

# SmarterMeasure Assessment Report – Spring 2014

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## 1 INTRODUCTION

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Florida SouthWestern State College's Quality Enhancement Plan goal is to provide students ways to develop strategies for effective writing and verbal communication and demonstrate independence through personal management, use of college resources, and positive relationships with peers, staff, and faculty. One measurement for the achievement of that goal is the use of the SmarterMeasure Learning Readiness Indicator. FSW has identified set criteria for defining student advancement in the Cornerstone Experience course through the published assessment tool SmarterMeasure.

The SmarterMeasure Learning Readiness Indicator was designed to help quantify the degree of student preparedness and breadth of skill set (SmarterServices, 2011). Through course completion, students are expected to statistically significantly improve in the following learning readiness indicators of the SmarterMeasure Student Readiness Test: Personal Attributes, Life Factors, Technology Knowledge, and Technology Competency. These indicators can serve as an effective tool for evaluating growth over time, allowing college assessment faculty and staff a means to identify strengths and weaknesses, and allow the college to compare FSW students with those across the country, if desired (Suskie, 2004). Results are compared by term in a longitudinal study in support of the QEP.

Pre-test/post-test studies in small groups provide an assessment foundation for learning and skill set adoption under given criteria. While scores do yield some error related to the target subject such as grade level or demographic, many can be accounted for in small sub-samples (individual classes). Moreover, those correlative measures that cannot be accounted for can be better understood through assessment (Cole et al., 2011).

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## 2 STATISTICS

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During the Spring 2014 semester, 1045 total tests (pre- and post-) were administered to students. Of those, between 426 and 431 of them were pre-/post- paired tests. Some students did not have pre-/post- counterparts for all readiness indicators. Depending on the readiness indicator, between 181 and 193 tests did not have counterparts. Basic descriptive statistics of pre- and post- test scores only are shown in Table 1.

All readiness indicators post-test scores except for Personal Attributes exhibit increases in means, although not all are significant (see discussion in 2.1 Significance Tests). Personal Attributes and Life Factors indicators post-test scores exhibit an increased standard deviation (spread of data distribution). Both technology indicators exhibit increased kurtosis, meaning they have become more leptokurtic (distribution of the scores has a steeper peak) (see Figure 1).

The Life Factors and Technology Knowledge indicators exhibit a very slight increase in skewness, but all indicators both pre- and post-tests exhibit negative skewness. For an example see Figure 2.

		Personal Attributes	Life Factors	Technology Knowledge	Technology Competency
Pre-Test	n	431	432	426	427
	mean	75.61	76.23	65.22	86.25
	median	75	77	66.41	90
	mode	75	78	68.75	100
	max / min	93.75 / 46.88	96 / 51	95.31 / 15.63	100 / 20
	standard deviation	7.71	8.67	13.31	13.01
	kurtosis	0.43	0.04	0.32	2.95
	skewness	-0.30	-0.45	-0.51	-1.32
Post-Test	n	431	432	426	427
	mean	75.28	76.46	69.16	88.41
	median	76.04	78	69.53	90
	mode	77.08	78	68.75	100
	max / min	94.79 / 47.92	100 / 51	98.44 / 23.44	100 / 20
	standard deviation	8.37	9.43	12.74	12.49
	kurtosis	0.22	-0.33	0.39	3.58
	skewness	-0.35	-0.32	-0.41	-1.59

Table 1. Pre-/Post- test scores with measured increases of the mean, standard deviation, kurtosis, and skewness in post-test results denoted with shaded cell.

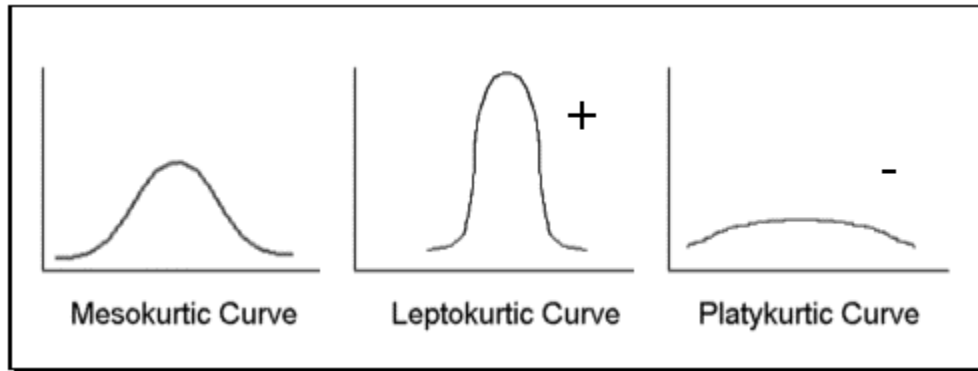


Figure 1. Example of kurtosis. The normal curve (left) has a kurtosis of 0.0. A positive value, or leptokurtic distribution (center) and negative value, or platykurtic distribution (right) are depicted here in an ideal scenario (Starkweather, 2010).

