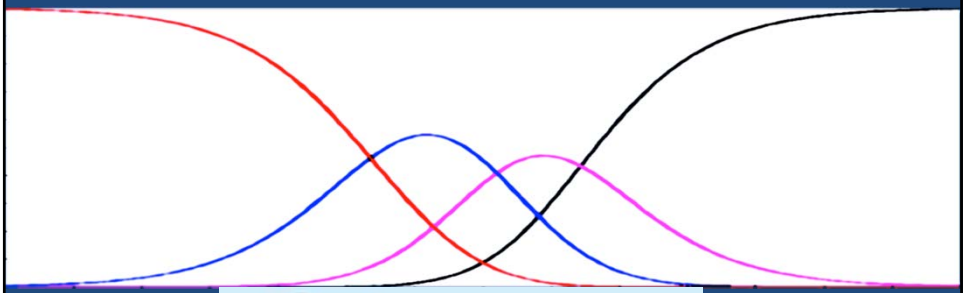
Faculty Confidence and Engagement Survey: Validation and Analysis with the Rasch Model



AIR ASSOCIATION FOR INSTITUTIONAL RESEARCH ANNUAL FORUM
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Assessment Office

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Reason for Technical Focus

- Great benefits (Fox and Bond, 2007; Linacre, 2012; Wright and Stone, 1999)
- Rare applications in education (e.g., Boone et al., 2011; Green, 1996; Muraki, 1990)

Terminology

1. Construct: psychological trait (e.g., confidence)
2. Category: answer options in a rating scale
3. Step: psychological distance between adjacent categories

Terminology

4. Endorsability: how easy to endorse an item; how easy to agree to an item

5. Measure
   - Item difficulty/endorsability estimate
   - Person attitude/confidence estimate

Sample Rating Scales

Agreement

5 - Strongly Agree
4 - Somewhat Agree
3 - Neutral
2 - Somewhat Disagree
1 - Strongly disagree

Sample Rating Scales

Confidence

5 - Confident
4 - Somewhat confident
3 - Neutral
2 - Somewhat unconfident
1 - Unconfident

Rating Scale: Analysis Dilemma

Rank-Order

Interval

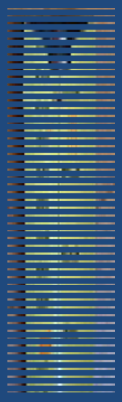


Image from: http://www.elmsholidayschemes.co.uk/assets/Bronze-Silver_Gold.jpg

Problems with Traditional Analysis (1)

- Numeric values assigned to response categories

Strongly Disagree (SD)	Somewhat Disagree (D)	Neutral (N)	Somewhat Agree (A)	Strongly Agree (SA)
1	2	3	4	5

Problems with Traditional Analysis (2)

- A SA on one item may indicate a higher level of the construct than SAs on others.

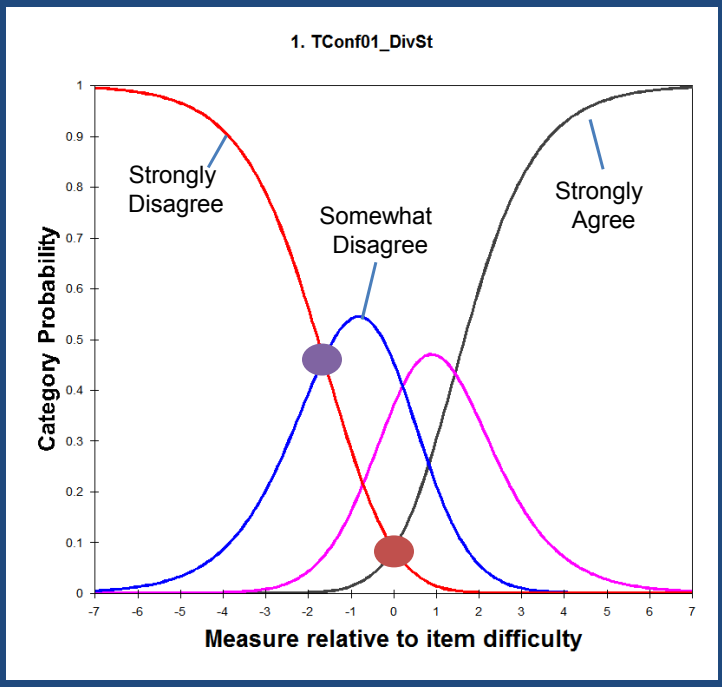
Computer Anxiety	Less ←→ More Anxiety						
(1) Avoid using computer			SD	D	N	A	SA
(2) Afraid of mistakes	SD	D	N	A	SA		

