TELL Framework Survey Analysis Report

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1. Introduction

Our client, Catherine Ritz, a professor at Boston University's Department of Education, administered a survey pilot, completed by 86 individuals. Her goal was to investigate how foreign language teachers felt about the TELL Framework, a set of suggested characteristics a model foreign language teachers should have. In particular, she was interested in seeing if they would differ by the teacher's demographic or the language of teaching. Her survey included 18 questions regarding the teacher's backgrounds, and 200 questions regarding the TELL Framework. In particular, she took the listed characteristics from four of the major domains, and asked two questions about each one: if the teacher thought it was important for model teaching, and if the teacher was confident in applying it.

At our intake meeting, our client discussed improving the survey design for her final study. In particular, she was looking for a way to reduce the number of survey questions. In this report, we will propose a method and structure to summarize and remove questions.

This report will first start with a description of the Data Structure, as well as our Data Analysis. We will then describe the methods we will use to analyze the data, followed by our analysis.

2. Data Structure and Expolatory Data Analysis

TELL Framework Structure

The Teacher Effectiveness for Language Learning (TELL) framework is categorized into multiple domains. Each domain has its own set of individual characteristics, put into smaller groups. For the purpose of this report, we will call each of the large sets "domains", and each smaller group a "subdomain".

Data Structure

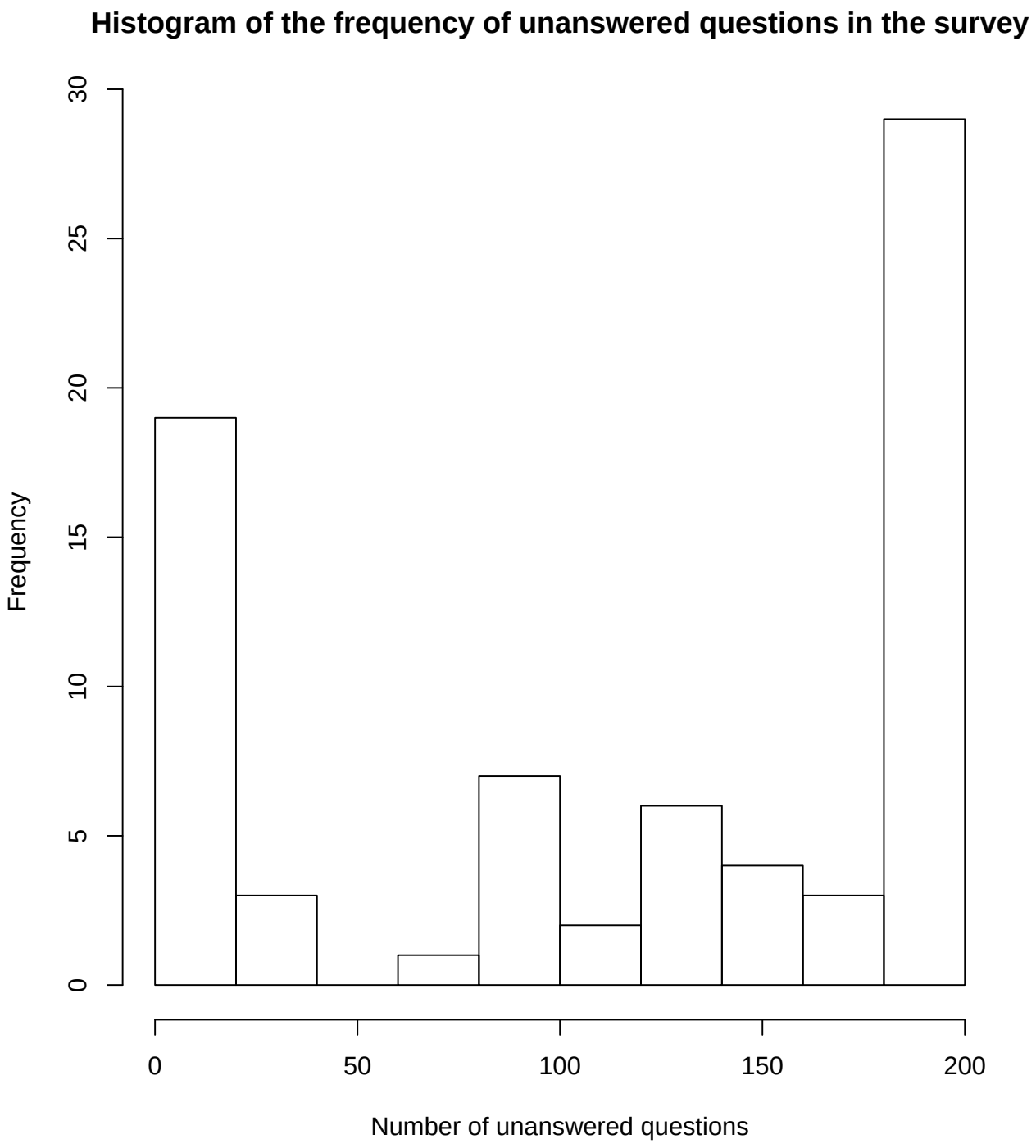
We were provided the data in an excel file with 6 spreadsheets including one sheet of notes, one sheet of personal information, and four sheets of questions on the Teacher Effectiveness for Language Learning (TELL) framework. The dataset of personal information contains questions regarding respondents' teaching language and education background.

Each sheet in the TELL Framework of the survey includes answers for part of one of four domains from the TELL Framework: planning, learning experience, learning tools, and performance & feedback. There are two questions asked for each characteristic, regarding the respondents' attitudes of contribution and confidence towards the characteristic, with 200 questions in total.

In this report, we will primarily focus on the questions regarding "Confidence". Additionally, we will refer to each question with its letter code, such as "PL1a". Each subdomain will be referred to by its shorter letter code, "PL1".

Exploratory Data Analysis

We conducted a basic Exploratory Data Analysis (EDA) for this project. Firstly, we focus on the time for respondents to complete this survey.



From this graph, it shows that most people (about 29 people) did not answer any questions in the survey, and the second high frequency (about 19 people) in the survey answered all questions, rest of people answered questions between 0 to 200.

