

**Bow Valley College Studies on the Psychometric Evaluation of the TOWES  
Summary Report**

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### **Acknowledgement**

Thanks to Mr. Robert Black of Bow Valley College for designing, collecting, analyzing and presenting the individual studies on which this report is based (and are appended to this report). This represents many weeks' worth of time and effort. The results of the individual were presented in such a manner as to facilitate the writing of this summary report.

## **Executive Summary**

This report summarizes the results of 11 individual reports assessing various aspects of the Test of Workplace Essential Skills (TOWES) at Bow Valley College. In addition, one analysis was conducted in 2007 and reported here. TOWES was developed specifically for the Canadian Workplace to assess individuals' literacy skills. These skills are divided into three domains each represented by a subscale of TOWES: *Reading Text* which is demonstrated when individuals are able to understand and use information found in general textual formats including memoranda, regulations, policies, etc.; *Document Use* which requires individuals to locate and use information contained in information displays such as entry forms, tables, schematics, maps, and graphs; and *Numeracy* where individuals are required to demonstrate their skill at applying arithmetic operations to numbers that appear in printed materials such as monetary calculations, scheduling, accounting, or data analysis.

The 11 reports and additional analysis were all based on programs at Bow Valley College. The data were gathered between October 2004 and January 2006. Six of the reports focused on the TOWES's utility in predicting student performance in five different programs. Two of reports examined the relationship of TOWES scores to other measures of cognitive skills. Two studies examined the relationship of TOWES scores with being a native-born Canadian. One study examined the effect of an intervention on TOWES scores. Finally, the relationship between TOWES skills and whether or not practical nursing students completed their programs was examined.

### *Findings Summary*

1. The three subscales of the TOWES are intercorrelated with one another at about 0.58 indicating that about 1/3 of their variance is shared and likely due to a common cause – that of the test-takers' general cognitive abilities.
2. To enter into most career training programs offered at Bow Valley College, prospective students are typically required to have pre-requisite academic courses (for example Math 30 and English 30) or to have successfully completed a

- specialized preparation course offered through the Academic Foundations Department. Consequently, To date, entrance scores as measured by TOWES have not determined although it is thought that most of the programs offered at Bow Valley College would require that students *enter programs* with skill complexities *at least* at Level 2 (although many recommend Level 3). Job requirement skill levels for graduates of career programs offered by Bow Valley College are usually at or above Level 3. (This level is based on the Essential Skills Profiles as determined the findings of national research conducted by Human Resources and Social Development Canada). Students tend to perform least well on the Document Use subscale of the TOWES (mean of 259 out of 500), and about equally well on the Reading Text and Numeracy subscales (means of 295 and 302, respectively). As a result, students are more likely to have the necessary skills at program entrance on the Reading Text and Numeracy subscales (80% and 77%, respectively), while far fewer are likely to have the necessary Document Use skills at program entrance (42%).
3. The three subscales of the TOWES are positively correlated with general program performance at approximately 0.45 indicating that at least 21% of general program performance (about 1/5) can be accounted for by basic skills at program entrance.
  4. The TOWES subscales are correlated with other tests of similar cognitive abilities (Reading Text at 0.61, Document Use at 0.49, and Numeracy at 0.47). However, the degree of overlap is not large and thus TOWES provides unique information about respondent skill levels above and beyond other types of tests.
  5. TOWES test scores tend to be lower for individuals that are not born in Canada.
  6. An intervention aimed at academic upgrading showed that TOWES was able to detect the changes in essential skills, especially in Reading Text and Document Use.
  7. Higher levels of TOWES skills were positively related to program completion for Practical Nurses.

*Conclusions*

1. TOWES is very useful in a college setting.
2. TOWES can be used to identify at risk students who might withdraw or perform poorly in their programs.
3. TOWES can be used to assess the effectiveness of interventions that claim to improve basic literacy skills.
4. TOWES can also be used as an “exit” criterion.
5. Bow Valley College should continue to assess students with TOWES at entrance into their programs and at exit.
6. TOWES should be used to assess the effectiveness of various interventions for students lacking essential literacy skills.

### **Introduction**

This report was requested because data for 11 studies that were conducted at Bow Valley College over nine different programs from October 2004 – January 2006 under the direction of Mr. Robert Black, provided a number of interesting results. However, synthesizing the findings into a comprehensive report was deemed an appropriate next step.