Rasch IRT Model

- Rasch (1960)
- Probability-based mathematic model (logistic regression)

Rasch Andrich Rating-Scale Model

- $\text{Log}_e\left(\frac{p_{nij}}{p_{ni(j-1)}}\right) = B_n - D_i - F_j$



Introduction of the Study

- Faculty Engagement and Confidence Survey (FaCES)
- Locally developed at Kapi‘olani CC to measure PD (C4WARD)
- Piloted in 2009 & adapted in 2012 to evaluate the impact of C4WARD
- construct mapping through focus group
- K = 36, n = 180

Analysis Software

Winsteps

Rasch Measurement Software

www.winsteps.com

Prompt, Perceptive, Powerful, Persuasive

Analysis Steps

1. Unidimensionality & reliability
2. Diagnostics:
   - Item fit
   - Point-Measure correlation
   - Scale diagnostics
3. Examine item hierarchy
4. Examine item-person measures map

STEP 1A: UNIDIMENSIONALITY

Criteria for Unidimensionality

- Method: Principal component factor analysis of model residuals (principal contrast analysis)
- Rasch dimension > any other dimension in variance explained
- More than two dimensions found → conduct Rasch analysis on each dimension (Bond & Fox, 2007)

Unidimensionality Result

- Winsteps Output Table 23. Item: Principle Contrast
- Variance explained: 79.3%
- 1st Contrast explained 2.3%
  - Imp9_OfferHelp (.70)
  - Imp10_HelpColleagues (.63)

Person/Item Separation

STEP 1B: RELIABILITY

Person/Item Separation

- Criterion: Separation > 3
- Source: Winsteps Table 3.1 Summary Statistics
- Results

