The Development of Scales to Measure QISA's Three Guiding Principles of Student Aspirations Using the My Voice™ Survey

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The My Voice Survey was designed to assess various aspects of student aspirations—which refer to students' ability to dream and set goals for the future, while being inspired and supported in the present to reach those dreams—by asking students to respond to 63 statements about their perceptions of their school and school-related self-perceptions regarding the 8 Conditions that Make a Difference®. These 8 Conditions were originally identified and defined by Dr. Russell J. Quaglia, an internationally known leader in the study of student aspirations and president and founder of the Quaglia Institute for Student Aspirations. They include: Belonging, Heroes, Sense of Accomplishment, Fun & Excitement, Curiosity & Creativity, Spirit of Adventure, Leadership & Responsibility, and Confidence to Take Action. A set of three Guiding Principles subsume the 8 Conditions:

- *Self-Worth* (comprising Belonging, Heroes, and Sense of Accomplishment) occurs when students feel accepted at school and believe they are valued members of the school community;
- *Active Engagement (*comprising Fun & Excitement, Curiosity & Creativity, and Spirit of Adventure) happens when students are deeply involved in the learning process as characterized by an enthusiasm and desire to learn new things;
- *Purpose* (comprising Leadership & Responsibility, and Confidence to Take Action) exists when students are goal-directed, apply themselves in their classes, and are motivated to do their best in school.

Objectives

This document is a technical report of the scale development process regarding the use of the My Voice Survey to operationalize the three Guiding Principles. The My Voice Survey was adapted from the Student Aspirations Survey (Plucker & Quaglia, 1998) and was originally constructed to address both intraindividual and environmental factors that support student aspirations. The three Guiding Principles focus on the intraindividual dimensions of student aspirations; as such, the primary goal of the present exploration is to determine whether selected items of the My Voice Survey reliably and validly operationalize each of the Guiding Principles: Self-Worth, Active Engagement, and Purpose.[1]

Participants and Procedure

For the present investigation, the My Voice Survey was administered in the spring of 2010 to 19,444 students in grades 6-12 from 43 different schools in six different states (from the South, Midwest, and Northeast regions of the United States). The mean age of respondents was 13.95

[1] The survey items intended to assess student perceptions of school climate or other environmental aspects were thus excluded from all analyses.

*Since this report was completed, the name of the survey has changed to the Quaglia School Voice Student Survey and four statements were added.

years, with a standard deviation of 1.95 years, and a range of 9-19 years old. The gender distribution was nearly even (49% female, 51% male), with a racial/ethnic breakdown as follows: 83% White, 9% Black or African American, 5% Hispanic/Latino, 3% Asian, and 9% other races[2]. All respondents took the survey online during school hours in a supervised setting. The median time to complete the survey was approximately 13 minutes.

Analysis plan

The statistical approach to developing the scales intended to assess the Guiding Principles employed two complementary types of factor analysis. Factor analysis is a common psychometric technique used to identify a set of factors representing underlying latent constructs from some larger number of observed variables (typically, as here, items on a survey). Factor analytic techniques, properly employed, help to determine whether groupings of the observed variables/items on a survey demonstrate the psychometric properties necessary to assert they reliably and validly measure one or more intended constructs. There are two main types of factor analysis: exploratory and confirmatory. As the names suggest, exploratory factor analysis (EFA) explores the factor structure of the responses to some set of survey items, while confirmatory factor analysis (CFA) may be used to confirm whether specified groupings of items properly measure the theorized constructs of interest.

Typically, when constructing new scales, researchers perform EFA followed by CFA; that is, the survey is first administered to a representative sample and the data are subjected to an EFA, and the factor structure uncovered by the EFA is subjected to a CFA using data collected from a new sample. In the present approach, surveys were collected for the full sample which was then randomly split, with half of the sample (n = 9,722) to be used for the EFA steps and the other half of the sample (n = 9,722) to be used for the CFA. This two-step approach to performing factor analyses, along with nearly all aspects of the present analytical plan, follows the comprehensive guidelines for scale development laid out by Worthington and Whittaker (2006). The present approach will be described separately for EFA and CFA.

