even though there is little variation between these different models as proposed by different authors, this study relied primarily on Churchill's (1979) procedure for the development of valid and reliable multi-item instruments. This procedure consists of six steps: specify domain of the construct, generate sample of items, purify the measure, assess reliability with new data, assess construct validity, and developing norms. The Stakeholder Inputs scale was developed following all the six steps suggested by Churchil (1979).

5 Methodology

5.1 Research approach

A quantitative, non-experimental, cross-sectional survey design was used in order to achieve the objective of this study. The study used primary data collected from five SETAs and a human resource professional body in South Africa.

5.2 Research participants

In this study, a sample of 900 respondents was drawn from six organisations: five Sector Education and Training Authorities (SETAs) and the South African Board for People Practices (SABPP), using a probabilistic simple random sampling technique. The sample was drawn from the databases of these organisations and the target participants were learning managers and employers, mentors and supervisors of learners or apprentices, skills development officers and providers, learning assessors and moderators as well as learners and apprentices. The conjecture was that all sampled participants have adequate knowledge of the South African skills development system, including occupational learning programmes. In view of this, the sample drawn was deemed representative of the research population. Only 652 usable questionnaires resulted from the administration process, a response rate of 72%. Participants in this study were mainly young people in their early career stages. About 78.8% were aged younger than 35 years and only 3.3% older than 56 years. The diversity of the sample was evident in terms of gender, educational achievement, type of learning programme and occupational profile. About 52.8% of respondents were females and males comprised the remaining 47%. At least 58.8% of the respondents achieved a senior certificate (Matric/N3) as their highest qualification; 4% did not have a completed matric. Only 13.9% of the respondents achieved a professional (four years) or honours, Master’s or Doctorate degree. About 86.6% of the respondents were involved in learnerships compared to 13.4% who were involved in apprenticeships. Just over 65% of the respondents constituted learners and apprentices and 9% comprising employers and managers.

5.3 Measuring instrument

The Stakeholder Inputs (SI) scale consisted of 16 items, measuring the the way an organisation assesses, identifies, and manage its key stakeholders that are critical for the successful delivery of an occupational learning programme (Tshilongamulenzhe, 2012). The instrument used a six-point Likert scale with a response format ranging from ‘strongly agree’ to ‘strongly disagree’. Sample items include ‘The skills development provider must have knowledge and understanding of the skills-based approach to training design and assessment’, ‘Qualified workplace mentors must be able to assist the learners with practical and workplace experience components’, and ‘Occupational learning programme stakeholders must always be aware of their roles and responsibilities’. Construct validity and internal consistency reliabilities of the SI scale were examined by means of exploratory factor analysis (EFA), and the Cronbach Alpha coefficient was found to be .93 (Tshilongamulenzhe, 2012). A single factor structure was obtained from EFA and all 16 items loaded perfectly.

5.4 Research procedure

Permission to undertake this research was sought from all 21 SETAs and the human resource professional body. The researcher wrote official letters of request for permission to all Chief Executive Officers of 21 SETAs. Unfortunately, only five of the 21 SETAs gave permission for the research to be undertaken within their jurisdictions. Permission was also obtained from the human resource professional body in South Africa. Once permission to undertake the research was granted, the researcher started the process of planning for sampling and data collection within the respective organisations. Five fieldworkers and a project administrator were appointed to render the data collection service and project fieldwork management support. The project management support included assistance to the fieldworkers and the researcher, management and capturing of data. The fieldwork took place Mpumalanga, North West and Gauteng provinces, South Africa.

The questionnaire distributed to respondents had a cover letter which informed respondents of the purpose and significance of the research, and that their participation was voluntary at their own consent. Also included in the letter was the assurance that respondents could discontinue their voluntary participation at any time. The cover letter also assured respondents of their anonymity and confidentiality of their responses, which would only be used for the current research purposes. In order to ensure a high degree of internal validity between the different fieldworkers, a number of criteria had to be met when appointing fieldworkers (Leedy and Ormrod, 2001, p. 103). Fieldworkers were required to at least have a bachelor’s degree in Human Resource Management (HRM) and knowledge of research methodology. A qualification in HRM provides a broader understanding of training, learning and human resource development issues and this knowledge was important to address questions that respondents may raise. The project administrator was required to have some experience with the research process, including logistics management, project management, data management and data capturing.