	Separation	Reliability
Persons	3.33	0.92
Items	5.79	0.97

Scale Diagnostics

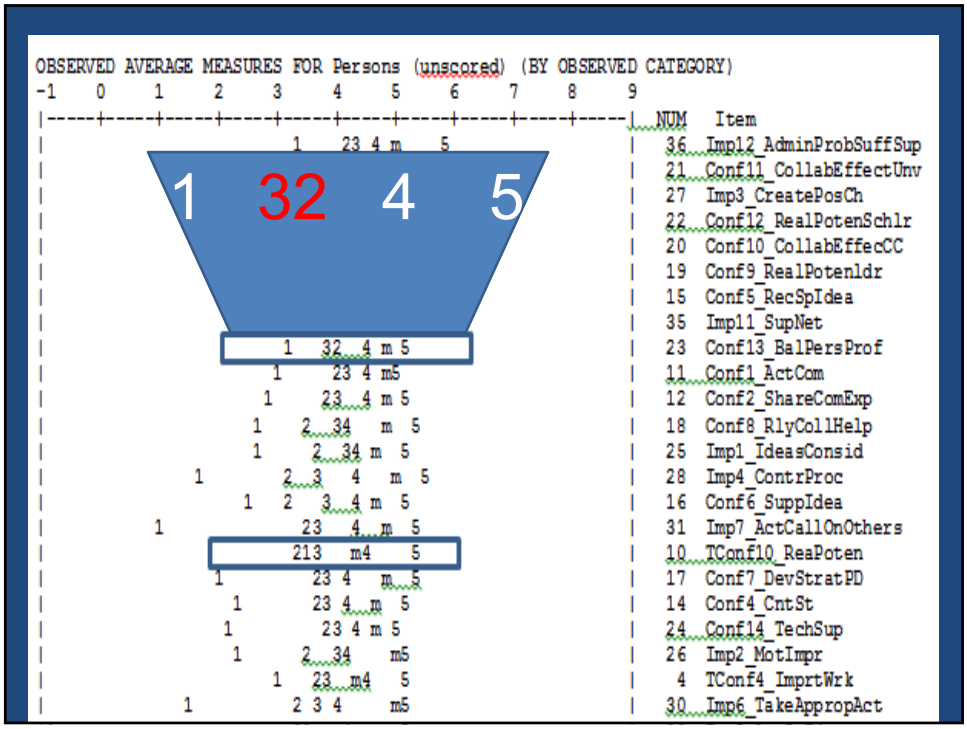
STEP 2: DIAGNOSTICS

Diagnostics Guidelines – Scale

- Category measures follow the order from 1 to 5.
- 1.4 logit distance between the thresholds (Fox and Bond, 2007)
- Relative equal frequency of responses under each category
- Collapsing category: do what makes sense

Scale Diagnostics Results 1

- Empirical Item-Category Measures Map (Winsteps Table 2.6, Handout Page 2)



Initial Thresholds
(Table 3.1 Winsteps Category Function)

Category Label	Observed Count	Average Measure	Threshold
1	206	-0.77	None
2	283	0.18	-0.57
3	683	0.53	-0.56
4	1831	1.18	-0.12
5	2665	2.17	1.25

Thresholds with Collapsed Categories

Category Label	Original Categories	Observed Count	Average Measure	Threshold
1	1	206	-0.97	None
2	2, 3	966	0.42	-1.64
3	4	1831	1.28	0.21
4	5	2665	2.43	1.44

Item Fit Diagnostics

STEP 2: DIAGNOSTICS

Two Fit Statistics

- Two fit statistics:
  - Infit: most sensitive to the unexpected responses in the transitional zone
  - Outfit: more sensitive to the unexpected responses outside of the transitional zone
- Linacre (2012, p. 33) illustrates the transitional zone

Transitional Zone

	Items Easiest ---------- Most Difficult	Infit	Outfit
1	1 1 1 1 1 1 1 1 1 0 1 0 1 0 1 0 0 0 0 0 0	1	< 1
2	1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0	< 1	< 1
3	1 1 1 1 1 1 1 1 0 0 0 1 1 1 1 1 0 0 0 0 0	> 1	< 1
4	1 1 0 1 1 1 1 1 1 0 1 0 1 0 1 0 0 0 1 0 0	1	1
5	0 0 0 1 1 1 1 1 1 0 1 0 1 0 1 0 0 0 0 0 0	1	> 1

Interpreting Item Fit

- > 1: underfit, noise in the data
- < 1: overfit, music is turned down or muted
- 0.6 – 1.4 for rating scales (Linacre, 2012, p. 25)

Item Reduction Based on Item Fit

- Outfit over infit
- Size (MS) over significance (ZSTD)
- Underfit (noise) over overfit (muted)
- Compare the person (or item) measures with and without the doubtful items (or persons). If there is no noticeable difference, then the misfit doesn't matter. (Linacre, 2012, p. 29)

Item Fit Results

- 17 outside of the range of good fit statistics
- Deletion caused reduction in person measures' reliability & separation
- All items were kept in the analysis
- 9 items with significant outfit > 1.20 were revised collaboratively

Point-Measure Correlation

STEP 2: DIAGNOSTICS

Point-Measure Correlation

- Criteria
  - Should be positive
  - Larger is better

Point-Measure Correlation Results

- Winsteps Table 13.1 Item: Measure
- Range 0.23 – 0.67
- Only one item below 0.30
- Median is 0.55