Exploratory factor analysis approach

There are a variety of types of extraction methods in EFA, the most prominent of which include principal factor, principal-component factor, and maximum likelihood factor. There is no commonly agreed-upon approach, though under conditions of non-normal data (as is the case with many of the My Voice Survey items) the principle factor method is recommended (Costello & Osborne, 2005) and was used in the present analyses. Once an extraction method is decided upon and the EFA is run, it is advised to verify the factorability of the data. The method employed in the present analyses was the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, where values greater than .60 are considered to be adequate and greater than .80 are considered to be high.

Once the factors are extracted and the factorability of the data confirmed, there are several different guidelines for determining the number of factors to retain; the present analyses used the most common of these, the traditional eigenvalue cut-off of 1.0 (Tabachnick & Fidell, 2007).

[2] Respondents were permitted to indicate more than one race/ethnicity.

Following determination of the number of factors, the factor solution is "rotated" so the factors may be interpreted. There are multiple approaches to rotation of the factor solution. When the factors are expected to be correlated, as is the case with the Guiding Principles, the most appropriate rotation method is oblique (rather than the commonly-used varimax, which assumes orthogonality of factors). Specifically, the present analyses were rotated via a direct oblimin rotation.

Once a factor solution is rotated, important decisions must then be made about which items in that solution adequately represent the factors. Following the guidelines of Tabachnick and Fidell (2007) and Worthington and Whittaker (2006), the loadings of each of the items on the factors should be at least .32, and not double-load (a.k.a., cross-load) onto any other factors at the .32 level. Double-loading is determined both by the .32 loading guideline, as well as by a separation in loadings of at least .15. For example, an item that loads .35 onto one factor and no higher than .20 onto any other factor may be considered representative of that factor; but an item that loads .44 onto one factor and .30 onto another factor would be considered double-loading. These guidelines would suggest that all items that double-loaded and/or loaded no higher than .32 on any factor may be considered insufficient indicators of the factors produced in the EFA, and when any items met these criteria the EFA was rerun with those items removed. It is important to note, however, that factor solutions produced by an EFA are always contingent upon the items included in that analysis; when multiple iterations of EFAs are run, the latter iterations may have not included items that were dropped from the previous iterations but may in fact have not met the criteria for exclusion with the new set of variables from those latter iterations. This fact was considered in the present analyses, such that under certain circumstances, latter iterations of the EFAs checked whether inclusion of items dropped from previous iterations was appropriate (see below).

One additional step was taken upon completion of the preceding steps. As the objective of the EFA was ultimately to produce a valid and reliable scale for each underlying construct, the internal consistency of the items comprising the resultant factors was checked via Cronbach's alpha. The conventional cut-off criterion for an acceptable alpha statistic is 0.70 and above (Nunnally, 1978). For any scale that did not meet this criterion, the items which were dropped in earlier iterations of the EFA were reconsidered (based on theory and face validity) in light of whether they might enhance the internal consistency of that scale. In such cases, these items were reintroduced into the last iteration of the EFA, and all steps of the analysis rerun. Additionally, for each item in the scales, the item-test correlation (i.e., the correlation between each item and the total scale) was inspected to ensure it was sufficiently high (here, at or above .60) and that the overall scale alpha was not notably reduced by including the item (see Hinkin, 1998). For scales in which one or more items did not meet these criteria, those items were dropped and the EFA rerun.

As noted earlier, the My Voice Survey items selected for the present investigation included only those intended to address intraindividual aspects of student aspirations.[3] These selected items, along with their item numbers on the survey, are presented in Table 1 of the Appendix.