Data Cleaning

Data Cleaning was conducted using R, primarily using the tidyverse package. The sheets were read in and bound together by row, allowing each row to contain the background data and all of the answers of an individual. Extra answers attached to no questions were removed. Names were also changed to fit a consistent structure among questions, allowing them to be effectively analyzed.

Concerns

Based on exploring the data, we found a few areas that may cause limitations. Firstly, many people did not answer most of the questions, meaning that the number of overall observations is limited. This may limit our analysis and our results.

3. Methods

We used a confirmatory factor analysis to assess how well questions can be grouped into their subdomains. A confirmatory factor analysis allows us to assess how well parts of a survey can fall within a proposed structure. Using this, we can try to group each survey questions into parts. If the questions all can be effectively grouped under a subdomain using a CFA, we can propose that each of those individual questions can be removed, and replaced with one question that addresses the listed subdomain. To do this, we used the lavaan package in R. A model was created for each subdomain, composed of all of its questions. We looked only at individuals who answered questions for each model, and excluded blank answers. For this report, we chose to focus on questions regarding confidence. The questions regarding contribution fall outside of our scope, so we would recommend consulting a survey expert if you want to find a way to address those.

To construct a model, we followed the structure of the TELL Framework, as described in the "Data Strcture" part of this report. We then used a protocol to assess the model and reduce questions. First, we looked at the standard errors for each of the questions and the loading. If the values of each were too low (in each case, lower than ~0.55), the question was considered not a good fit in the subdomain, and removed from the model. The process then continued, and the p-value was collected afterwards. Then, we checked the p-value of the model. A p-value higher than 0.05 indicates that the questions are all similar under the model, and the grouping is good. If the p-value was lower, it means there was strong evidence that questions were not equal, and one of the questions could be removed. We continued this process until achieving a sufficient model, and then collected summary statistics.

There were a few additional cases we had to consider as well. For subdomains with three questions, rather than removing questions, a transformation was done in order to assess the subdomain. Additionally, subdomains with two questions cannot be analyzed using this method. Rather than treating them by themselves, they were grouped with another subdomain, effectively grouping them together.

4. Analysis

Planning Domain

Table 1: 'Planning' Subdomain Summary

Section	Questions	P-Value	CFI	TLI
PL1	PL1a,PL1b,PL1c,PL1d,PL1f	0.887	1	1.103
PL2	PL2a,PL2b,PL2c	0.292	0.995	0.986
PL3	PL3a,PL3d,PL3e	0.902	1	1.071
PL4	PL4a,PL4b,PL4c	0.051	0.944	0.832
PL5	PL5a,PL5b,PL5c,PL5d	0.261	0.981	0.943
PL6	PL6a,PL6b,PL6c	0.283	0.991	0.974
PL7	PL7a,PL7b,PL7c	0.903	1	1.091
PL8	PL8a,PL8b,PL8c	0.301	0.998	0.994

Summary statistics for the subdomains of PL1 are shown in Table 1. Questions were removed based on our protocol, and the remaining questions are shown in the "Questions" table. Questions PL1e, PL1g, PL3b,PL3c, PL6d, and PL8d were removed. All additional questions were found to not fit well within the model, and may need to be treated separately. The models meet the gold standard of a Comparative Fit Index (CFI) of 0.90, indicating that there is not a major discrepancy between the hypothetical models and the data. The Tucker-Lewis Index (TLI) for each model are also close or lower to 1, supporting that the data and models seem to be close. The P-values for each of the model all are relatively high, indicating that they most likely follow the null hypothesis. Effectively, this means that the questions within the model can be grouped into their subdomain. PL4 may be the only exception, since it has a P-value close to 0.051. However, the CFI and TLI of the model remain high, so it may be correct to use it as one model.

Learning Tool Domain

Table 2: 'Learning Tools' Subdomain Summary

Section	Questions	P-Value	CFI	TLI
LT1	LT1a,LT1b,LT1c	0.741	1	1.607
LT2	LT2a,LT2b,LT2c	0.953	1	1.234
LT3	LT3a,LT3b,LT3d	0.897	1	1.087
LT4	LT4a,LT4b,LT4c	0.899	1	1.06
LT5	LT5a,LT5b,LT5c	0.379	1	1.055

The summary statistics for the Learning Tools subdomains are shown in Table 2. As before, questions included in each subdomain are listed in the "Questions" column. The only question removed due to the protocal was LT3c, which may need to be treated separately. The CFI and TLI both seem high and close to 1 respectively, showing that the data and proposed models are relatively close. LT1 may need to be considered more closely, since its LT1 is relatively larger than the rest of these values. However, it still seems to show a relatively close comparison between the data and proposed models. Once again, our p-values indicate that the null hypothesis cannot be rejected, and the questions can effectively be grouped into a subdomain.

Per & Feedback Domain

Table 3: 'Performance & Feedback' Subdomain Summary

Section	Questions	P-Value	CFI	TLI
PF1	PF1a,PF1b,PF1c,PF1d	0.967	1	1.088
PF2	PF2a,PF2b,PF2d,PF2e	0.459	1	1.019
PF3	PF3a,PF3b,PF3c,PF3d,PF3e	0.485	1	1.104
PF4 & PF5	PF4a,PF4b,PF5a,PF5b	0.362	1	1.024

The summary statistics for the Performance and Feedback subdomain is shown in Table 3. Excluded questions from our protocol were PF1e, PF2c, and PF5c. Since PF4 only contained two questions, following our protocol, it was treated in combination with PL5 in order to be assessed with our CFA method.

Once again, the calculated CFI and TLI are above 0.9 and close to 1 respectively, indicating that the data and proposed models follow each other well. Additionally, p-values are higher than the 0.05 threshold, indicating that these subdomains can be used to group questions together effectively.