(Handout Page 3)

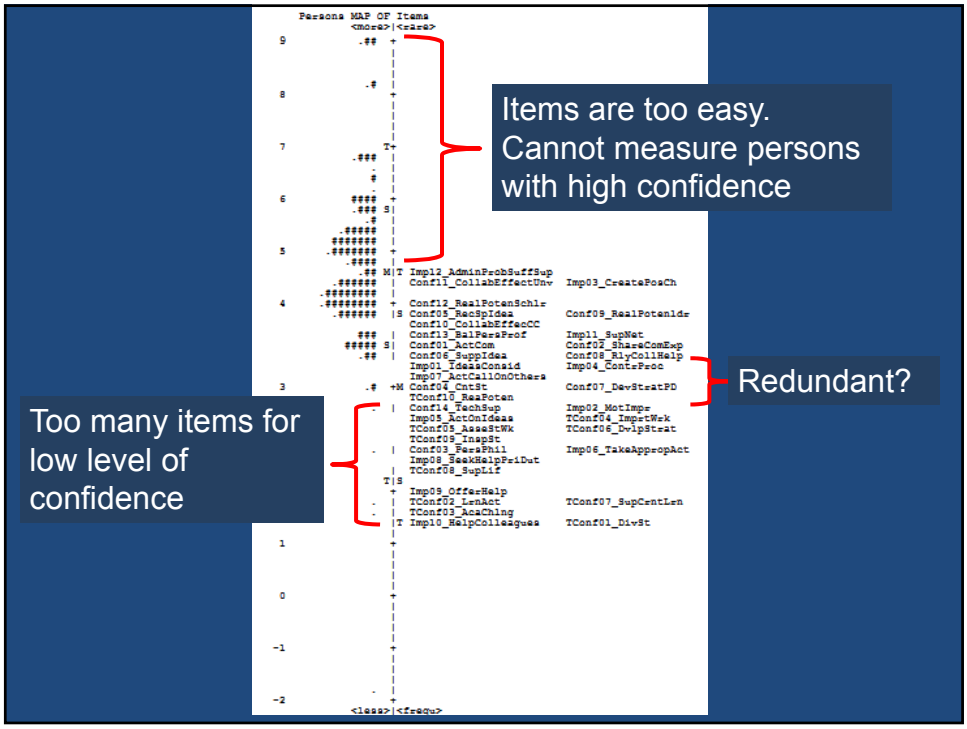
STEP 3: EXAMINE ITEM MEASURES AND CONCEPTUAL HIERARCHY

More confident on things within locus of control

Item Hierarchy Says…

- Items related to teaching practices are most easily endorsed.
- Items about what one can do through one's own action and related to one's primary duties are easier for the respondents to feel confident/engaged in.
- On the contrary, areas that involve impacting the institution, calling for help, seeking out resources, and involving oneself in the community are harder to feel confident/engaged in.
- faculty and staff are more confident in doing than in leading and collaborating. Self-assessment of professional development (PD) needs, development of PD strategies, and balancing personal and professional life are moderately difficult to feel confident/engaged in.
- The most difficult area to feel confident in is the support from the administration to help faculty/staff improve their professional practices