6 Results

In order to achieve the purpose of this study, data were analysed using SPSS (version 23.0) (IBM, 2014) and Winsteps software (Version 3.70.0) (Linacre, 2010). SPSS was used to conduct exploratory factor analysis while Winsteps was used to compute Rasch analysis which included response category performance, person/item separation indices, measure order and unidimensionality. The person/item separation indices examine the extent to which the new measure distinguishes the different levels of responses and respondents abilities. The reliability coefficient assesses the internal consistency of the measure. Person-item mapping assesses the manner in which the new measure targets respondents (whether or not there is balance between respondents’ ability and item difficulty). Measure order assesses the goodness of item fit to the Rasch model as well as unidimensionality.

Table1. Factor loading for the SI scale (*n* = 537)

Code	Item	Factor load
B3.9	The skills development provider must be able to assist learners with the theoretical component of the learning programme.	.731
B3.10	The skills development provider must encourage learners' interaction and group discussions.	.671
B3.11	The skills development provider must always be well prepared for teaching and assessment.	.680
B3.12	The skills development provider must have knowledge and understanding of the skills-based approach to training design and assessment.	.751
B3.13	A qualified workplace mentor must be available (A mentor is someone who is able to help learners by showing them how to solve difficult problems at work).	.695
B3.14	Qualified workplace mentors must be able to assist the learners with practical and workplace experience components.	.751
B3.15	The skills development provider, mentor and supervisor must be knowledgeable about an occupation for which the learner is training.	.711
B3.16	The skills development provider, mentor and supervisor must be available when learners need them.	.686
B3.17	A qualified learning assessor must be available (An assessor is someone who marks learners' assignments).	.678
B3.18	The learning assessor must have relevant expertise and demonstrated competence in learning design and learning assessment.	.745
B3.19	A qualified workplace supervisor must be available (A supervisor is someone whom the learner reports to at the workplace and who manages the learner's performance).	.744
B3.20	The skills development provider must have excellent knowledge of the subject content/occupation.	.736
B3.21	The skills development provider must use up-to-date equipment, facilities and learning material.	.771
B3.22	The skills development provider must have a range of services to support the learner.	.742
B3.23	Inputs from other key stakeholders (SETAs, Professional Bodies, etc.) are necessary for the successful implementation of occupational learning programmes.	.626
B3.24	Occupational learning programme stakeholders must always be aware of their roles and responsibilities.	.692

The results depicted in Table 1 show the factor loads for all 16 items of the Stakeholder Inputs (SI) scale after the exploratory factor analysis. It is clear that all items loaded perfectly on a single factor extracted using varimax rotation. Item factor loads ranged from the minimum of .626 to a maximum of .771 as depicted in Table 1. An overall explanation of how well the Stakeholder Inputs (IS) scale was constructed and whether respondents' ability levels exist or otherwise, is presented in the summary statistics as depicted in Table 2. About 99.0% of the responses to the SI scale were valid. The scale yielded a Cronbach alpha coefficient of α = .93 which is acceptable for a new measure. The Cronbach Alpha (KR-20) person raw score reliability is the conventional 'test' reliability index (Bond and Fox, 2007). It reports approximate test reliability based on the raw scores of the sample and it is only reported for complete data.