Confirmatory factor analysis approach

Once the scales were established via the EFA approach using the first half of the overall sample and checked for internal consistency, the items comprising these scales and the factor structure uncovered by the EFA were subjected to a CFA using the second half of the overall sample. As this CFA step was intended to be purely confirmatory, the results were not intended to be subject to further changes based on the model respecifications typically suggested in the results produced by most structural equation modeling packages (once model respecification takes place following a CFA, the process effectively reverts to the exploratory phase; see Byrne, 2005). The present CFA was run using the LISREL 8.80 software package (Jöreskog & Sörbom, 2006).

Before running a CFA, the scales of the model were set. There are a number of different (and under most circumstances equally valid) ways to approach scale setting (Kline, 2005). In the present analyses, the unit loading identification constraint—which fixes the factor loading for the direct effect of one of each factor's indicators to 1.0—was imposed. This is the most common approach to scale setting in CFA (Byrne, 1998).

The following model fit indices will be reported: (1) the model chi-square with corresponding degrees of freedom and level of statistical significance, (2) the Root Mean Square-Error of Approximation (RMSEA) with corresponding 90% confidence intervals, (3) the Comparative Fit Index (CFI), and (4) the Tucker-Lewis Index (TFI; a.k.a., Non-normed Fit Index). In large samples (i.e., over 200), the model chi-square statistic is nearly always statistically significant; thus, it is typically ignored in large samples (Kline, 2005). The traditional cut-off criterion for acceptable fit using the RMSEA index remains under debate; fit has been alternatively considered acceptable at levels at or below 0.08 (MacCallum, Browne, & Sugawara, 1996), at or below 0.07 (Steiger, 2007), and at or below 0.06 (Hu & Bentler, 1999). Some have even suggested there should be no universal cut-off criterion for RMSEA fit (Chen, Curran, Bollen, Kirby, & Paxton, 2008). With this uncertainty in mind, the preferred RMSEA in the present work will be at or below .06, with values between .06 and .08 viewed as acceptable with room for improvement. The CFI and TFI fit indices each have a more generally accepted cut-off criterion at equal to or greater than .95 (Hu & Bentler, 1999).

Results

The results of the first run of the EFA on the items in Table 2 revealed a probable three-factor solution, which cumulatively accounted for 96% of the variance. The eigenvalue for the first

[3] One item which may be considered intraindividual, Item #41 (Going to college is important to my future), was also excluded from consideration, since the QISA framework does not view students' post-high school aspirations as restricted to college going.

factor was 9.57, accounting for the greatest proportion of the variance (75%); the second factor eigenvalue was 1.55 (12% of the variance), and the third factor eigenvalue was 1.17 (9% of the variance). No other factors had eigenvalues > 1. The inspection of the rotated solution revealed four items that did not load onto any of the three factors at .32 or above (items 27, 33, 36, and 52) and two items that clearly double loaded (items 11 and 62), thus necessitating a second run of the EFA with these items dropped. The overall KMO statistic on this first EFA run was 0.95, with no item KMO under .77.

The second run of the EFA, with the six poorly loading items from the first run dropped, produced a more clear three-factor solution, which explained all of the variance (first factor eigenvalue = 8.65, proportion of variance explained = 0.80; second factor eigenvalue = 1.19, proportion of variance explained = 0.11; third factor eigenvalue = 1.08, proportion of variance explained = 0.10). The inspection of the rotated solution revealed that one item double loaded (Item 23), necessitating third run of the EFA with this item dropped. The overall KMO statistic was 0.95, with no item KMO under .69.

The third run of the EFA with the one poorly loading item from the second run dropped again produced a clear three-factor solution and explained all of the variance (first factor eigenvalue = 8.34, proportion of variance explained = 0.80; second factor eigenvalue = 1.12, proportion of variance explained = 0.11; third factor eigenvalue = 1.07, proportion of variance explained = 0.10). The inspection of the rotated solution revealed that one item double loaded (Item 67), necessitating fourth run of the EFA with this item dropped. Again, the overall KMO statistic was 0.95, with no item KMO under .69.