STEP 4: ITEM-PERSON MEASURES MAP



Construct Validity

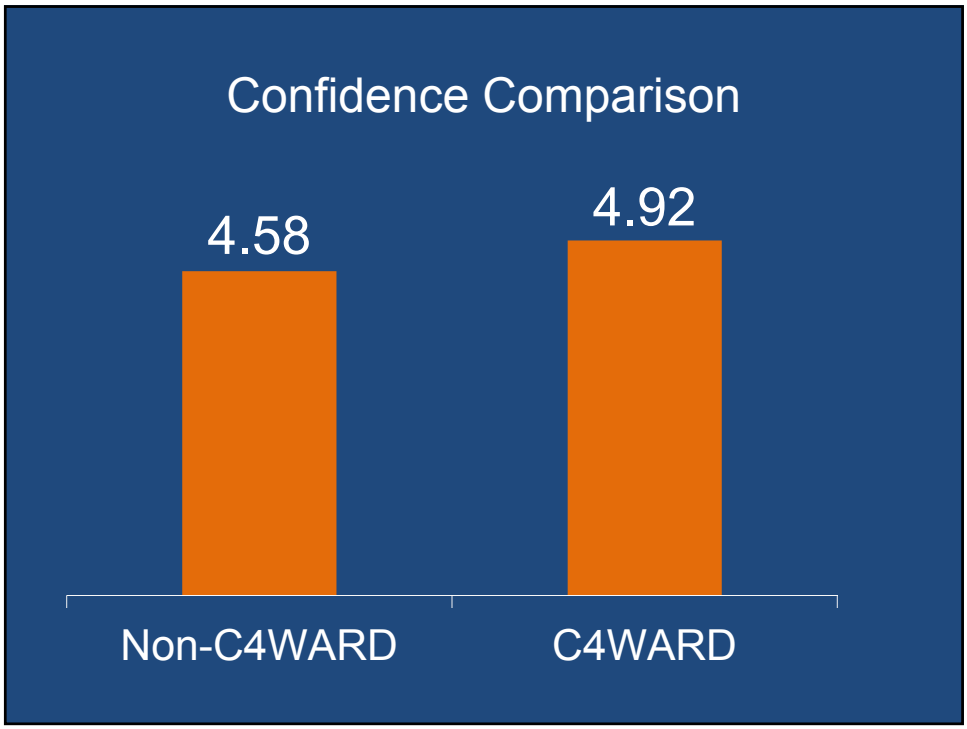
At the test level:

- Unidimensional?
- Item hierarchy matches construct composition?
- Item measures matches person measures?

At the item level:

- Fit model?
- Correlates with the measure?
- Scale categories separate from each other and ordered as expected?

USING PERSON MEASURES



Advantages

- Estimates in interval units (logits)
- Produce one measure per person!
- Relative item-invariant and person-invariant
- Person's confidence estimates can be mapped onto items' difficulty estimates
- Produce threshold estimates between categories

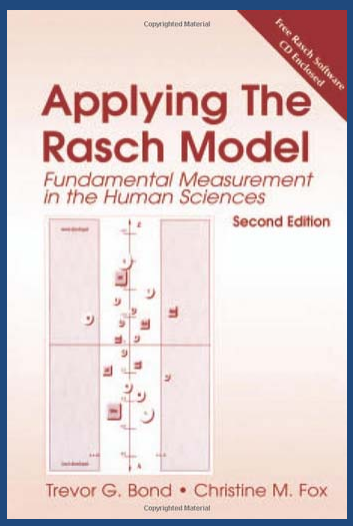
Summaries

- Major steps
  - Unidimensionality & Reliability
  - Item fit
  - Point-measure correlation
  - Scale diagnostics
  - Item measure hierarchy examination
  - Item-persons measures map
- Major statistics
- Advantages

Study Conclusions

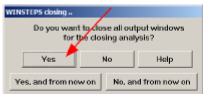
- FaCES is a good measure overall
  - One overall construct
  - Good person & item separation, high reliability
  - Poor item fit did not influence much of the quality
  - Produces one measure per person
- Still needs improvement: scale, items with poor fits, redundancy
- Next step: use anchor items to examine change

Resources – Introduction to Rasch Model



Bond and Fox, 2007

Resources – Practical Guide using Winsteps

#	Winsteps Rasch Tutorial 2 Mike Linacre, instructor – June 2012	
1.	**Tutorial 2. Fit analysis and Measurement Models** *Welcome back!* • Rasch-Andrich Rating Scale Model • Quality-control fit statistics • Scalograms This lesson builds on Lesson 1, so please go back and review when you need to. If you run into difficulties or want to talk about what you are learning, **please post to the Discussion Forum:** http://www.winsteps.com/forum	
2.	**A. Liking for Science - the control and data file**	
3.	Let's start with rating scales .... Double-click on the Winsteps short-cut on your desktop	
4.	If you see the "Welcome" dialog, please Click on **Don't ask again** Click on **No** You can access this function from **Data Setup** on the Winsteps menu bar.	