There were several different foci of the 11 studies: 6 focused on the TOWES's utility in predicting student performance in five different programs; 2 examined the relationship of TOWES scores to other measures of cognitive skills; 2 examined the relationship of TOWES scores with being a native-born Canadian; 1 examined the effect of an intervention on TOWES scores. One additional analysis was conducted assessing the relationship between TOWES skills and whether or not practical nursing students who started their programs in 2005 and either completed their program or withdrew for academic reasons.

### Interrelationships Between the TOWES Subscales

The TOWES is comprised of three subscales: Reading Text, Document Use and Numeracy. Because all of them assess aspects of cognitive ability, there was likely to be significant relationships among the subscale scores. Indeed, this was the case. The following data is based on 6 different programs:

1. Accounting and Financial Management (2 different program times)
2. Dental Business Assistant
3. Medical Office Assistant
4. Unit Clerk
5. Health Care Aide (2 different program times)
6. Practical Nurse,

The total sample size for these programs was 231 students. The correlations between the TOWES' subscales reported in Table 1 below are weighted based on the sample size of students in each program.

*Table 1: Intercorrelations Between the TOWES Subscales*

	Reading Text	Document Use	Numeracy
Reading Text	--	.65	.52
Document Use		--	.57
Numeracy			--

The three subscales of the TOWES are intercorrelated with one another at about 0.58. This indicates that about 1/3 of their variance is shared and likely due to a common cause – that of the test-takers' general cognitive abilities. It was not unexpected to find such relationships. The implication for such findings is to ensure that individuals using the test information be aware that individuals with high (or low) scores on one of the subscales is likely to score high (or low) on the others.

### **Overall TOWES Scores**

For eight of the 11 studies (six different programs), it was possible to present overall individual TOWES scores (range from 0 – 500) as well as the Level (1 – 5) that TOWES uses based in the individual score. This 1 – 5 Level is based on the same level of complexity as are the International Adult Literacy Scale levels (Level 1 = 0–225, Level 2 = 226-275, Level 3 = 276-325, Level 4 = 326 – 375, Level 5 = 376-500). In addition to the students receiving a “level” as well as an individual 0 – 500 score, the programs into which the students enter also have recommended essential skills levels associated with them. These levels have been determined through the Essential Skills Research Project conducted by HRSDC and reflect the skill levels required for safe and productive work in that occupation. For example, based upon these national standards, graduates of the Practical Nurse Program will require essential skills of Level 3 for Reading Text, Level 3 for Document Use and Level 2 for Numeracy to function in their occupations in a satisfactory manner. This means the students whose individual scores are at or above the recommended program standard have the essential skills needed to successfully complete the training program

The six programs at Bow Valley College that participated in these studies were:

1. Accounting & Financial Management (2 program times assessed differently)
2. Dental Business Assistant
3. Medical Office Assistant
4. Unit Clerk
5. Health Care Aide (2 program times assessed differently)
6. Practical Nurse

Table 2 shows the program, date of program, sample size, average individual TOWES scores, level of skill recommended by the program at entry (and consequently the skills required by the occupation), and the percent of students performing at or above the level recommended for the program. In addition, a weighted average of the relevant variables are shown in the final column.

Table 2: Overall TOWES Scores and Recommended TOWES Levels for Programs

Program	Account. & Financial Mgmt (1)	Account. & Financial Mgmt (2)	Dental Business Assist.	Medical Office Assist.	Unit Clerk	Health Care Aide (1)	Health Care Aide (2)	Practical Nurse	Weighted Average
Date	Feb. 05	Sept. 05	Jan 05 Aug 05	Jan 05 Aug 05	Aug. 05	Feb. 05	Aug. 05	Jan 06	
Sample Size	21	26	34	34	29	20	20	47	
Reading Text	302	284	311	301	302	280	275	295	295
Document Use	277	248	264	263	259	235	231	258	256
Numeracy	317	300	300	309	307	294	282	302	302
Recommended Reading Text Level	Level 3	Level 3	Level 3	Level 3	Level 3	Level 2	Level 2	Level 3	
Recommended Document Use Level	Level 3	Level 3	Level 3	Level 3	Level 3	Level 2	Level 2	Level 3	
Recommended Numeracy Level	Level 3	Level 3	Level 2	Level 2	Level 2	Level 1	Level 1	Level 2	
% Students at or above Reading Text Level	77%	58%	84%	81%	81%	96%	100%	72%	80%
% Students at or above Document Use Level	57%	27%	37%	32%	45%	61%	65%	34%	42%
% Students at or above Numeracy Level	90%	66%	89%	97%	89%	100%	100%	23%	77%