Likert response categories to the SI scale items were examined in the current study, and no evidence of under usage, infrequent usage or disorder was found in the data. Consequently, no response categories were collapsed and merged. The results in Table 2 shows that about 99.4% of the responses to the SI scale were valid. The results further show a wider person spread of 6.91 logits (Min: -5.39 logits, Max: 1.53 logits). The mean score of -2.86 for the measure shows that respondents had some difficulty in answering the items of the measure and therefore fall below the expected performance. The person separation index (G = 2.09) clearly separates respondents into three statistically distinct strata of persons (high-ability, medium-ability and low-ability persons) with a good person reliability coefficient of .81.

Equally significant, the reliability for the items was found to be extremely good (*α* = .90). That is, the chances that the difficulty ordering of the items would be repeated if the measure were given to another group of respondents is very high. The results show a good item separation (G = 3.01) which is broader than that of a person. This index translates to about four levels of item difficulty. An item reliability of .90 indicates that a similar item hierarchy along the construct is highly reproducible in a similar sample from the population. If another sample with a wider spread of abilities were to be tested, these statistics would improve.

Table 2. Person-item separation index for SI scale (n = 608)

	Index	Mean	SD	Max	Min	α
Person separation	2.09	-1.86	1.32	1.53	-5.38	.81
Item separation	3.01	.00	.26	.46	-.62	.90

Note: SD = Standard Deviation; α = Reliability coefficient

6.1 Person-Measure targeting

Once the item and person calibrations are obtained, they are placed on a vertical ruler as shown in Figure 1. This vertical ruler measures person ability and item difficulty on the same logit scale. Figure 1 shows the ordering of items according to their difficulty. Items with negative calibrations are easier, and those with positive calibrations are more difficult than the item average whose difficulty is set at zero. The spacing between the items is also very important. Items should not be too close in difficulty, because otherwise one item is not distinctly separate from the next. However, the separation between two items should also not be too large to avoid large gaps between the items (Planinic *et al.*, 2010). On the right-hand side of the ruler are the scale items sorted by difficulty, with the most difficult items on the top and the easiest items on the bottom of the plot. On the left-hand side of the ruler are the persons, sorted by their ability to successfully respond to the items and with the most successful persons on the top. The results shown on the plot in Figure 1 depict that the items were difficult to the respondents since the distribution of item difficulties and of person abilities are significantly shifted with respect to each other. The mean item difficulty is just under 3 logits above the mean person ability. The large difference between the mean person location and the mean item location reflects the relative mismatch between the person and item location. Ideally, the measure should be centred on the target population (Planinic *et al.*, 2010).

A close inspection of Figure 1 reveals that the width of the measure is less than 1.5 logits, whereas the width of the person distribution is just over 7 logits suggesting that respondents may have had low ability to understand items of the measure resulting in unexpected extreme responses. The terminology used in the items was very new as the occupational learning system has just been recently introduced in South Africa. All the items of the measure are located between -.1 logit and +.5 logit, but only a small fraction of persons can be found in this range. Items B3.18, B3.19 and B3.22 are similar in difficulty, and so are items B3.13, B3.14, B3.16, B3.21, B3.24 and B3.9. Items B3.10 and B3.15 were also placed on the same level of difficulty as items B3.12 and 3.20. The theoretical probabilities for the success of each person on each item were calculated and compared with the observed scores as shown in Table 2. The differences between the two are called residuals and they are used to evaluate the fit of data to the model (Bond and Fox, 2001).

6.2 Item fit statistics

Table 3 shows the results of the fit statistics for the SI scale which is presented as two Chi-square (x^2) ratios: infit and outfit mean square statistics. Outfit is based on the conventional averaged sum of squared standardised residuals, whereas infit is an information-weighted sum which gives more value to on-target observation (Planinic *et al.*, 2010). A large infit value on a particular item indicates that some respondents who had the ability to respond to difficult items did not respond in a way consistent with the model. A large outfit value of an item indicates that persons who did not have the ability to respond to difficult items, responded in an unexpected way. For example, large outfit of an easy item means that some able persons have unexpectedly failed on that item. Larger outfit of a difficult item means that some persons of low ability have unexpectedly succeeded on this item. Large infit values are generally considered more problematic than larger outfit values. The expected mean value of both infit and outfit is 1 (Wright and Linacre, 1994; Planinic *et al.*, 2010). Values < 1 suggest a lack of stocasticity in the data, potentially due to a violation of local independence. Local independence means that, after controlling for the latent trait, responses to items should be independent of each other (Fendrich *et al.*, 2009). Values > 1 are indicative of excessive variability, which may signify a departure from unidimensionality.