(Linacre, 2012)

Resources – Rasch is not just math

Using Rasch Theory to Guide the Practice of Survey Development and Survey Data Analysis in Science Education and to Inform Science Reform Efforts: An Exemplar Utilizing STEBI Self-Efficacy Data

WILLIAM J. BOONE
Educational Psychology, Miami University, Oxford, OH 45056, USA

J. SCOTT TOWNSEND
College of Education, Eastern Kentucky University, Richmond, KY 40475, USA

JOHN STAVER
Center for Research and Engagement in Science and Mathematics Education, Purdue University, West Lafayette, IN 47907, USA

(Boone, Townsend, & Staver, 2010)

Resources

- Bond, T. G., & Fox, C. M. (2013). *Applying the Rasch Model: Fundamental Measurement in the Human Sciences, Second Edition*. Mahwah, NJ: Psychology Press.
- Boone, W. J., Townsend, J. S., & Staver, J. (2011). Using Rasch theory to guide the practice of survey development and survey data analysis in science education and to inform science reform efforts: An exemplar utilizing STEBI self-efficacy data. *Science Education*, *95*(2), 258–280.
- Linacre, M. (2012). *Winsteps Rasch Tutorial 2*. Retrieved from www.winsteps.com/a/winsteps-tutorial-2.pdf.

Rasch Andrich Rating-Scale Model Formula

$$\mathbf{Log_e}\left(\frac{p_{nij}}{p_{ni(j-1)}}\right) = \boldsymbol{B_n - D_i - F_j}$$

- B_n = confidence level of Person n
- D_i = difficulty/endorsability level of item i
- F_j = difficulty level of Step j moving from one scale category to the next

Winsteps Control File

```
&INST
TITLE = "FaCES survey results"
PERSON = Person ; persons are …
ITEM = Item ; items are …
ITEM1 = 12 ; column of response to first item in data record
NI = 36 ; number of items
NAME1 = 1 ; column of first character of person identifying label
NAMELEN = 11 ; length of person label
XWIDE = 1 ; number of columns per item response
CODES = 12345 ; valid codes in data file
NEWSCORE=12234; joining category 2 and 3 together
RESCOR=2; do rescoring for all the items
UIMEAN = 3 ; item mean for local origin
USCALE = 1 ; user scaling for logits
UDECIM = 2 ; reported decimal places for user scaling

&END
Tconf01_DivSt
Tconf02_LrnAct
Tconf03_AcaChlng
Tconf04_ImprtWrk
Tconf05_AsseStWk
.
.
.
END LABELS
17456245330545545554533554445443544554555455543
17425205291554445555434544554222114443344455542
17393057360545455555454542544244415443345445542
17378172991445344544454444344411434544444444543
17369130001555555555555555555554555355555555554
17362455061555545544554545555544535555455555544
.
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```

Scale Diagnostics: Empirical Item-Category Measures (Winsteps Table 2.6)