The findings of these studies are that:

1. Most of the programs offered at Bow Valley College recommend students *enter programs* with skill complexities *at least* at Level 2 (although many recommend Level 3). Depending upon the career program, job requirement skill levels for graduates of Bow Valley College are usually at or above Level 2 and in some cases Level 3 (Personal Communication, Conrad Murphy, Jan. 25, 2007).
2. Students tend to perform about equally well on the Reading Text and Numeracy subscales (means of 295 and 302, respectively).

3. As a result, students are more likely to have the necessary skills at program entrance on the Reading Text and Numeracy subscales (80% and 77%, respectively).
4. Far fewer students are likely to have the necessary Document Use skills at program entrance (42%).

### **Criterion-Related Validity Studies**

Six of the 11 studies focused on the TOWES's utility in predicting student performance in five different programs. These are criterion-related validity studies in that they assess the direction and strength of relationships between specified predictors (in this case the TOWES subscale scores) and criterion (student performance in program). These studies were all carried out in a predictive manner (TOWES data was collected at one point in time and the performance criteria was collected at a later point in time) as opposed to concurrently (data is collected on the predictor and criterion simultaneously). As such they are a stronger test of the relationship between the predictor and criterion.

The five programs at Bow Valley College that participated in these studies were:

1. Dental Business Assistant
2. Medical Office Assistant
3. Unit Clerk
4. Health Care Aide (2 program times assessed differently)
5. Practical Nurse

In each of these programs the students are graded on a number of different courses. The students do have, at the end of the program, a final grade point average based on their total performance throughout the program. Table 3 shows the program, time the data were collected at the program, number of students participating in the research, and correlations between TOWES scores and overall program performance.

Each of the subscales was positively correlated with the overall program performance, indicating that the higher the TOWES scores on entrance to the program, the higher the performance in the program. A weighted average of these correlations showed that Reading Text was correlated at 0.44 with overall performance, and Document Use and Numeracy at 0.46. On average then the three subscales of the TOWES are positively correlated with general program performance at approximately 0.45 indicating that 21% of general program performance (about 1/5) can be accounted for by basic skills at program entrance. This moderate effect size is quite substantial and indicates that

TOWES testing at program entrance would be very useful to target students that may have difficulty in the program and assist them accordingly.

*Table 3: Results for Programs Participating in Criterion-Related Validity Research*

<b>Program</b>	<b>Date</b>	<b>Sample Size</b>	<b>Correlation: Reading Text and Overall Performance</b>	<b>Correlation: Document Use and Overall Performance</b>	<b>Correlation: Numeracy and Overall Performance</b>
<b>Dental Business Assistant</b>	Jan 05 Aug 05	34	.58	.53	.39
<b>Medical Office Assistant</b>	Jan 05 Aug 05	34	.40	.41	.45
<b>Unit Clerk</b>	Aug. 05	29	.43	.55	.50
<b>Health Care Aide (1)</b>	Feb. 05	20	.45	.59	.54
<b>Health Care Aide (2)</b>	Aug. 05	20	.69	.79	.81
<b>Practical Nurse</b>	Jan 06	47	.28	.22	.29
<b>WEIGHTED AVERAGE</b>			.44	.46	.46

It should be noted that the correlations for the Practical Nurse program are somewhat lower than for the other programs. The most likely reason for this is that those students with lower TOWES scores tend to withdraw from this program (correlated at about 0.40 – that is those with higher TOWES scores are more likely to complete the program). Therefore the correlation between TOWES scores and final marks is calculated on a sample with a restricted range on the variables.

### **Relationships of TOWES Scores with Other Cognitive Ability Measures**

Two reports provided information as to the relationship of TOWES with other tests of similar cognitive abilities. Specifically, TOWES, Test of Adult Basic Education (TABE), and Math Survey were administered to the Academic Foundations program students in September 2005. The Canadian Language Benchmarks (CLB) test and TOWES were administered to students in the Work Experience for Immigrant Professionals (WEIP) and the Language Instruction for New Canadian (LINC) programs in 2004 and 2005. Archival data from students in the Practical Nurse program (2002) and Office Administration (2002) were also used in the report summarized here.