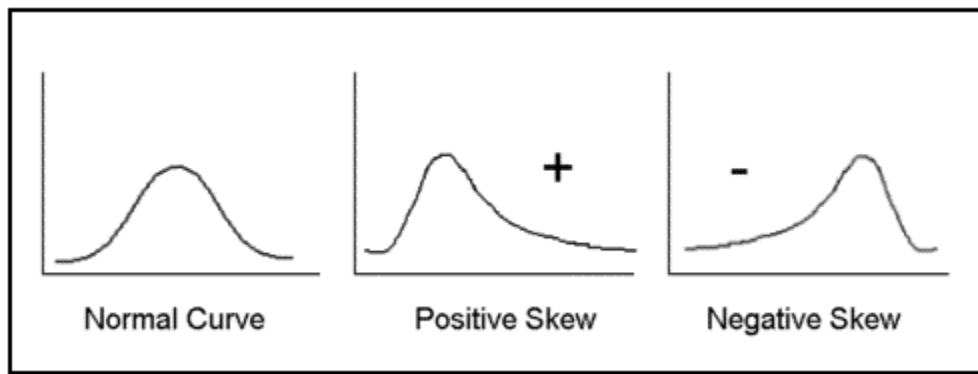


Figure 2. Example of skewness. The normal curve (left) has a skewness of 0.0. A positive value skewness (center) and negative value skewness (right) are depicted here in an ideal scenario (Starkweather, 2010).

## 2.1 SIGNIFICANCE TESTS

Study goals demand that significance tests be conducted to determine whether the difference in the means of pre- and post-test scores is solely due to chance. Each learning readiness indicator (Personal Attributes, Life Factors, Technology Knowledge, and Technology Competency) was tested for significance using a paired means t-test according to standard methods (Davis, 1973; McDonald, 2009; Wilkinson, 1999). The results of significance testing for each readiness indicator are shown in Table 2. Additional details of the distribution of the results are explored in subsequent sections to provide further information into the variation of the pre-/post-test score relationship as foundation for potential future causal studies, if necessary.

	Personal Attributes	Life Factors	Technology Knowledge	Technology Competency
<b>Difference in mean</b>	-0.32	0.24	3.89	2.11
<b>standard deviation</b>	7.45	8.02	10.40	13.31
<b>standard error</b>	0.36	0.39	0.50	0.64
<b>df</b>	430	431	425	426
<b>t<sub>crit</sub></b>	1.97	1.97	1.97	1.97
<b>t<sub>obs</sub></b>	-0.90	0.63	7.72	3.28
<b>p-value</b>	0.371	0.533	9.57x10 <sup>-14</sup>	8.71x10 <sup>-4</sup>

Table 2. Difference between Pre-/Post- results with significance at the  $\alpha=0.05$  level. Shaded cells denote statistically significant difference.

The paired means t-test results indicate that for two of the four learning readiness indicators, Technology Knowledge and Technology Competency, we must reject the null hypothesis that the difference in the means of the pre- and post-test scores are equal to 0; and, we can conclude with a 95% confidence that the differences in scores are not solely due to chance. With the remaining two learning readiness indicators, Personal Attributes and Life Factors, we cannot reject the null hypothesis. Therefore, the slight decrease in mean score from pre-to-post test scores for Personal Attributes and the slight increase in Life Factors from pre-to-post test scores can be a result of chance.

For the two indicators which exhibit statistically significant increases in mean score, it can be reasonably concluded that the average increase in score of the students as a group is a result of some change in the students as a group. For the remaining two this cannot be stated or quantified.