```
OBSERVED AVERAGE MEASURES FOR Persons (unscored) (BY OBSERVED CATEGORY)
-1    0     1     2     3     4     5     6     7     8     9
|-----+-----+-----+-----+-----+-----+-----+-----+-----+-----|  NUM   Item
|                          1    23 4 m    5                 |   36  Imp12_AdminProbSuffSup
|                          1   2 34 m    5                 |   21  Conf11_CollabEffectUnv
|                          1   23  4 m     5                |   27  Imp3_CreatePosCh
|                         1    23m 4     5                 |   22  Conf12_RealPotenSchlr
|                           12  34  m   5                   |   20  Conf10_CollabEffecCC
|                    1         23  4   m  5                 |   19  Conf9_RealPotenldr
|                        1   2 3 4  m    5                 |   15  Conf5_RecSpIdea
|                        1   2 3  4  m  5                   |   35  Imp11_SupNet
|                       1    32  4 m 5                      |   23  Conf13_BalPersProf
|                        1     23 4 m5                      |   11  Conf1_ActCom
|                       1      23  4 m 5                    |   12  Conf2_ShareComExp
|                      1    2  34   m  5                    |   18  Conf8_RlyCollHelp
|                      1     2  34 m  5                     |   25  Imp1_IdeasConsid
|                 1         2  3   4   m  5                |   28  Imp4_ContrProc
|                      1   2   3  4 m  5                    |   16  Conf6_SuppIdea
|            1             23   4  m  5                    |   31  Imp7_ActCallOnOthers
|                         213   m4    5                    |   10  TConf10_ReaPoten
|                   1         23 4   m  5                  |   17  Conf7_DevStratPD
|                     1       23 4  m  5                   |   14  Conf4_CntSt
|                    1         23 4 m 5                    |   24  Conf14_TechSup
|                     1      2  34    m5                   |   26  Imp2_MotImpr
|                        1   23  m4   5                    |    4  TConf4_ImprtWrk
|                 1          2 3 4     m5                  |   30  Imp6_TakeAppropAct
|1                           23   4    m5                  |   29  Imp5_ActOnIdeas
|                       1  3    m24  5                     |    5  TConf5_AsseStWk
|                          2 3  4m    5                    |    6  TConf6_DvlpStrat
|                         2 3    m4   5                    |    9  TConf9_InspSt
|           1               3   24    m5                  |   32  Imp8_SeekHelpPriDut
|             1            2  3  4    m5                  |   13  Conf3_PersPhil
|                          3    4m   5                     |    8  TConf8_SupLif
|           1              3   4    5m                     |   33  Imp9_OfferHelp
|                          3   4 m   5                     |    7  TConf7_SupCrntLrn
|                         1    3 m4  5                     |    2  TConf2_LrnAct
|                         1   3  m4  5                     |    3  TConf3_AcaChlng
|                        3 2 m4  5                         |    1  TConf1_DivSt
|1                        3    4     5m                    |   34  Imp10_HelpColleagues
|-----+-----+-----+-----+-----+-----+-----+-----+-----+-----|  NUM   Item
-1    0     1     2     3     4     5     6     7     8     9
  Code for unidentified missing data: m