Learning Experience Domain

Table 4: 'Learning Experience' Subdomain Summary

Section	Questions	P-Value	CFI	TLI
LE1	LE1a,LE1b,LE1c,LE1d	0.672	1	1.173
LE2	LE2a,LE2c,LE2d,LE2f	0.412	1	1.036
LE3	LE3a,LE3b,LE3d,LE3e,LE3f	0.951	1	1.492
LE4	LE4a,LE4b,LE4c,LE4d	0.13	0.94	0.819
LE5	LE5a,LE5c,LE5d	0.857	1	1.18
LE6	LE6b,LE6c,LE6d	0.657	1	1.072

The results for the Learning Experience Domain can be shown in Table 4. The questions removed due to the question removal protocol are LE1a, LE2b, LE2e, LE3c, LE3g, LE4e, LE5b, and LE6a. These questions may need to be treated separately when restructuring the survey.

Our CFI and TLI values are both high and close to 1, indicating that the models fit the data. The TLI for LE3 is relatively higher than the rest, which may mean it needs to be considered separately. However, it is still relatively close to 1, and still indicates a decent fit between data and model. The p-values are above our threshold of 0.05, indicating that each one groups each set of questions well.

5. Conclusion

In this report, we have proposed a structure to group and remove large set of question based on the structure of the TELL Framework. In our analysis, we used a Confirmatory Factor Analysis to show that many of the survey questions can be grouped in a larger structure. This may highlight a method to reduce question number, where, rather than asking each of the questions, one question is asked for each group. However, this will require a change in questioning and possibly a change in structure.

The questions removed from the subdomains must be considered separately. Usually, they were removed because the way they were answered followed a significantly different pattern from other questions. There may be a final structure that does group these with the rest. Our analysis only shows that they don't fit best under the groupings provided by the TELL framework.

Appendix

Learning Tool Domain Analysis

For Learning Tools table in TELL Statements, we numeric character answers of LT 1a~5c Confidence, and NA values stay as same as NA that will not count in. First, I made CFA models for each subdomain (ex: LT1 has 3 variables: LT1a_Confidence, LT1b_Confidence, LT1c_Confidence).Then we have an available P-value for each subdomain and we find factor loadings of each variables in each subdomain. Third, we compare P-value of each subdomain to 0.05, if P-value > 0.05, our null hypothesis retained, and we do not need to make any further change on that subdomain; if P-value < 0.05, it means our null hypothesis is rejected, and we need to remodel by droping the variable with lowest factor loadings in that subdomain and check its P-value again. Following are detailed results: # First subdomain:

```
## lavaan 0.6-5 ended normally after 12 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                          6
##   Number of equality constraints                     1
##   Row rank of the constraints matrix                 1
##
##                                                   Used       Total
##   Number of observations                            27          84
##
## Model Test User Model:
##
##   Test statistic                                 0.109
##   Degrees of freedom                                 1
##   P-value (Chi-square)                           0.741
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   lt1 =~
##     LT1_Cnfdn (aa)    0.384    0.165    2.331    0.020    0.384    0.488
##     LT1b_Cnfd (aa)    0.384    0.165    2.331    0.020    0.384    0.472
##     LT1c_Cnfd         0.612    0.282    2.167    0.030    0.612    0.722
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .LT1a_Confidenc    0.472    0.168    2.816    0.005    0.472    0.762
##    .LT1b_Confidenc    0.515    0.177    2.914    0.004    0.515    0.777
##    .LT1c_Confidenc    0.344    0.314    1.095    0.273    0.344    0.479
##     lt1               1.000                              1.000    1.000
```

Table 5: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
lt1	LT1a_Confidence	0.384	0.165	2.331	0.02	0.488
lt1	LT1b_Confidence	0.384	0.165	2.331	0.02	0.472

Latent Factor	Indicator	B	SE	Z	p-value	loading
lt1	LT1c_Confidence	0.612	0.282	2.167	0.03	0.722

Since p-value of the first subdomain is $0.741 > 0.05$, there is no need to make any change in the first subdomain and we can save all questions.

Second subdomain

```
## lavaan 0.6-5 ended normally after 12 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                          6
##   Number of equality constraints                     1
##   Row rank of the constraints matrix                 1
##
##                                                   Used       Total
##   Number of observations                            28          84
##
## Model Test User Model:
##
##   Test statistic                                 0.003
##   Degrees of freedom                                 1
##   P-value (Chi-square)                           0.953
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   lt2 =~
##     LT2_Cnfdn (aa)    0.443    0.126    3.531    0.000    0.443    0.587
##     LT2b_Cnfd (aa)    0.443    0.126    3.531    0.000    0.443    0.603
##     LT2c_Cnfd         0.776    0.222    3.499    0.000    0.776    0.817
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .LT2a_Confidenc    0.373    0.127    2.930    0.003    0.373    0.655
##    .LT2b_Confidenc    0.345    0.122    2.838    0.005    0.345    0.637
##    .LT2c_Confidenc    0.300    0.270    1.110    0.267    0.300    0.333
##     lt2               1.000                              1.000    1.000
```

Table 6: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
lt2	LT2a_Confidence	0.443	0.126	3.531	0	0.587
lt2	LT2b_Confidence	0.443	0.126	3.531	0	0.603
lt2	LT2c_Confidence	0.776	0.222	3.499	0	0.817

Since p-value of the second subdomain is $0.953 > 0.05$, there is no need to make any change in the second subdomain and we can save all questions.

Third subdomain

```
## lavaan 0.6-5 ended normally after 15 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                          8
##
##                                                   Used       Total
##   Number of observations                            27          84
##
## Model Test User Model:
##
##   Test statistic                                 9.736
##   Degrees of freedom                                 2
##   P-value (Chi-square)                           0.008
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   lt3 =~
##     LT3a_Confidenc    0.858    0.158    5.419    0.000    0.858    0.885
##     LT3b_Confidenc    0.724    0.147    4.933    0.000    0.724    0.827
##     LT3c_Confidenc    0.528    0.161    3.273    0.001    0.528    0.604
##     LT3d_Confidenc    0.804    0.200    4.020    0.000    0.804    0.709
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .LT3a_Confidenc    0.204    0.120    1.697    0.090    0.204    0.217
##    .LT3b_Confidenc    0.242    0.102    2.375    0.018    0.242    0.316
##    .LT3c_Confidenc    0.486    0.144    3.376    0.001    0.486    0.635
##    .LT3d_Confidenc    0.638    0.204    3.131    0.002    0.638    0.497
##     lt3               1.000                              1.000    1.000
```