## 2.2 SUPPORTING EXPLORATORY DATA ANALYSIS

Since significance tests only provide information on the rejection of a null hypothesis, and not on specific details of the changes from pre-/post-test scores, it is necessary that exploratory analyses be performed so that further information of value can be extracted if an evaluation of the program methods effects is to be quantitatively understood. Therefore, each dimension was rigorously analyzed using multiple standard processes for support of significance testing in order to most effectively apply the results toward instructive improvement, therefore allowing assessment to drive instruction as defined by Elder and Paul (2007).

Each readiness indicator varied widely with respect to student-by-student pre- to post- test score. Figure 3 highlights the percentage of student test scores that improved and declined.

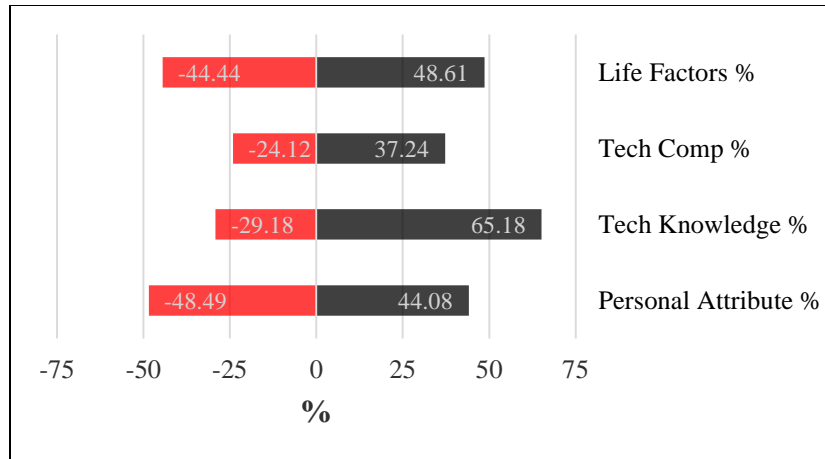


Figure 3. Percentage of students improved vs. declined. Difference of the sum of increase and decline from 100 is the percentage of test takers that exhibited no change.

The Technology Knowledge exhibits the greatest improvement percentage where 65.18% of students improved from pre- to post- test scores. By way of contrast, 29.18% of post-test scores were lower than pre-test scores, and 5.65% showed no change. Both the Life Factors and Personal Attributes readiness indicators are reflective of their significance tests, both with improvement/decline percentages within 5% of each other. The Technology Competency exhibits a large majority of students displaying no change, 38.64%.

Figure 4 depicts the distribution of pre-test scores using 10-point bins. The Personal Attributes, Technology Knowledge, and Technology Competency readiness indicators all clearly reflect modality in the 70-79 scoring range (peak of data distribution in 70-79 bin). The Technology Competency reflects a negative skewness (as shown in Section 2: Statistics). This fact, coupled with the data presented in Figure 3 where the indicator exhibited a large percentage of students showing no change is interpreted as a case where students enter the course proficient in the category and acquire little more from the course.

Figure 5 depicts the distribution of post-test scores using 10-point bins. The Personal Attributes, Technology Knowledge, and Technology Competency readiness indicators all again clearly reflect modality in the 70-79 scoring range (peak of data distribution in 70-79 bin). The Personal Attributes indicator, the only indicator to show a decrease in mean score from pre-to-post test, albeit not statistically significant, exhibits most of that loss in the lower scoring range, where a marked increase in scores between 40-49 and 50-59 is evident when comparing Figure 4 with Figure 5. A clearer review of these changes can be found in Figure 6.

Figure 6 depicts a plot of the difference in data distribution from pre-to-post test scores. By combining the 10-point scoring bins into three larger scoring bins the changes can be more readily understood. Since a change in one bin means an opposite effect in one of the other scoring bins, with three bins instead of ten, a reduction, for example, in the number of scores falling in one scoring bin must mean an increase in an adjacent bin. The difference between expected change in the adjacent bin and actual change is the result of the input from the third bin.