Figure 1. Items-Persons Map for Stakeholder Inputs scale

```
INPUT: 652 PERSONS  17 ITEMS  MEASURED: 608 PERSONS  16 ITEMS  6 CATS       1.0.0
--------------------------------------------------------------------------------

       PERSONS MAP OF ITEMS
       <high ability>|<difficult items>
    2                +
                     |
                     |
                     |
                  .  |
                     |
    1             .  +
                     |
                  .  |
                  .  |T B3.11
                     |S B3.12  B3.20
                  .  |  B3.10  B3.15
    0             .  +M B3.13  B3.14  B3.16  B3.21  B3.24  B3.9
                  . T|  B3.18  B3.19  B3.22
                  .  |S B3.17
                  .  |T
                  .  |  B3.23
                  .  |
   -1             .  +
                  .  |
                .##  |
                 .# S|
                .##  |
                 .#  |
   -2            .#  +
                 .#  |
                .##  |
                 .#  |
                 .#  |
                .## M|
   -3           .##  +
                .##  |
                ###  |
                  .  |
                 .#  |
                ###  |
   -4                +
                 .# S|
                     |
                  .  |
                .##  |
                     |
   -5                +
                     |
                  .  |
               .### T|
                     |
                     |
   -6 .############  +
        <low ability>|<easy items>

Each '#' is 11 respondents.
Each '.' is 1-10 respondents.
```

It is evident in Table 3 that the spread of logit scale of item measure yielded a maximum value of .46 logits and a minimum value of -.62 logits. The difference between logitmax where item B3.11 is and the logitmin where item B3.23 is, is δ= 1.08. This indicates that the item difficulty is spread over 1.08 logit units. The results in Table 3 show the average infit mean value of 1.00 (expected by the model) and an outfit mean value of 1.01 which is slightly above the value expected by the model. The focus in this study was more on the evaluation of infit values since they are weighted to take less notice of extreme responses (Vianya-Estopa et al., 2010).

Table 3. Measure order statistics for SI scale

		INFIT		OUTFIT		
Code	**Item**	**MNSQ**	**ZSTD**	**MNSQ**	**ZSTD**	**PTMEA**
B3.9	The skills development provider must be able to assist learners with the theoretical component of the learning programme.	.99	-.1	1.13	1.4	.61
B3.10	The skills development provider must encourage learners' interaction and group discussions.	1.01	.2	1.26	2.6	.59
B3.11	The skills development provider must always be well prepared for teaching and assessment.	1.04	.5	1.02	.2	.56
B3.12	The skills development provider must have knowledge and understanding of the skills-based approach to training design and assessment.	.79	-2.6	.80	-2.1	.61
B3.13	A qualified workplace mentor must be available (A mentor is someone who is able to help learners by showing them how to solve difficult problems at work).	1.18	2.0	1.10	1.1	.59
B3.14	Qualified workplace mentors must be able to assist the learners with practical and workplace experience components.	1.03	.4	.93	-.8	.61
B3.15	The skills development provider, mentor and supervisor must be knowledgeable about an occupation for which the learner is training.	1.00	.0	.96	1.4	.61
B3.16	The skills development provider, mentor and supervisor must be available when learners need them.	1.12	1.4	1.09	1.0	.61
B3.17	A qualified learning assessor must be available (An assessor is someone who marks learners' assignments).	1.10	1.2	1.10	1.2	.64
B3.18	The learning assessor must have relevant expertise and demonstrated competence in learning design and learning assessment.	.92	-1.0	.96	-.4	.64
B3.19	A qualified workplace supervisor must be available (A supervisor is someone whom the learner reports to at the workplace and who manages the learner's performance).	1.02	.3	.96	-.5	.64
B3.20	The skills development provider must have excellent knowledge of the subject content/occupation.	.94	-.7	.89	-1.2	.61
B3.21	The skills development provider must use up-to-date equipment, facilities and learning material.	.85	-1.8	.89	-1.3	.64
B3.22	The skills development provider must have a range of services to support the learner.	.84	-2.0	.86	-1.6	.67
B3.23	Inputs from other key stakeholders (SETAs, Professional Bodies, etc.) are necessary for the successful implementation of occupational learning programmes.	1.18	2.1	1.25	2.9	.64
B3.24	Occupational learning programme stakeholders must always be aware of their roles and responsibilities.	.96	-.4	.98	-.2	.62
	Mean	1.00	.0	1.01	.1	
	SD	.11	1.3	.13	1.4	