Table 7: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
lt3	LT3a_Confidence	0.858	0.158	5.419	0.000	0.885
lt3	LT3b_Confidence	0.724	0.147	4.933	0.000	0.827
lt3	LT3c_Confidence	0.528	0.161	3.273	0.001	0.604
lt3	LT3d_Confidence	0.804	0.200	4.020	0.000	0.709

Since p-value of the third subdomain is $0.008 < 0.05$, and question "LT3c_Confidence" has the lowest factor loading 0.604, we drop "LT3_c_Confidence" and then remodel the third subdomain.

```
## lavaan 0.6-5 ended normally after 14 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                          6
##   Number of equality constraints                     1
##   Row rank of the constraints matrix                 1
##
##                                                   Used       Total
##   Number of observations                            27          84
##
## Model Test User Model:
##
##   Test statistic                                 0.017
##   Degrees of freedom                                 1
##   P-value (Chi-square)                           0.897
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   lt3 =~
##     LT3_Cnfdn         0.931    0.164    5.660    0.000    0.931    0.959
##     LT3b_Cnfd (aa)    0.706    0.144    4.892    0.000    0.706    0.802
##     LT3d_Cnfd (aa)    0.706    0.144    4.892    0.000    0.706    0.629
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .LT3a_Confidenc    0.075    0.170    0.442    0.659    0.075    0.080
##    .LT3b_Confidenc    0.276    0.122    2.259    0.024    0.276    0.357
##    .LT3d_Confidenc    0.761    0.228    3.330    0.001    0.761    0.604
##     lt3               1.000                              1.000    1.000
```

Table 8: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
lt3	LT3a_Confidence	0.931	0.164	5.660	0	0.959
lt3	LT3b_Confidence	0.706	0.144	4.892	0	0.802
lt3	LT3d_Confidence	0.706	0.144	4.892	0	0.629

After we remodel the third subdomain, the p-value of third domain is $0.897 > 0.05$. Then we can save all the remaining questions in the third subdomain ("LT3a_Confidence", "LT3b_Confidence", "LT3d_Confidence").

Fourth subdomain

```
## lavaan 0.6-5 ended normally after 19 iterations
##
##   Estimator                                         ML
```

```
##   Optimization method                           NLMINB
##   Number of free parameters                          6
##   Number of equality constraints                     1
##   Row rank of the constraints matrix                 1
##
##                                                   Used       Total
##   Number of observations                            28          84
##
## Model Test User Model:
##
##   Test statistic                                 0.016
##   Degrees of freedom                                 1
##   P-value (Chi-square)                           0.899
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   lt4 =~
##     LT4_Cnfdn         0.370    0.140    2.640    0.008    0.370    0.469
##     LT4b_Cnfd (aa)    1.077    0.150    7.191    0.000    1.077    1.012
##     LT4c_Cnfd (aa)    1.077    0.150    7.191    0.000    1.077    0.886
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .LT4a_Confidenc    0.485    0.129    3.749    0.000    0.485    0.780
##    .LT4b_Confidenc   -0.027    0.095   -0.282    0.778   -0.027   -0.024
##    .LT4c_Confidenc    0.316    0.127    2.486    0.013    0.316    0.214
##     lt4               1.000                              1.000    1.000
```

Table 9: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
lt4	LT4a_Confidence	0.370	0.14	2.640	0.008	0.469
lt4	LT4b_Confidence	1.077	0.15	7.191	0.000	1.012
lt4	LT4c_Confidence	1.077	0.15	7.191	0.000	0.886

Since p-value of the fourth subdomain is $0.899 > 0.05$, there is no need to make any change in the fourth subdomain and we can save all questions.

Fifth subdomain

```
## lavaan 0.6-5 ended normally after 13 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                          6
##   Number of equality constraints                     1
```

```
##   Row rank of the constraints matrix                 1
##
##                                                   Used       Total
##   Number of observations                            26          84
##
## Model Test User Model:
##
##   Test statistic                                 0.774
##   Degrees of freedom                                 1
##   P-value (Chi-square)                           0.379
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   lt5 =~
##     LT5_Cnfdn (aa)    0.398    0.124    3.205    0.001    0.398    0.618
##     LT5b_Cnfd         0.620    0.186    3.331    0.001    0.620    0.844
##     LT5c_Cnfd (aa)    0.398    0.124    3.205    0.001    0.398    0.532
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .LT5a_Confidenc    0.257    0.101    2.544    0.011    0.257    0.618
##    .LT5b_Confidenc    0.155    0.186    0.832    0.405    0.155    0.287
##    .LT5c_Confidenc    0.402    0.132    3.034    0.002    0.402    0.717
##     lt5               1.000                              1.000    1.000
```

Table 10: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
lt5	LT5a_Confidence	0.398	0.124	3.205	0.001	0.618
lt5	LT5b_Confidence	0.620	0.186	3.331	0.001	0.844
lt5	LT5c_Confidence	0.398	0.124	3.205	0.001	0.532

Since p-value of the fifth subdomain is $0.379 > 0.05$, there is no need to make any change in the fifth subdomain and we can save all questions.