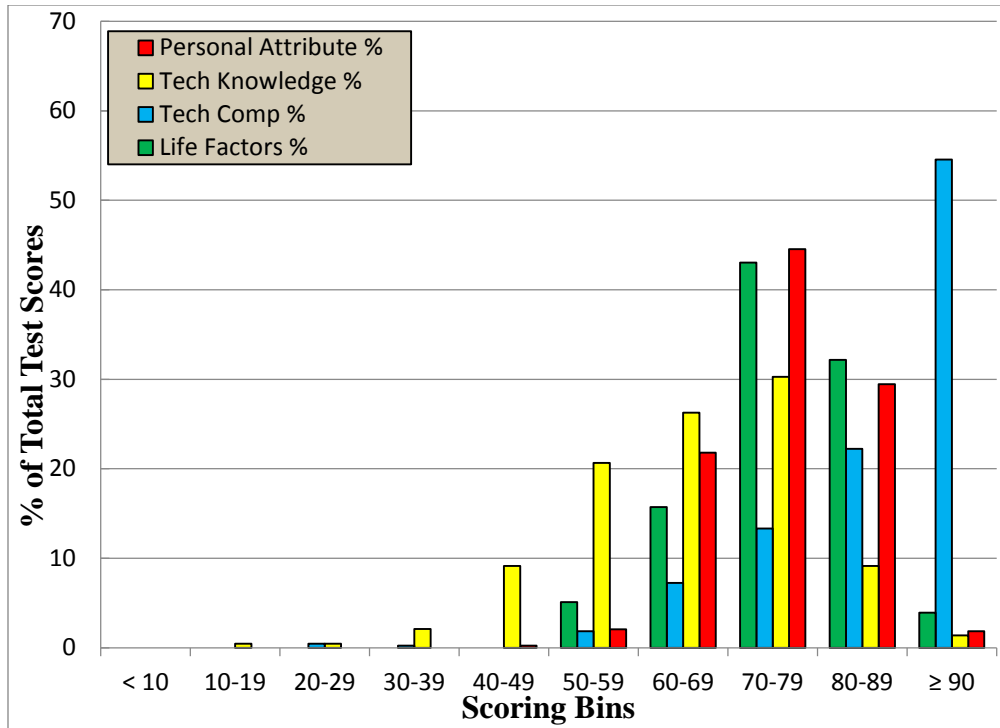


Figure 4. Histogram of Pre-Test scores data distribution binned by 10-point increments.

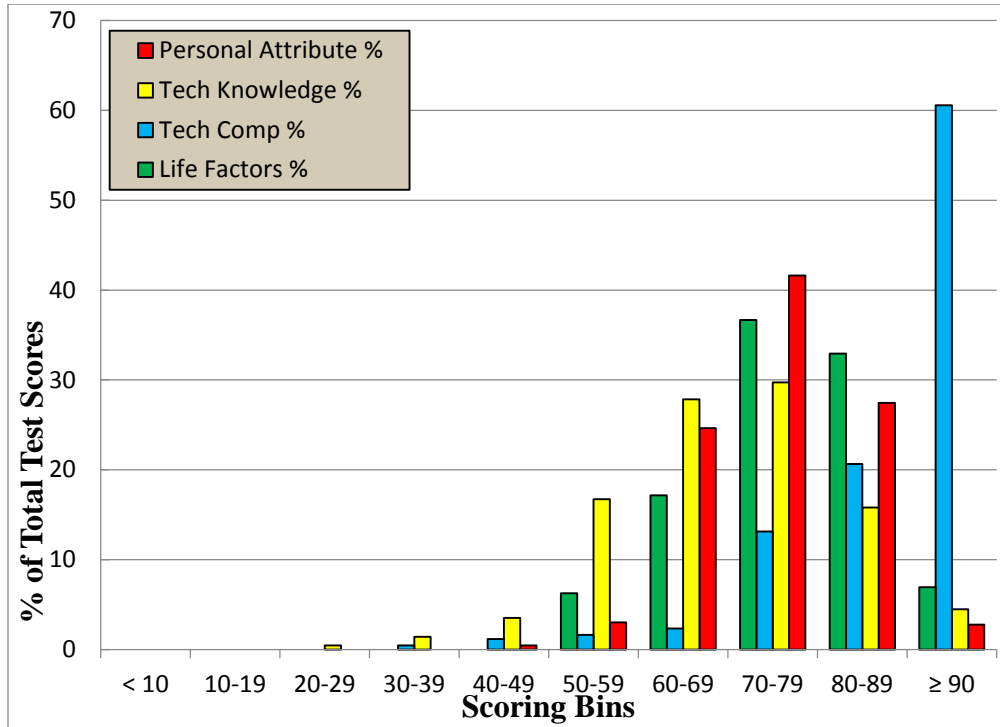


Figure 5. Histogram of Post-Test scores data distribution binned by 10-point increments.