Note: MNSQ = Mean Square; ZSTD = Standard Deviation; PTMEA = Point Measure Correlation

However, the data for the items show goodness-of-fit satisfying the condition that the values should not exceed 1.40. Items which are sufficiently in accordance with the Rasch model to be productive must have infit and outfit values between .6 and 1.4 for a rating scale (Wright and Linacre, 1994). The results show that the amount of distortion of the measurement is nil as all individual items for the SI scale demonstrated infit and outfit values within the expected range of 0.60 and 1.40. The concept of unidimensionality is very important for the Rasch model. All items are expected to work together and define a single underlying construct. The content of the items of the measure is considered an empirical definition of the construct. The point-measure correlation (PTMEA CORR) examines the presence of the construct in the measure. It is the correlation between the Rasch person ability measures and the person's response to the item (Linacre, 1994).

Winsteps software has the capability to compute these correlations as Pearson product-moment correlation (*r*) coefficients. The size of correlations can indicate which items contribute more to the construct and which ones contribute less. The results depicted in Table 3 show that the point measure correlation (PTMEA CORR) ranged from 0.56 to 0.67, with no item containing zero or negative values. This correlation indicates that all items were working together in the same way in defining the SI construct and met all the criteria of a quality question, and thus review is not required. If the Point Measure = x; $.4 < x < .8$, an item is acceptable. The theory is that higher response values to the items imply higher person measures and vice versa. For this to be true, the correlations must be positive as shown in Table 3. The lowest correlation is .56 for item B3.11 and its value is positive. There are no misfitting items shown in the table.

6.3 Principal Component Analysis (PCA)

A further examination of unidimensionality was conducted using Principal Component Analysis (PCA) of standardised residuals as shown in Table 4.

Table 4. Principal Component Analysis of standardised residuals for Stakeholder Inputs scale

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INPUT: 652 PERSONS  16 ITEMS  MEASURED: 608 PERSONS  16 ITEMS  6 CATS       1.0.0
--------------------------------------------------------------------------------
        STANDARDISED RESIDUAL VARIANCE SCREE PLOT
Table of STANDARDISED RESIDUAL variance (in Eigenvalue units)
                                             Empirical       Modelled
Total variance in observations     =        32.6 100.0%        100.0%
Variance explained by measures     =        16.6  50.9%          51.0%
Unexplained variance (total)       =        16.0  49.1% 100.0%   49.0%
Unexplained variance in 1st contrast =          1.6   5.0%  10.2%