The fourth run of the EFA, with the one poorly loading item from the third run dropped again, produced a clear three-factor solution and explained all of the variance (first factor eigenvalue = 8.03, proportion of variance explained = 0.80; second factor eigenvalue = 1.11, proportion of variance explained = 0.11; third factor eigenvalue = 1.07, proportion of variance explained = 0.11). This time, the rotated factor solution was clean (no items double loaded or loaded below .32), and the KMO statistics were again acceptable (overall KMO = .94, with no item KMO under .69).

With an acceptable factor solution, the next step was to check the internal consistency of the resultant scales. The scale produced by the first factor consisted of 11 items (including items 14, 21, 50, 54, 57, 58, 59, 60, 61, 64, and 66). The Cronbach's alpha was high ($\alpha = .90$), and all items correlated at least $r = .60$ with the rest of the scale. The scale produced by the second factor consisted of seven items (including items 10, 12, 37, 46, 47, 56, and 65). The Cronbach's alpha was also high ($\alpha = .86$), and again all items correlated at least $r = .60$ with the rest of the scale. The scale produced by the third factor consisted of five items (items 16, 22, 25, 31, and 39). Unlike the other two scales, this scale did not meet all of the criteria of acceptability. The Cronbach's alpha was slightly below the recommended cutoff criterion level ($\alpha = .64$), and one of the items (item 39) did not demonstrate a sufficiently high item-test correlation ($r = .58$).

In light of the internal consistency checks, a fifth run of the EFA was warranted, with two adjustments. First, the item which reduced the internal consistency of the third factor's scale (item 39) was removed. Second, in an attempt to compensate for this factor's low internal consistency, an item that was originally hypothesized to contribute to this factor but was dropped following the first run of the EFA due to double-loading (item 52) was reintroduced. This run produced a three-factor solution, which explained all of the variance (first factor eigenvalue = 8.30, proportion of variance explained = 0.81; second factor eigenvalue = 1.12, proportion of variance explained = 0.11; third factor eigenvalue = 1.06, proportion of variance explained = 0.10). The rotated factor solution was not entirely clean; though no items loaded below .32, one item (item 52) double loaded with a separation of loadings of .07 (on factors 2 and 3). However, the loading on the second factor was below .32 while the loading on the third factor was above .32. Removing this item would unacceptably reduce the internal consistency of the third factor; as such, it was determined to be reasonable to keep this item and deem this final solution acceptable for testing via the CFA framework (provided the reliability checks proved to be sound, as below). The final KMO statistics were strong (overall KMO = .95, with no item KMO under .72).

Following this final EFA run, the internal consistencies of the resultant scales were again checked and each was this time at or above acceptable levels (factor 1: $\alpha = .90$; factor 2: $\alpha = .86$; factor 3: $\alpha = .70$), and all item-test correlations were at or above .60. The final scale compositions and item factor loadings are presented in Table 2. The content of the items comprising each scale, in combination with existing theory, helped to inform the following scale labels: Factor 1 = *Purpose*, Factor 2 = *Active Engagement*, Factor 3 = *Self-Worth*.

With the factor structure established, the CFA was run using the second half of the sample. Figure 1 shows the CFA model and results of the analysis, including fit statistics. The item loadings of the CFA are shown in Table 3; all loadings were significant at the $p < .05$ level, and all but one was above .50. The fit statistics suggest the model was a reasonably acceptable fit to the data, given the guidelines described earlier. The RMSEA index was less than ideal, but acceptable (.08); the relative strength of the CFI (.96) and TFI (.96) helped offset the middling RMSEA and contribute to an overall picture of satisfactory model fit. Additionally, these results show that the three Guiding Principles scales are highly intercorrelated: Purpose was strongly significantly related to Active Engagement ($r = .77$, $p < .001$) and Self-Worth ($r = .62$, $p < .001$), and Active Engagement and Self-Worth were strongly significantly related to one another ($r = .63$, $p < .001$).