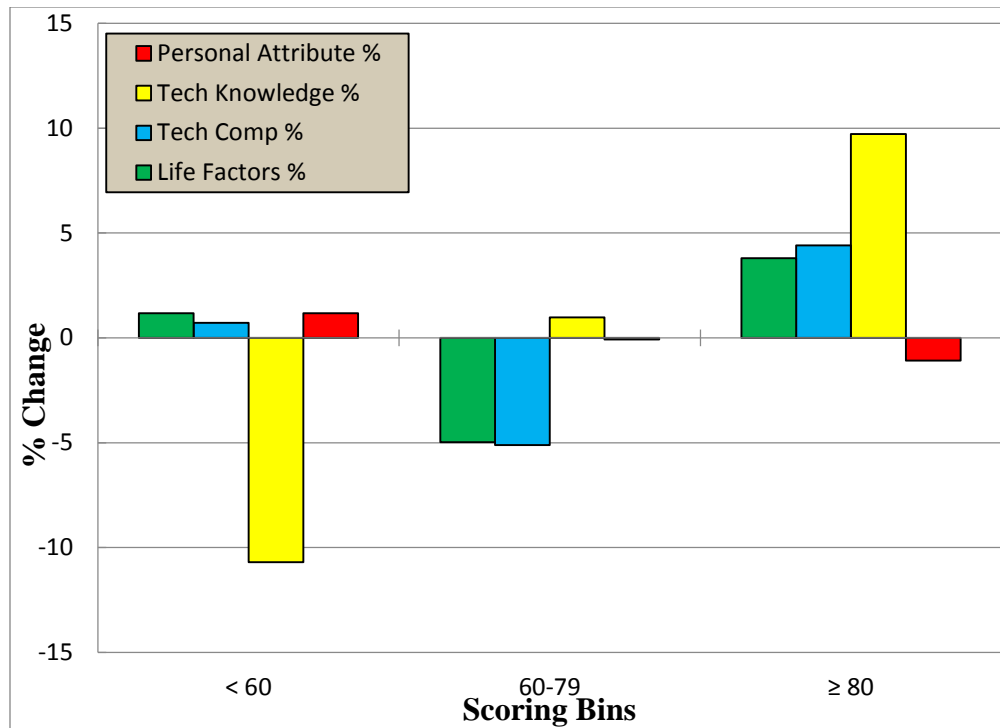


Figure 6. Histogram depicting change from pre-to-post test scores.

The Personal Attributes indicator exhibits a net decline of 1.09% in the  $\geq 80$  scoring bin. With no other change, the 60-79 bin would exhibit a net increase of 1.09%. However, the 60-79 scoring bin exhibits a net decline of 0.08%, meaning the total decrease is now up to 1.17% of students from pre-test 60-79 and the  $\geq 80$  bin. Therefore, the  $< 60$  bin must have registered an increase in this difference, and this is confirmed in the results.

Technology Knowledge exhibited a shift of 10.69% out of the  $< 60$  scoring bin and distributed across both higher scoring bins. Technology Competency and Life Factors both exhibited shifts from the 60-79 scoring bin to both higher and lower scores. The weakness in scoring bin reduction is demonstrated when comparing Technology Competency and Life Factors, where one exhibits a statistically significant increase in the mean, and the other does not. From Figure 6 this is not clear. The changes in scores from pre-to-post tests in these readiness indicators largely occur within the reduced number of scoring bins, and so do not register on the figure.

### 2.3 COMPARISON WITH PREVIOUS FSW ASSESSMENTS

The results of paired means t-test of pre-/post- test scores for all semesters from Fall 2012 through Spring 2014 are shown in Table 3. All SmarterMeasure readiness indicators mean scores are reported and exhibit statistically significant results in at least one indicator every semester over the course of the study thus far. Technology Knowledge has consistently had the strongest increases across the study, with all five semesters exhibiting a statistically significant increase. The Personal Attributes indicator recorded decreases in all but one semester, although only one of those decreases was statistically significant.