                          11111 11 1
 1                  11 15322184492191845462122 4  1    3     3  Persons
                   T      S      M       S      T
```

FaCES 2012 Survey Item Endorsability Chart

Code	Item	Item Endorsability
Imp	(10) I willingly help colleagues when asked.	1.41
T	(1) I am able to work with demographically diverse students.	1.44
T	(3) My courses are academically challenging for my students.	1.58
T	(2) My assignments provide an opportunity for students to learn actively and collaboratively.	1.83
T	(7) My interaction with students supports their current learning needs.	1.89
Imp	(9) I offer help to colleagues whenever I see the opportunity to do so appropriately.	2.01
T	(8) My interaction with students supports their lifelong learning needs.	2.31
A	(3) My professional philosophy is aligned with the mission of my college.	2.53
Imp	(8) I seek help when I need it for performing my primary duties.	2.63
Imp	(6) I can take appropriate actions when I identify what changes are necessary in my area of primary responsibilities.	2.67
Imp	(2) I am motivated to improve my professional practice in my primary responsibilities.	2.76
T	(6) I am able to develop strategies to increase success for all students.	2.76
T	(9) I am able to motivate and inspire students to become engaged learners.	2.76
T	(5) I am able to assess the diverse academic strengths and weaknesses of my students.	2.78
Imp	(5) I act on ideas to create positive change.	2.80
A	(14) I use technology effectively to support my primary responsibilities.	2.84
T	(4) My assessment strategies lead to improvements in my professional work.	2.89
A	(4) I am able to connect students to appropriate campus resources to support their success.	2.94
A	(7) I am able to develop strategies for my own professional advancement.	3.09
T	(10) I am realizing my potential as a scholar of teaching and learning.	3.09
A	(6) I am able to assess my professional development needs.	3.13
Imp	(7) If I decide to implement change, I will actively call on others for help to do so.	3.14
A	(8) I can rely on my colleagues for help solving problems related to my primary responsibilities.	3.21
Imp	(1) My ideas are seriously considered when I share them with my department chair or unit head.	3.25
Imp	(4) I contribute to the process that helps the institution move in a positive direction.	3.29
A	(2) I share my community engagement experiences with my students and/or colleagues, as appropriate.	3.35
A	(1) I am actively involved in my community (e.g., participating in blood drives, volunteering for the community).	3.46
A	(13) I can balance my personal and professional life.	3.59
Imp	(11) There is a support network among colleagues to help me to improve my professional practices in the area of my primary responsibilities.	3.65
A	(5) I am able to find resources to support my ideas for innovation.	3.73
A	(10) I collaborate effectively with colleagues at other UH community colleges.	3.87
A	(9) I am realizing my potential as a leader on my campus.	3.89
A	(12) I am realizing my potential as a scholar in my discipline.	4.09
Imp	(3) When I try to create positive change, I receive appreciation and encouragement from the campus.	4.38
A	(11) I collaborate effectively with colleagues at UH baccalaureate campuses.	4.41
Imp	(12) The administration provides me with sufficient support to help me improve my professional practices.	4.55

Item-Person Measures Map (Winsteps TABLE 12.2)

```
       Persons MAP OF Items
               <more>|<rare>
    9           .##  +
                     |
                     |
                     |
                 .#  |
    8                +
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    7               T+
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                  #  |
                  .  |
    6           ####  +
                .### S|
                  .#  |
             .#####   |
            #######   |
    5      .#######   +
              .####   |
                .## M|T Imp12_AdminProbSuffSup
             .######  |  Conf11_CollabEffectUnv  Imp03_CreatePosCh
           .########  |
    4      .########  +  Conf12_RealPotenSchlr
             .######  |S Conf05_RecSpIdea        Conf09_RealPotenldr
                      |  Conf10_CollabEffecCC
                  ###  |  Conf13_BalPersProf      Imp11_SupNet
                #####  S|  Conf01_ActCom           Conf02_ShareComExp
                  .##  |  Conf06_SuppIdea         Conf08_RlyCollHelp
                       |  Imp01_IdeasConsid       Imp04_ContrProc
                       |  Imp07_ActCallOnOthers
    3              .#  +M Conf04_CntSt            Conf07_DevStratPD
                       |  TConf10_ReaPoten
                    .  |  Conf14_TechSup          Imp02_MotImpr
                       |  Imp05_ActOnIdeas        TConf04_ImprtWrk
                       |  TConf05_AsseStWk        TConf06_DvlpStrat
                       |  TConf09_InspSt
                    .  |  Conf03_PersPhil         Imp06_TakeAppropAct
                       |  Imp08_SeekHelpPriDut
                       |  TConf08_SupLif
                      T|S
    2                  +  Imp09_OfferHelp
                    .  |  TConf02_LrnAct          TConf07_SupCrntLrn
                    .  |  TConf03_AcaChlng
                       |T Imp10_HelpColleagues    TConf01_DivSt
                       |
    1                  +
                       |
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    0                  +
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                       |
   -1                  +
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                       |
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   -2                  +
               <less>|<frequ>
 EACH '#' IS 2.
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