The final version of the scales, as suggested by the EFA and supported by the CFA, can be found in Table 4.

References

Byrne, B. M. (1998). *Structural equation modeling with LISREL, PRELIS, and SIMPLIS: Basic concepts, applications, and programming*. Mahwah, NJ: Lawrence Erlbaum.

Byrne, B. M. (2005). Factor analytic models: Viewing the structure of an assessment instrument from three perspectives. *Journal of Personality Assessment, 85,* 17–32.

Chen, F., Curran, P. J., Bollen, K. A., Kirby, J., & Paxton, P. (2008). An empirical evaluation of the use of fixed cutoff points in RMSEA test statistic in structural equation models. *Sociological Methods and Research, 36,* 462–494.

Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research and Evaluation, 10,* 1–9.

Hinkin, T. R. (1998). A brief tutorial on the development of measures for use in survey questionnaires. *Organizational Research Methods, 1,* 104–121.

Hu, L. T. & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1–55.

Jöreskog, K., & Sörbom, D. (2007). *LISREL 8 user's guide*. Chicago: Scientific Software.

Kline, R. B. (2005). *Principles and practices of structural equation modeling* (2nd ed.). New York: Guilford.

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods, 1*, 130–149.

Nunnally, J. (1978). *Psychometric theory*. New York: McGraw-Hill.

Plucker J. A. & Quaglia, R. J. (1998). Student aspirations survey: Assessing student effort and goals. *Educational and Psychological Measurement, 58,* 252–257.

Steiger, J. H. (2007), Understanding the limitations of global fit assessment in structural equation modeling. *Personality and Individual Differences, 42*, 893–898.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). New York: Allyn and Bacon.

Worthington, R. L., & Whittaker, T. A. (2006). Scale development research: A content analysis and recommendations for best practices. *The Counseling Psychologist, 34,* 806–838.

Appendix

Table 1. Intraindividual items of the My Voice Survey for use in scale development

My Voice Survey item number and wording
10. I enjoy being at school.
11. I feel comfortable asking questions in class.
12. I like challenging assignments.
14. I believe I can be successful.
16. I feel accepted for who I am at school.
21. I push myself to do better academically.
22. I see myself as a leader.
23. I believe I can make a difference in this world.
25. I have difficulty fitting in at school.
27. I have never been recognized for something positive at school.
31. Other students see me as a leader.
33. I enjoy working on projects with other students.
36. I give up when schoolwork is difficult.
37. School is boring.
39. I am afraid to try something if I think I may fail.
46. I enjoy participating in my classes.
47. I enjoy learning new things.
50. I work hard to reach my goals.
52. I am a valued member of my school community.
54. I put forth my best effort at school.
56. I learn new things that are interesting to me at school.
57. I want to do my best at school.
58. I am a good decision maker.
59. I am excited about my future.
60. I think it is important to set high goals.
61. I know the kind of person I want to become.
64. Getting good grades is important to me.
65. Learning can be fun.
66. What I learn in school will benefit my future.
67. I am excited to tell my friends when I get good grades.

Table 2. Exploratory factor analysis of the three Guiding Principles results: scale compositions with item factor loadings.