Across all these programs, 564 students completed the TOWES Reading Text, TOWES Document Use and one or more other reading skills tests (TABE 5M and 5D Vocabulary and Comprehension, TABE 7D Reading and Reading GE, and CLB Reading).

The weighted average of the correlation between the TOWES Reading Text and other reading tests was 0.61. This indicates that they share a moderate amount of the same variance (about 37%), but the tests capture more unique information (63%) than redundant information.

The weighted average of the correlation between the TOWES Document Use and other reading tests was 0.49. This indicates that they share a moderate amount of the same variance (about 24%), but the tests capture more unique information (76%) than redundant information.

Across programs, 280 students completed the TOWES Numeracy and one or more other math skills test scores (Math Survey, TABE 7A Math Comprehension and Math Comprehension GE, TABE 7A Applied Math and Applied Math GE).

The correlation between the TOWES Numeracy subscale scores and other math scores was 0.47. The tests share only a small amount of the same variance (about 22%) and capture far more unique information (78%) than redundant information.

Overall, the correlations between the TOWES and other tests that assess similar constructs were generally of low to moderate in magnitude. This indicates that there is while there is some overlap in the assessment process, more of the variance of the TOWES tests and the other instruments are unique.

### **Relationships of TOWES Scores with Being Canadian-Born**

Two studies provided information as to the impact of being non-Canadian born on TOWES test scores. The instructors of these courses noted that there was a high number of recent immigrants in their program, thus, it provided an opportunity to explore demographic variables that might have an impact on TOWES scores. These two studies used the Accounting and Financial Management Program students that began their programs in February 2005 and September 2005. The total sample size for the analysis based on these two programs was 59, with 28 students born outside Canada and 31 born in Canada..

The findings are as follows; Students born outside Canada compared to those born in Canada were:

1. Older (typically 35-44 compared to 16-24)
2. Had more formal education (completed University versus completed high school)
3. Had lower TOWES scores (Reading Text: 272 versus 317, Document Use: 238 versus 289, Numeracy: 294 versus 327).

This suggests that those born outside Canada pose unique pedagogical issues for educational institutions such as colleges. That is, students from outside Canada tend to be older and more educated than their Canadian-born counterparts, but due to language and cultural barriers, they are likely to perform more poorly on standardized tests developed in Canada and therefore also be more likely to struggle in their programs.

### Use of TOWES in Detecting an Academic Upgrading Intervention

A total of 22 students were enrolled in an Academic Upgrading program at Bow Valley College took the TOWES test on the first day of class in September 2005. After two 5-month semesters of upgrading (three of the 22 took the test part way through the second 5-month semester), the students took the TOWES test again. The pre and post test TOWES scores are noted in Table 5.

*Table 5: Pre and Post-Academic Upgrading on TOWES Test Scores*

	<b>Reading Text</b>	<b>Document Use</b>	<b>Numeracy</b>
<b>Pre-upgrading</b>	232	203	239
<b>Post-upgrading</b>	256	212	265
<b>Average Gain Score</b>	24 points	9 points	26 points

Most of the students made impressive gains in the areas of Reading Text and Numeracy. However, the gains in Document Use scores were minimal. This suggests a need to have upgrading curriculum focus directly on improving Document Use scores.

**Completion Rates – Practical Nurse Program**

An opportunity to assess the completion rates of individuals in the Practical Nurse program presented itself. Specifically, In January, July and September of 2005 a total of 59 students completed the program and 15 left the program due to academically related difficulties in completing their program. All of the students competed the TOWES test prior to starting the program. Table 6 shows the TOWES skill levels of these students and how they were distributed as per their completion.

*Table 6: TOWES Skill Levels and Completion Rates – Practical Nurse Program 2005*

<b>TOWES Subscale</b>	<b>TOWES Skill Level</b>	<b>Withdrew (Academic Reason)</b>	<b>Completed Program</b>	<b>Total Count</b>
<b>Reading Text</b>	1	0	1	1
		0%	100%	
	2	6	7	13
		46%	54%	
	3 or higher	9	51	60
		15%	85%	
<b>Document Use</b>	1	6	4	10
		60%	40%	
	2	6	30	36
		17%	83%	
	3 or higher	3	25	28
		11%	89%	
<b>Numeracy</b>	1	2	1	3
		67%	33%	
	2	6	7	13
		46%	54%	
	3 or higher	7	51	58
		12%	88%	

For all three of the TOWES skills, the difference in completion rates was significant. For Reading Text the  $\chi^2$  value was 6.67 (2 degrees of freedom),  $p = .04$ . For Document Use the  $\chi^2$  value was 11.64 (2 degrees of freedom),  $p = .003$ . For Numeracy the  $\chi^2$  value was 11.80 (2 degrees of freedom),  $p = .003$ .