+-------------------------------------------------+  -------------------------------------------+
|CON-  |       |        INFIT OUTFIT| ENTRY       |  |       |        INFIT OUTFIT| ENTRY       |
| TRAST|LOADING|MEASURE  MNSQ MNSQ |NUMBER CODE   |  |LOADING|MEASURE  MNSQ MNSQ |NUMBER CODE   |
|------+-------+-------------------+-------------|  +-------+-------------------+-------------|
|  1   |  .52 |    -.62 1.18 1.25 |A   15 B3.23 |  |  -.49 |     .46 1.04 1.02 |a    3 B3.11 |
|  1   |  .46 |     .04  .96  .98 |B   16 B3.24 |  |  -.44 |     .01  .99 1.13 |b    1 B3.9  |
|  1   |  .40 |    -.16  .84  .86 |C   14 B3.22 |  |  -.41 |     .38  .79  .80 |c    4 B3.12 |
|  1   |  .31 |     .02  .85  .89 |D   13 B3.21 |  |  -.35 |     .11 1.01 1.26 |d    2 B3.10 |
|  1   |  .24 |     .25  .94  .89 |E   12 B3.20 |  |  -.24 |    -.20  .92  .96 |e   10 B3.18 |
|  1   |  .16 |    -.05 1.12 1.09 |F    8 B3.16 |  |  -.13 |    -.14 1.02  .96 |f   11 B3.19 |
|      |       |                   |             |  |  -.09 |     .07 1.03  .93 |g    6 B3.14 |
|      |       |                   |             |  |  -.05 |     .15 1.00  .96 |h    7 B3.15 |
|      |       |                   |             |  |  -.04 |    -.36 1.10 1.10 |H    9 B3.17 |
|      |       |                   |             |  |   .00 |     .02 1.18 1.10 |G    5 B3.13 |
+-------------------------------------------------+  -------------------------------------------+

+-------------------------------------------------+
|CON-  |       |        INFIT OUTFIT| ENTRY       |
| TRAST|LOADING|MEASURE  MNSQ MNSQ |NUMBER CODE   |
|------+-------+-------------------+-------------|
|  1   |  .52 |    -.62 1.18 1.25 |A   15 B3.23 |
|  1   |  .46 |     .04  .96  .98 |B   16 B3.24 |
|  1   |  .40 |    -.16  .84  .86 |C   14 B3.22 |
|  1   |  .31 |     .02  .85  .89 |D   13 B3.21 |
|  1   |  .24 |     .25  .94  .89 |E   12 B3.20 |
|  1   |  .16 |    -.05 1.12 1.09 |F    8 B3.16 |
|      |-------+-------------------+-------------|
|  1   | -.49 |     .46 1.04 1.02 |a    3 B3.11 |
|  1   | -.44 |     .01  .99 1.13 |b    1 B3.9  |
|  1   | -.41 |     .38  .79  .80 |c    4 B3.12 |
|  1   | -.35 |     .11 1.01 1.26 |d    2 B3.10 |
|  1   | -.24 |    -.20  .92  .96 |e   10 B3.18 |
|  1   | -.13 |    -.14 1.02  .96 |f   11 B3.19 |
|  1   | -.09 |     .07 1.03  .93 |g    6 B3.14 |
|  1   | -.05 |     .15 1.00  .96 |h    7 B3.15 |
|  1   | -.04 |    -.36 1.10 1.10 |H    9 B3.17 |
|  1   |  .00 |     .02 1.18 1.10 |G    5 B3.13 |
+-------------------------------------------------+
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The PCA of standardised residuals has an advantage over fit statistics in detecting departures from unidimensionality when (1) the level of common variance between components in multidimensional data increases and (2) there are approximately an equal number of items contributing to each component (Smith, 2004). To judge whether a residual component adequately constitutes a separate dimension, the researcher looked at the size of the first eigenvalue (<2) of unexplained variance that is attributable to this residual contrast. The PCA results in Table 4 show that only 50.9% of the variance was explained by the measure. The unexplained variance explained by the first contrast had an eigenvalue of 1.6 (5.0%), which is slightly lower than the chance value of 2.0 (Smith, 2002). The fact that items of the SI scale fit the model and that the variance explained by the SI scale is 5 times higher than the unexplained variance in the 1st contrast is an indication of the unidimensionality of the construct.