Factor 1	Factor 2	Factor 3	My Voice Survey item number and wording
0.75	0.06	-0.11	64. Getting good grades is important to me.
0.75	0.12	-0.12	57. I want to do my best at school.
0.74	-0.03	0.08	60. I think it is important to set high goals.
0.70	0.02	0.04	50. I work hard to reach my goals.
0.70	-0.09	0.12	59. I am excited about my future.
0.66	0.13	-0.02	54. I put forth my best effort at school.
0.61	-0.13	0.10	61. I know the kind of person I want to become.
0.57	0.12	0.10	21. I push myself to do better academically.
0.48	0.29	-0.04	66. What I learn in school will benefit my future.
0.46	-0.03	0.25	58. I am a good decision maker.
0.44	0.04	0.26	14. I believe I can be successful.
-0.07	**0.76**	0.08	10. I enjoy being at school.
-0.11	**0.72**	-0.01	37. School is boring.
0.19	**0.59**	-0.03	65. Learning can be fun.
0.12	**0.59**	0.16	46. I enjoy participating in my classes.
0.25	**0.56**	-0.03	56. I learn new things that are interesting to me at school.
0.28	**0.51**	0.00	47. I enjoy learning new things.
0.13	**0.43**	0.10	12. I like challenging assignments.
0.01	0.08	**0.63**	31. Other students see me as a leader.
0.23	-0.04	**0.53**	22. I see myself as a leader.
-0.02	0.24	**0.50**	16. I feel accepted for who I am at school.
-0.10	0.00	**0.45**	25. I have difficulty fitting in at school.
0.09	0.31	**0.38**	52. I am a valued member of my school community.

Note. n = 9,722. Loadings equal to or above .32 are bold.

Table 3. Confirmatory factor analysis of the three Guiding Principles factor loadings.

Purpose	Active Engagement	Self-Worth	My Voice Survey item number and wording
0.78	-	-	57. I want to do my best at school.
0.75	-	-	67. I put forth my best effort at school.
0.75	-	-	64. Getting good grades is important to me.
0.74	-	-	60. I think it is important to set high goals.
0.73	-	-	50. I work hard to reach my goals.
0.70	-	-	21. I push myself to do better academically.
0.67	-	-	59. I am excited about my future.
0.65	-	-	66. What I learn in school will benefit my future.
0.58	-	-	14. I believe I can be successful.
0.54	-	-	61. I know the kind of person I want to become.
0.54	-	-	58. I am a good decision maker.
-	0.75	-	46. I enjoy participating in my classes.
-	0.74	-	47. I enjoy learning new things.
-	0.74	-	56. I learn new things that are interesting to me at school.
-	0.72	-	65. Learning can be fun.
-	0.69	-	10. I enjoy being at school.
-	0.59	-	37. School is boring.
-	0.57	-	12. I like challenging assignments.
-	-	0.66	31. Other students see me as a leader.
-	-	0.65	52. I am a valued member of my school community.
-	-	0.61	22. I see myself as a leader.
-	-	0.58	16. I feel accepted for who I am at school.
-	-	0.32	25. I have difficulty fitting in at school.

Note. n = 9,722. All coefficients are standardized.

Table 4. Three Guiding Principles scales with accompanying My Voice Survey item number and wording.