PER & FEEDBACK Domain Analysis

For PER&FEEDBACK table in TELL Statements, I numeric character answers of PF 1a~5c Confidence, and NA values stay as same as NA that will not count in. First, I made CFA models for each subdomain whose variables should greater than 2 (ex: PF1 has 5 variables: PF1a_Confidence, PF1b_Confidence, PF1c_Confidence,PF1d_Confidence and PF1e_Confidence), or the P-value of that model will become NA. And we get an exception in PF table: PF4 only has 2 varaibles, so I combine PF4 with PF5 to one CFA model so that we have an available P-value. Second, we find factor loadings of each variables in each subdomain and record them. Third, we compare P-value of each subdomain to 0.05, if P-value > 0.05, our null hypothesis retained, and we do not need to make any further change on that subdomain; if P-value < 0.05, it means our null hypothesis is rejected, and we need to remodel by droping the variable with lowest factor loadings in that subdomain and check its P-value again. Following are detailed results

First subdomain:

```
## lavaan 0.6-5 ended normally after 21 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                         10
##
##                                                   Used       Total
##   Number of observations                            27          84
##
## Model Test User Model:
##
##   Test statistic                                15.646
##   Degrees of freedom                                 5
##   P-value (Chi-square)                           0.008
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   PF1 =~
##     PF1a_Confidenc    0.690    0.202    3.421    0.001    0.690    0.609
##     PF1b_Confidenc    0.879    0.168    5.229    0.000    0.879    0.830
##     PF1c_Confidenc    0.828    0.128    6.471    0.000    0.828    0.946
##     PF1d_Confidenc    0.823    0.135    6.110    0.000    0.823    0.915
##     PF1e_Confidenc    0.584    0.178    3.275    0.001    0.584    0.587
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .PF1a_Confidenc    0.808    0.228    3.545    0.000    0.808    0.630
##    .PF1b_Confidenc    0.349    0.110    3.160    0.002    0.349    0.311
##    .PF1c_Confidenc    0.080    0.049    1.628    0.104    0.080    0.105
##    .PF1d_Confidenc    0.132    0.057    2.306    0.021    0.132    0.163
##    .PF1e_Confidenc    0.647    0.182    3.559    0.000    0.647    0.655
##     PF1               1.000                               1.000    1.000
```

Table 11: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
PF1	PF1a_Confidence	0.690	0.202	3.421	0.001	0.609
PF1	PF1b_Confidence	0.879	0.168	5.229	0.000	0.830
PF1	PF1c_Confidence	0.828	0.128	6.471	0.000	0.946
PF1	PF1d_Confidence	0.823	0.135	6.110	0.000	0.915
PF1	PF1e_Confidence	0.584	0.178	3.275	0.001	0.587

Since p-value of first subdomain is $0.008 < 0.05$, and the factor loadings of "PF1e_Confidence" is lowest, thus, we try to drop it from the first subdomain:

```
## lavaan 0.6-5 ended normally after 31 iterations
```

```
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                          8
##
##                                                   Used       Total
##   Number of observations                            28          84
##
## Model Test User Model:
##
##   Test statistic                                 0.068
##   Degrees of freedom                                 2
##   P-value (Chi-square)                           0.967
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   PF1 =~
##     PF1a_Confidenc    0.660    0.196    3.360    0.001    0.660    0.593
##     PF1b_Confidenc    0.835    0.173    4.830    0.000    0.835    0.780
##     PF1c_Confidenc    0.796    0.130    6.135    0.000    0.796    0.914
##     PF1d_Confidenc    0.831    0.129    6.432    0.000    0.831    0.940
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .PF1a_Confidenc    0.804    0.223    3.601    0.000    0.804    0.649
##    .PF1b_Confidenc    0.449    0.135    3.321    0.001    0.449    0.392
##    .PF1c_Confidenc    0.125    0.061    2.048    0.041    0.125    0.165
##    .PF1d_Confidenc    0.091    0.061    1.498    0.134    0.091    0.116
##     PF1               1.000                              1.000    1.000
```

P-value $= 0.967 > 0.05$, thus we do not need to change any more on the first subdomain.

Second subdomain:

```
## lavaan 0.6-5 ended normally after 18 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                         10
##
##                                                   Used       Total
##   Number of observations                            27          84
##
## Model Test User Model:
##
##   Test statistic                                14.489
##   Degrees of freedom                                 5
##   P-value (Chi-square)                           0.013
```

```
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   PF2 =~
##     PF2a_Confidenc    0.561    0.172    3.255    0.001    0.561    0.587
##     PF2b_Confidenc    0.948    0.159    5.981    0.000    0.948    0.905
##     PF2c_Confidenc    0.575    0.188    3.060    0.002    0.575    0.558
##     PF2d_Confidenc    0.896    0.151    5.941    0.000    0.896    0.901
##     PF2e_Confidenc    1.016    0.173    5.880    0.000    1.016    0.896
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .PF2a_Confidenc    0.599    0.169    3.534    0.000    0.599    0.655
##    .PF2b_Confidenc    0.199    0.083    2.384    0.017    0.199    0.181
##    .PF2c_Confidenc    0.731    0.206    3.554    0.000    0.731    0.689
##    .PF2d_Confidenc    0.185    0.076    2.439    0.015    0.185    0.188
##    .PF2e_Confidenc    0.255    0.101    2.520    0.012    0.255    0.198
##     PF2               1.000                              1.000    1.000
```

Table 12: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
PF2	PF2a_Confidence	0.561	0.172	3.255	0.001	0.587
PF2	PF2b_Confidence	0.948	0.159	5.981	0.000	0.905
PF2	PF2c_Confidence	0.575	0.188	3.060	0.002	0.558
PF2	PF2d_Confidence	0.896	0.151	5.941	0.000	0.901
PF2	PF2e_Confidence	1.016	0.173	5.880	0.000	0.896

Since p-value of first subdomain is $0.013 < 0.05$, and the factor loadings of "PF2c_Confidence" is lowest, thus, we try to drop it from the second subdomain:

```
## lavaan 0.6-5 ended normally after 18 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                          8
##
##                                                   Used       Total
##   Number of observations                            28          84
##
## Model Test User Model:
##
##   Test statistic                                 1.559
##   Degrees of freedom                                 2
##   P-value (Chi-square)                           0.459
##
## Parameter Estimates:
```

```
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   PF2 =~
##     PF2a_Confidenc    0.553    0.169    3.275    0.001    0.553    0.583
##     PF2b_Confidenc    0.910    0.158    5.765    0.000    0.910    0.877
##     PF2d_Confidenc    0.884    0.147    6.012    0.000    0.884    0.901
##     PF2e_Confidenc    1.011    0.167    6.057    0.000    1.011    0.905
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .PF2a_Confidenc    0.596    0.166    3.588    0.000    0.596    0.660
##    .PF2b_Confidenc    0.248    0.093    2.675    0.007    0.248    0.231
##    .PF2d_Confidenc    0.182    0.077    2.349    0.019    0.182    0.189
##    .PF2e_Confidenc    0.227    0.099    2.280    0.023    0.227    0.181
##     PF2               1.000                              1.000    1.000
```

P-value $= 0.459 > 0.05$, thus we can stay here for the second subdomain.