As a result, the SI scale fits the Rasch model, is unidimensional and has successfully distinguished three strata of respondents (G = 2.09) with a person reliability coefficient of .81. Individual items are not calibrated too far apart and they all contribute to the underlying construct (SI). It can be concluded that the unidimensionality requirement has been realised sufficiently well and that all items work together and fit the model. The items of the measure are neither difficult nor easy as shown in the Person-Item Map, and they are well-separated with sufficient width. Nevertheless, the only problem is that the measure is poorly targeted to the sample. It is evident from the Person-Item Map plot that respondents did not have the required ability to respond to the items of the measure. The probability for this extreme response is that the terminology used in the scale items is still very new as the occupational learning system has just recently been introduced in South Africa.

7 Conclusions

The purpose of this study was to examine the psychometric properties of the SI scale developed by Tshilongamulenzhe (2012) using a Rasch analysis technique. Occupational learning programmes are proclaimed as a pioneering method of overcoming skills shortage in South Africa, as their design obliges a number of stakeholders (SETAs, learners, skills development providers and employers) to coordinate both theoretical and practical vocational education and training (De Louw, 2009). These skills development interventions require active participation of all key stakeholders for effective implementation, management and evaluation. The efficacy of occupational learning programmes is reliant on the contribution of all key stakeholders from policy implementation to learner beneficiaries. Best practice dictates that strategies relating to human resources and specifically human resource development (HRD) are enhanced when all stakeholders are able to offer their contribution and perceived opinions with regard to the efficacy of occupational learning programmes (Skinner et al., 2004).

The SI scale was developed by Tshilongamulenzhe (2012) guided by the elements in his theoretical framework and by the scale development procedure formulated by Benson and Clark (1982). The content and construct validity of the scale were tested using a pool of skills development experts and learners/apprentices. The scale was subjected to exploratory factor analysis. However, the current study seeks to explore as to whether or not the SI scale as a conceptual domain has used the response categories appropriately; whether it represents the independent latent trait; whether it is capable of discriminating persons; and, whether its items are targeted to the person appropriately. Traditional validation criteria are superficial and do not assess key issues such as whether response categories are used as intended (response category ordering), whether a single scale score represents a single construct (dimensionality), ability of the instrument to discriminate between people (person separation), and targeting of questions to persons (McAlinden et al., 2011, p. 5685).

The results of this study show no evidence of under usage, infrequent usage or disorder with response categories. Consequently, no response categories were collapsed and merged. Person separation was found to be adequate in discriminating between the individuals in the sample population and the value was significantly higher (G = 2.09) than the minimum of ≥ 1.0 as suggested by Green and Frantom (2002). Item separation was also found to be significantly higher (G = 3.01) than the minimum value. Targeting in general was not adequate as depicted by a mismatch between the mean item difficulty and mean person ability estimates. The mean item difficulty is under 3 logits above the mean person ability. The reasonable probable cause of this is the vocabulary used in the measure. New concepts underpinning the new occupational learning landscape were recently introduced and were included in the items for the purposes of relevance. However, respondents appear not to have had a clear understanding of the new vocabulary at the time the survey was conducted.

In terms of item fit, the results show a goodness-of-fit satisfying the condition that the values should not exceed 1.40 as suggested by Linacre (1994) and Bond and Fox (2007). The amount of distortion of the SI measure was found to be nil. The point measure correlation (PTMEA CORR) indicates that all items were working together in the same way in defining the SI construct and have met all the criteria of a quality question, and thus review is not required. The results further show that the SI scale fits the Rasch model; is unidimensional; and has successfully distinguished three strata of respondents.

A conclusion drawn from the findings of this study is that the SI scale is valid, reliable and meets the standard psychometric properties required for a good measure. The scale can be used by organisations to assess, identify and manage their key stakeholders that are critical for the successful delivery of an occupational learning programme. Future research is suggested over a period of time which may focus on a different sample in order to establish the respondents' understanding of the new occupational learning vocabulary which is being used in the new occupational learning landscape in South Africa.

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