Purpose

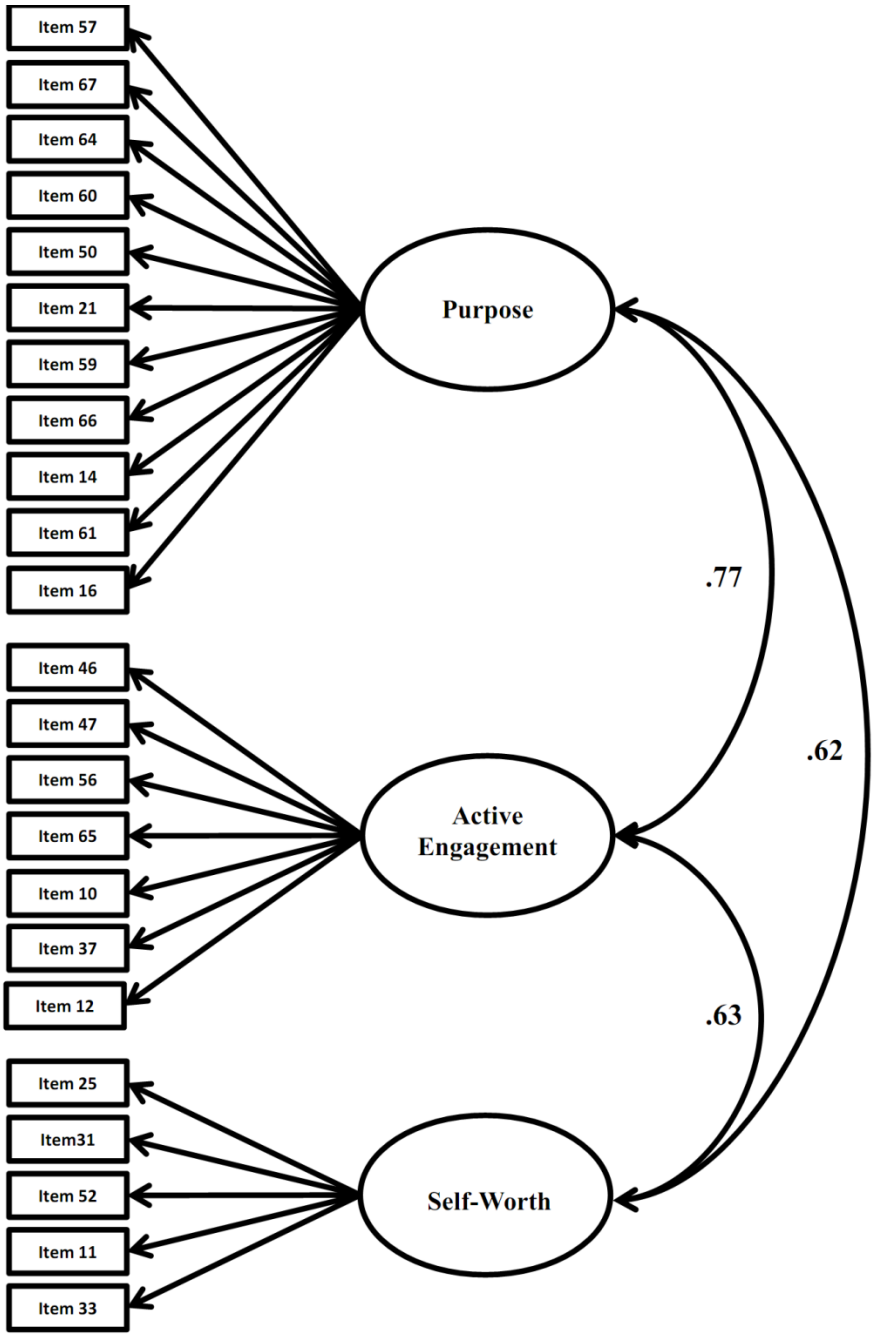
14. I believe I can be successful.
21. I push myself to do better academically.
50. I work hard to reach my goals.
54. I put forth my best effort at school.
57. I want to do my best at school.
58. I am a good decision maker.
59. I am excited about my future.
60. I think it is important to set high goals.
61. I know the kind of person I want to become.
64. Getting good grades is important to me.
66. What I learn in school will benefit my future.

Active Engagement

10. I enjoy being at school.
12. I like challenging assignments.
37. School is boring.
46. I enjoy participating in my classes.
47. I enjoy learning new things.
56. I learn new things that are interesting to me at school.
65. Learning can be fun.

Self-Worth

16. I feel accepted for who I am at school.
22. I see myself as a leader.
25. I have difficulty fitting in at school.
31. Other students see me as a leader.
52. I am a valued member of my school community.



Model Fit : χ^2 (df = 227, n = 9,722) = 14891.18, p<.001; RMSEA = 0.082 (0.080-0.083); CFI = 0.96; TFI = 0.96
Note. Item loadings on factors and error terms not shown due to space constraints. All coefficients are standardized.

Figure 1. Confirmatory factor analysis of the three Guiding Principles scales model with results.