Third subdomain:

```
## lavaan 0.6-5 ended normally after 15 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                         10
##
##                                                   Used       Total
##   Number of observations                            28          84
##
## Model Test User Model:
##
##   Test statistic                                 2.920
##   Degrees of freedom                                 5
##   P-value (Chi-square)                           0.712
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   PF3 =~
##     PF3a_Confidenc    0.466    0.184    2.533    0.011    0.466    0.485
##     PF3b_Confidenc    0.869    0.173    5.032    0.000    0.869    0.838
##     PF3c_Confidenc    0.628    0.146    4.300    0.000    0.628    0.746
##     PF3d_Confidenc    0.753    0.169    4.468    0.000    0.753    0.767
##     PF3e_Confidenc    0.543    0.171    3.179    0.001    0.543    0.588
```

```
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .PF3a_Confidenc    0.706    0.199    3.543    0.000    0.706    0.765
##    .PF3b_Confidenc    0.320    0.149    2.153    0.031    0.320    0.298
##    .PF3c_Confidenc    0.315    0.109    2.893    0.004    0.315    0.444
##    .PF3d_Confidenc    0.396    0.143    2.759    0.006    0.396    0.411
##    .PF3e_Confidenc    0.557    0.164    3.396    0.001    0.557    0.654
##     PF3               1.000                              1.000    1.000
```

Table 13: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
PF3	PF3a_Confidence	0.466	0.184	2.533	0.011	0.485
PF3	PF3b_Confidence	0.869	0.173	5.032	0.000	0.838
PF3	PF3c_Confidence	0.628	0.146	4.300	0.000	0.746
PF3	PF3d_Confidence	0.753	0.169	4.468	0.000	0.767
PF3	PF3e_Confidence	0.543	0.171	3.179	0.001	0.588
Since p-value >	0.05, the third su	bdomain	is ok, n	o longer	to remode	l it.

Fourth subdomain:

PF4 only has 2 varaibles, so I combine PF4 with PF5 to one CFA model so that we can get an available P-value.

```
## lavaan 0.6-5 ended normally after 22 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                         11
##
##                                                   Used       Total
##   Number of observations                            24          84
##
## Model Test User Model:
##
##   Test statistic                                12.824
##   Degrees of freedom                                 4
##   P-value (Chi-square)                           0.012
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   PF4 =~
##     PF4a_Confidenc    0.754    0.148    5.099    0.000    0.754    0.888
##     PF4b_Confidenc    0.681    0.145    4.699    0.000    0.681    0.835
##   PF5 =~
##     PF5a_Confidenc    0.690    0.173    3.988    0.000    0.690    0.757
```

```
##     PF5b_Confidenc    0.632    0.158    4.003    0.000    0.632    0.759
##     PF5c_Confidenc    0.535    0.192    2.782    0.005    0.535    0.567
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   PF4 ~~
##     PF5               0.877    0.113    7.732    0.000    0.877    0.877
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .PF4a_Confidenc    0.153    0.101    1.511    0.131    0.153    0.212
##    .PF4b_Confidenc    0.201    0.094    2.131    0.033    0.201    0.302
##    .PF5a_Confidenc    0.355    0.143    2.484    0.013    0.355    0.427
##    .PF5b_Confidenc    0.294    0.119    2.470    0.014    0.294    0.424
##    .PF5c_Confidenc    0.603    0.192    3.135    0.002    0.603    0.678
##     PF4               1.000                              1.000    1.000
##     PF5               1.000                              1.000    1.000
```

Table 14: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
PF4	PF4a_Confidence	0.754	0.148	5.099	0.000	0.888
PF4	PF4b_Confidence	0.681	0.145	4.699	0.000	0.835
PF5	PF5a_Confidence	0.690	0.173	3.988	0.000	0.757
PF5	PF5b_Confidence	0.632	0.158	4.003	0.000	0.759
PF5	PF5c_Confidence	0.535	0.192	2.782	0.005	0.567

Since P-value is $0.012 < 0.05$, and the lowest factor loading is "PF5c_Confidence", thus we try to drop it from the subdomain:

```
## lavaan 0.6-5 ended normally after 21 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                          9
##
##                                                   Used       Total
##   Number of observations                            24          84
##
## Model Test User Model:
##
##   Test statistic                                 0.832
##   Degrees of freedom                                 1
##   P-value (Chi-square)                           0.362
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
```

```
##   PF4 =~
##     PF4a_Confidenc    0.724    0.155    4.671    0.000    0.724    0.851
##     PF4b_Confidenc    0.710    0.148    4.808    0.000    0.710    0.871
##   PF5 =~
##     PF5a_Confidenc    0.812    0.171    4.742    0.000    0.812    0.890
##     PF5b_Confidenc    0.635    0.160    3.970    0.000    0.635    0.763
##
## Covariances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   PF4 ~~
##     PF5               0.755    0.137    5.507    0.000    0.755    0.755
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .PF4a_Confidenc    0.199    0.116    1.720    0.085    0.199    0.275
##    .PF4b_Confidenc    0.160    0.107    1.497    0.134    0.160    0.241
##    .PF5a_Confidenc    0.173    0.157    1.100    0.271    0.173    0.207
##    .PF5b_Confidenc    0.289    0.124    2.342    0.019    0.289    0.418
##     PF4               1.000                              1.000    1.000
##     PF5               1.000                              1.000    1.000
```

P-value is $0.362 > 0.05$, thus no longer remodel this subdomain.