In examining the pattern it is apparent that for Document Use and Numeracy those that had higher skills had higher completion rates. There is an anomaly in the Reading Text assessment as there was only one person at Reading Level 1. Given there was only one person in this row, it would be more appropriate to assess only the difference in completion rates between those at Level 2 and those with Level 3 or higher. When this was done there was a statistically significant improvement in completion rates for students at Level 3 or higher compared to those at Level 2 ( $\chi^2$  6.35 (1),  $p = .012$ ).

This suggests that completion rates may be due in part to the essential skill levels of students at program entrance. This has tremendous implications for the students, instructors, college, and the province in that the cost to train individuals is quite high for all stakeholders. Students who would have withdrawn for academic reasons may, with some intervention, complete their programs.

## Conclusions and Recommendations

### *Summary of Findings*

The three subscales of the TOWES are intercorrelated with one another at about 0.58 indicating that about 1/3 of their variance is shared and likely due to a common cause – that of the test-takers' general cognitive abilities.

Most of the programs offered at Bow Valley College recommend students *enter programs* with skill complexities *at least* at Level 2 (although many recommend Level 3). Job requirement skill levels for graduates of Bow Valley College are usually at or above Level 3. Students tend to perform least well on the Document Use subscale of the TOWES (mean of 259 out of 500), and about equally well on the Reading Text and Numeracy subscales (means of 295 and 302, respectively). As a result, students are more likely to have the necessary skills at program entrance on the Reading Text and Numeracy subscales (80% and 77%, respectively), while far fewer are likely to have the necessary Document Use skills at program entrance (42%).

The three subscales of the TOWES are positively correlated with general program performance at approximately 0.45 indicating that at least 21% of general program performance (about 1/5) can be accounted for by basic skills at program entrance.

The TOWES subscales are correlated with other tests of similar cognitive abilities (Reading Text at .68, Document Use at .54, and Numeracy at .47). However, the degree of overlap is not large and thus TOWES provides unique information about respondent skill levels above and beyond other types of tests.

TOWES test scores tend to be lower for individuals that are not born in Canada.

An intervention aimed at academic upgrading showed that TOWES was able to detect the changes in essential skills, especially in Reading Text and Document Use.

Higher levels of TOWES skills were positively related to program completion for Practical Nurses.

#### *Limitations*

All relationships examined were correlational. That is, TOWES scores were related to criterion variables of interest, but cannot be said to CAUSE the variable to change. To make this claim, an experimental design would need to be used. Demographic variables were not included as potential covariates in the analyses. This is problematic in making direct comparisons across all demographic groups based on age, gender, first language, and formal education level. Despite these limitations several conclusions regarding TOWES are warranted. Each of the individual program data sets were relatively small, however, aggregated across the studies, the findings are more compelling.

#### *Practical Recommendations*

Given the diverse programs and conditions under which TOWES was used, these studies provide convincing evidence of the utility of TOWES in a college setting. The test can be used at program entrance to identify at risk students who might perform poorly in the program. It can be used to assess the effectiveness of interventions that claim to improve basic literacy skills. TOWES can also be used as an “exit” criterion. That is, students are expected to increase their basic skills as well as work-specific skills during their tenure at Bow Valley College. A TOWES test at the end of their programs would allow them to carry this for credentialing purposes as they move forward in their careers.

#### *Research Recommendations*

It is suggested that Bow Valley College pursue assessing accurately the Return On Investment (ROI) for students successfully completing their college programs. While this is often a time-consuming exercise, it is one that will offer the most compelling evidence to stakeholders of the importance of assessing and developing essential skills as part of the overall mandate of the institution.

It is also suggested that Bow Valley College continue to assess students at entrance into their programs and at exit. This data will continue to be used to assess overall student skill levels, their changes over time, as well as allowing more accurate assessments of the role of demographic characteristics in standardized test performance and program performance.

Finally, given the importance of interventions for students who do not have the appropriate level of basic skills, the use of TOWES to assess the effectiveness of various interventions is needed. This will assist in determining the best intervention programs for the various student populations in need.

**Appendices**