	Fall '12	Spring '13	Summer '13	Fall '13	Spring '14
<b>Personal Attributes</b>	-0.17	-0.98*	0.82	-0.45	-0.32
<b>Technology Knowledge</b>	3.77	4.22	3.06	3.07	3.89
<b>Technology Competency</b>	-0.07	2.02*	2.97	-1.00	2.11
<b>Life Factors</b>	-0.42	0.57	2.08	-0.20	0.24

Table 3. SmarterMeasure Pre-/Post- test results mean difference. Comparison of significance test results for mean difference of pre-/post-test scores for Fall 2012 through Spring 2014. Shaded cells indicate statistically significant differences in the mean at the 95% confidence level. \*Denote marginal significance as defined by Johnson (2013).

Table 4 provides additional information regarding the paired means t-test including the observed t-statistic ( $t_{obs}$ ) and probability of difference due to chance (p-value) with respect to the degrees of freedom for each study. No effect size is calculated since measurement units (test score) are typical of the field and therefore already meaningful (Wilkinson, 1999). Based on the work of Johnson (2013), there is a 17-25% chance the marginally significant results depicted in Table 4 may be false positives (i.e. Type I errors). These marginal results, defined as those within the 95-99% confidence level, include Spring 2013 Personal Attributes and Technology Competence.

	Fall '12 $t_{crit} = 1.97$	Spring '13 $t_{crit} = 1.97$	Summer '13 $t_{crit} = 1.98$	Fall '13 $t_{crit} = 1.96$	Spring '14 $t_{crit} = 1.97$
<b>Personal Attributes</b>	t(292)=-0.44, p=0.66	t(200)=-2.01, p=0.0464*	t(166)=1.81, p=0.072	t(779)=-1.89, p=0.0594	t(430)=-0.90, p=0.371
<b>Technology Knowledge</b>	t(292)=7.04, p<<0.001	t(193)=6.37, p<<0.001	t(166)=4.74, p<<0.001	t(775)=8.91, p<<0.001	t(425)=7.72, p=9.57x10 <sup>-14</sup>
<b>Technology Competency</b>	t(292)=-0.09, p<<0.001	t(194)=2.29, p=0.023*	t(166)=3.17, p=0.002	t(775)=-1.84, p=0.066	t(426)=3.28, p=8.71x10 <sup>-4</sup>
<b>Life Factors</b>	t(292)=-0.79, p<<0.001	t(200)=0.86, p=0.390	t(166)=3.57, p=0.0005	t(779)=-0.71, p=0.478	t(431)=0.63, p=0.533

Table 4. Additional significance testing statistics for SmarterMeasure readiness indicators including observed t-stat ( $t_{obs}$ ), probability of difference due to chance (p-value), degrees of freedom (df) (listed as t(x), and critical t-stat. In some cases, earlier reports did not include p-value when  $p < 0.05$  or in later studies,  $p < 0.001$  and are indicated where applicable. Mean difference of pre-/post-test scores are reported in Table 3. \*Denote marginal significance as defined by Johnson (2013).

### 3 CONCLUSIONS

In Florida SouthWestern State College's QEP assessment, students are expected to statistically significantly improve in the following learning readiness indicators of the SmarterMeasure Student Readiness Test: Personal Attributes, Life Factors, Technology Knowledge, and Technology Competency.

For Spring 2014, the paired means t-test results indicate that for two of the four readiness indicators, Technology Knowledge and Technology Confidence, we can conclude with a 95% confidence that the improvement in mean scores is not solely due to chance. There was a slight decrease in means for Personal Attributes and a slight increase for Life Factors; however, we cannot conclude that this difference is not simply due to chance.

Based on the results, it can, with reasonable certainty, be stated that the Spring 2014 FSW student is more proficient in Technology Competence and Technology Knowledge upon completion of the Cornerstone course. Further, most FSW students actually enter the Cornerstone course with a strong background in technology. In the case of Technology Competence, the indicator exhibited a large percentage of students showing no change from pre-to-post tests and 54.57% of pre-test scores were greater than or equal to 90. In contrast, the students do not appear to make any gains in the readiness indicators of Personal Attributes or Life Factors.

In comparison with earlier studies, it can be shown that since the study began in Fall 2012, only Personal Attributes has exhibited no statistically significant increases across the ongoing study period. The Life Factors indicator has exhibited irregular results, with only Summer 2013 exhibiting a statistically significant increase; other semesters exhibit both minor increases and decreases, one of which being statistically significant. The FSW student has shown statistically significant growth with each semester of the Cornerstone course in Technology Knowledge. The FSW student also tends to enter the course already proficient in Technology Competency, often showing little growth over the course of the semester as a result.

## 4 REFERENCES

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