Learning Experience Domain Analysis

For learning experience table in TELL Statements, we numeric character answers of LE 1a~6d Confidence, and NA values stay as same as NA that will not count in. First, I made CFA models for each subdomain (ex: LE1 has 5 variables: LE1a_Confidence, LE1b_Confidence, LE1c_Confidence,LE1d_Confidence and LE1e_Confidence).Then we have an available P-value for each subdomain and we find factor loadings of each variables in each subdomain. Third, we compare P-value of each subdomain to 0.05, if P-value > 0.05, our null hypothesis retained, and we do not need to make any further change on that subdomain; if P-value $<$ 0.05, it means our null hypothesis is rejected, and we need to remodel by droping the variable with lowest factor loadings in that subdomain and check its P-value again. Following are detailed results

First subdomian

```
## lavaan 0.6-5 ended normally after 28 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                         10
##
##                                                   Used       Total
##   Number of observations                            29          84
##
## Model Test User Model:
##
##   Test statistic                                 2.594
##   Degrees of freedom                                 5
##   P-value (Chi-square)                           0.762
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
```

```
##   Standard errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   LE1 =~
##     LE1a_Confidenc    1.000
##     LE1b_Confidenc    0.601    0.230    2.619    0.009
##     LE1c_Confidenc    0.837    0.298    2.812    0.005
##     LE1d_Confidenc    0.589    0.236    2.495    0.013
##     LE1e_Confidenc    0.351    0.215    1.632    0.103
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .LE1a_Confidenc    0.690    0.699    0.987    0.324
##    .LE1b_Confidenc    2.142    0.632    3.391    0.001
##    .LE1c_Confidenc    3.173    0.985    3.221    0.001
##    .LE1d_Confidenc    2.411    0.696    3.465    0.001
##    .LE1e_Confidenc    2.590    0.698    3.711    0.000
##     LE1               2.646    1.091    2.424    0.015
```

Table 15: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
LE1	LE1a_Confidence	1.000	0.000	NA	NA	0.891
LE1	LE1b_Confidence	0.601	0.230	2.619	0.009	0.556
LE1	LE1c_Confidence	0.837	0.298	2.812	0.005	0.607
LE1	LE1d_Confidence	0.589	0.236	2.495	0.013	0.525
LE1	LE1e_Confidence	0.351	0.215	1.632	0.103	0.334

The p-value of this subdomian is 0.762, so we will keep all the questions in this subdomian.

Second Subdomain

```
## lavaan 0.6-5 ended normally after 32 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                         12
##
##                                                   Used       Total
##   Number of observations                            28          84
##
## Model Test User Model:
##
##   Test statistic                                18.696
##   Degrees of freedom                                 9
##   P-value (Chi-square)                           0.028
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
```

```
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   LE2 =~
##     LE2a_Confidenc    1.000
##     LE2b_Confidenc    1.036    0.486    2.131    0.033
##     LE2c_Confidenc    1.428    0.539    2.647    0.008
##     LE2d_Confidenc    1.164    0.493    2.360    0.018
##     LE2e_Confidenc    0.855    0.407    2.101    0.036
##     LE2f_Confidenc    1.419    0.597    2.378    0.017
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .LE2a_Confidenc    1.221    0.403    3.033    0.002
##    .LE2b_Confidenc    2.313    0.691    3.345    0.001
##    .LE2c_Confidenc    1.539    0.593    2.595    0.009
##    .LE2d_Confidenc    1.975    0.627    3.151    0.002
##    .LE2e_Confidenc    1.656    0.492    3.364    0.001
##    .LE2f_Confidenc    2.840    0.907    3.131    0.002
##     LE2               0.769    0.482    1.596    0.110
```

Table 16: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
LE2	LE2a_Confidence	1.000	0.000	NA	NA	0.622
LE2	LE2b_Confidence	1.036	0.486	2.131	0.033	0.513
LE2	LE2c_Confidence	1.428	0.539	2.647	0.008	0.710
LE2	LE2d_Confidence	1.164	0.493	2.360	0.018	0.587
LE2	LE2e_Confidence	0.855	0.407	2.101	0.036	0.503
LE2	LE2f_Confidence	1.419	0.597	2.378	0.017	0.594

In the second subdomain, the p-value is 0.028<0.05, so we will drop the question LE2a to see how the model will be.

```
## lavaan 0.6-5 ended normally after 30 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                         10
##
##                                                   Used       Total
##   Number of observations                            29          84
##
## Model Test User Model:
##
##   Test statistic                                 1.583
##   Degrees of freedom                                 5
##   P-value (Chi-square)                           0.903
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
```

```
##   Standard errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   LE2 =~
##     LE2b_Confidenc    1.000
##     LE2c_Confidenc    1.065    0.423    2.520    0.012
##     LE2d_Confidenc    0.791    0.363    2.179    0.029
##     LE2e_Confidenc    0.640    0.305    2.098    0.036
##     LE2f_Confidenc    0.871    0.424    2.053    0.040
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .LE2b_Confidenc    1.704    0.642    2.652    0.008
##    .LE2c_Confidenc    1.676    0.675    2.482    0.013
##    .LE2d_Confidenc    2.153    0.662    3.250    0.001
##    .LE2e_Confidenc    1.610    0.485    3.323    0.001
##    .LE2f_Confidenc    3.219    0.959    3.358    0.001
##     LE2               1.354    0.811    1.670    0.095
```

Table 17: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
LE2	LE2b_Confidence	1.000	0.000	NA	NA	0.665
LE2	LE2c_Confidence	1.065	0.423	2.520	0.012	0.692
LE2	LE2d_Confidence	0.791	0.363	2.179	0.029	0.532
LE2	LE2e_Confidence	0.640	0.305	2.098	0.036	0.506
LE2	LE2f_Confidence	0.871	0.424	2.053	0.040	0.492

After dropping the LE2a, we have a p value of 0.9>0.05. So we will keep all the other questions.

Third Subdomain

```
## lavaan 0.6-5 ended normally after 33 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                         14
##
##                                                   Used       Total
##   Number of observations                            29          84
##
## Model Test User Model:
##
##   Test statistic                                20.428
##   Degrees of freedom                                14
##   P-value (Chi-square)                           0.117
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
```

```
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   LE3 =~
##     LE3a_Confidenc    1.000
##     LE3b_Confidenc    0.977    0.377    2.593    0.010
##     LE3c_Confidenc    0.273    0.219    1.242    0.214
##     LE3d_Confidenc    0.563    0.326    1.729    0.084
##     LE3e_Confidenc    0.653    0.306    2.132    0.033
##     LE3f_Confidenc    0.679    0.308    2.205    0.027
##     LE3g_Confidenc    0.302    0.246    1.229    0.219
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .LE3a_Confidenc    2.782    1.002    2.778    0.005
##    .LE3b_Confidenc    1.836    0.785    2.340    0.019
##    .LE3c_Confidenc    1.865    0.504    3.700    0.000
##    .LE3d_Confidenc    3.508    0.985    3.561    0.000
##    .LE3e_Confidenc    2.503    0.751    3.335    0.001
##    .LE3f_Confidenc    2.399    0.733    3.272    0.001
##    .LE3g_Confidenc    2.355    0.636    3.703    0.000
##     LE3               2.069    1.248    1.657    0.097
```

Table 18: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
LE3	LE3a_Confidence	1.000	0.000	NA	NA	0.653
LE3	LE3b_Confidence	0.977	0.377	2.593	0.010	0.720
LE3	LE3c_Confidence	0.273	0.219	1.242	0.214	0.276
LE3	LE3d_Confidence	0.563	0.326	1.729	0.084	0.397
LE3	LE3e_Confidence	0.653	0.306	2.132	0.033	0.511
LE3	LE3f_Confidence	0.679	0.308	2.205	0.027	0.534
LE3	LE3g_Confidence	0.302	0.246	1.229	0.219	0.273

In the third subdomian,we have a p value of 0.117>0.05, so we will keep all the questions.

Fourth Subdomain

```
## lavaan 0.6-5 ended normally after 30 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                         10
##
##                                                   Used       Total
##   Number of observations                            29          84
##
## Model Test User Model:
##
##   Test statistic                                 8.065
##   Degrees of freedom                                 5
##   P-value (Chi-square)                           0.153
##
```

```
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)
##   LE4 =~
##     LE4a_Confidenc    1.000
##     LE4b_Confidenc    0.570    0.215    2.654    0.008
##     LE4c_Confidenc    0.593    0.171    3.466    0.001
##     LE4d_Confidenc    0.869    0.224    3.872    0.000
##     LE4e_Confidenc    0.522    0.229    2.285    0.022
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)
##    .LE4a_Confidenc    1.148    0.708    1.622    0.105
##    .LE4b_Confidenc    3.175    0.893    3.555    0.000
##    .LE4c_Confidenc    1.603    0.496    3.234    0.001
##    .LE4d_Confidenc    2.159    0.766    2.820    0.005
##    .LE4e_Confidenc    3.848    1.059    3.635    0.000
##     LE4               3.501    1.345    2.603    0.009
```

Table 19: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
LE4	LE4a_Confidence	1.000	0.000	NA	NA	0.868
LE4	LE4b_Confidence	0.570	0.215	2.654	0.008	0.513
LE4	LE4c_Confidence	0.593	0.171	3.466	0.001	0.659
LE4	LE4d_Confidence	0.869	0.224	3.872	0.000	0.742
LE4	LE4e_Confidence	0.522	0.229	2.285	0.022	0.446

In the fourth subdomain, we have a p value of 0.153. We will keep all the questions in this subdomain.

Fifth subdomain

```
## lavaan 0.6-5 ended normally after 26 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                          8
##
##                                                   Used       Total
##   Number of observations                            29          84
##
## Model Test User Model:
##
##   Test statistic                                 4.188
##   Degrees of freedom                                 2
##   P-value (Chi-square)                           0.123
##
## Parameter Estimates:
```

```
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   LE5 =~
##     LE5a_Confidenc    1.000
##     LE5b_Confidenc    0.570    0.243    2.343    0.019
##     LE5c_Confidenc    1.325    0.474    2.794    0.005
##     LE5d_Confidenc    0.629    0.289    2.178    0.029
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .LE5a_Confidenc    1.564    0.580    2.696    0.007
##    .LE5b_Confidenc    1.328    0.381    3.487    0.000
##    .LE5c_Confidenc    0.689    0.723    0.952    0.341
##    .LE5d_Confidenc    1.985    0.558    3.557    0.000
##     LE5               1.351    0.765    1.766    0.077
```

Table 20: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
LE5	LE5a_Confidence	1.000	0.000	NA	NA	0.681
LE5	LE5b_Confidence	0.570	0.243	2.343	0.019	0.498
LE5	LE5c_Confidence	1.325	0.474	2.794	0.005	0.880
LE5	LE5d_Confidence	0.629	0.289	2.178	0.029	0.460

In the fifth subdomain, we have a p-value of 0.123, so we will keep all the questions in this dubdomain.

Sixth subdomain

```
## lavaan 0.6-5 ended normally after 37 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                          8
##
##                                                   Used       Total
##   Number of observations                            29          84
##
## Model Test User Model:
##
##   Test statistic                                 0.832
##   Degrees of freedom                                 2
##   P-value (Chi-square)                           0.660
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard errors                             Standard
```

```
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   LE6 =~
##     LE6a_Confidenc    1.000
##     LE6b_Confidenc    2.725    2.229    1.223    0.222
##     LE6c_Confidenc    2.058    1.717    1.198    0.231
##     LE6d_Confidenc    3.160    2.585    1.222    0.222
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .LE6a_Confidenc    4.983    1.322    3.770    0.000
##    .LE6b_Confidenc    0.807    0.466    1.732    0.083
##    .LE6c_Confidenc    1.545    0.473    3.270    0.001
##    .LE6d_Confidenc    1.195    0.640    1.867    0.062
##     LE6               0.309    0.503    0.614    0.539
```

Table 21: Factor Loadings

Latent Factor	Indicator	B	SE	Z	p-value	loading
LE6	LE6a_Confidence	1.000	0.000	NA	NA	0.241
LE6	LE6b_Confidence	2.725	2.229	1.223	0.222	0.860
LE6	LE6c_Confidence	2.058	1.717	1.198	0.231	0.677
LE6	LE6d_Confidence	3.160	2.585	1.222	0.222	0.849

In the sixth subdomain, the p-value is 0.66>0.05. We will not drop any question in this subdomain.