















tools. The results seem to indicate that TEL played a significant role in helping to restore student performance to that of the ‘low social media’ period. The goal of restoring students’ performance was

achieved, and the failure rate fell to 12.3%, which is a 14% reduction when compared to the ‘high social media’ period.

Table 3. Summary of Student Performance

Period	Final Course Mark (%)	A- or Higher (%)	Failure Rate (%)
<b>1998-2018</b>	70.2	31.5	13.7
<b>Low social media (1998-2007)</b>	69.8	30.3	14.2
<b>High social media (2008-2011)</b>	<b>64.0</b>	<b>23.3</b>	<b>26</b>
<b>TEL (2012-2018)</b>	71.4	34.8	12.3

We conducted an ANOVA on students’ performance over the 3 periods to determine if the differences were statistically significant. The results, which are summarized in Table 4, reveal significant differences in average course mark and failure rate, with the differences attributed to the 2008-2011 period. There are no significant differences in the percentage of students getting an A- or higher. However, a one-

tailed t-test comparing the periods 1998-2007 and 2008-2011 show evidence that the percentage of students getting an A- or higher is greater for the period 1998-2007 ( $p = 0.1$ ). A similar one-tailed t-test for 2008-2011 and 2012-2018 did not yield a significant result. This is likely due to the smaller sample sizes and the level of variability in the data.

Table 4. Summary of ANOVA Results

	ANOVA Results for the Difference Between Means		
	Average Course Mark	A – or Higher	Failure Rate
<i>F-statistic</i>	4.54	1.36	9.789
<i>p-value</i>	0.0188*	0.271	0.00053**

\* Significant at a 5% level

\*\* Significant at a 1% level

Table 5 summarizes the strength and direction of a linear trend for the three periods. We report the value of the coefficient of determination ( $r^2$ ) and the direction of the trend. The results show that the trend is significant in some cases. For the period 1998-2007 it appears that failure rate was trending upwards towards the latter part of the period. For the 2008-2011 period all results were trending downwards including the failure rate. Our data shows that the

highest failure rates for that period occurred at the beginning, 29% compared to 21% at the end. For 2012-2018, we observe average marks and the percentage of students getting an A- or higher trending upwards while the failure rate trended downwards. The results show once again that the period 2012-2018 was a period of recovery with respect to students’ performance.

Table 5.  $R^2$  Values for a Linear Trend for Performance in the Three Periods

Period	Average Course Marks	A – or Higher	Failure Rate
Low social media (1998-2007)	0.2075 (negative trend)	0.0375 (negative trend)	0.397 (positive trend)
High social media (2008 – 2011)	0.191 (negative trend)	0.579 (negative trend)	0.733 (negative trend)
TEL (2012 – 2018)	0.099 (positive trend)	0.165 (positive trend)	0.316 (negative trend)

## 5. Conclusion

Statistics is generally regarded as a difficult course by many business students. It is not uncommon to witness failure rates of up to 30%. It has been a constant goal of ours to keep the failure rate in the course to below 15%. Between 1998 and 2007, the failure rate in the course averaged 14.6%. The rising failure rate to 26% between 2008 and 2011 suggested some level of misalignment between how students were learning and the way in which the course was being taught and that there was a need for correction. The need to address the growing failure rate led to our foray into technology enhanced learning. A mix of technology-based learning support tools were deployed between 2012 and 2018 as the authors became more and more familiar with different learning technologies and their capabilities.

Student performance over the period 2012-2018 showed a marked improvement in the average overall course mark, the percentage of students finishing the course with an A- grade or higher, and course failure rate. The average failure rate has fallen to 12.3% from a high of 26% and many students have indicated that the Facebook group, video lectures, and video tutorials played a significant role in enhancing their performance in the course. Some indicated that while they noted the potential value of the flipped method, as the semester wore on with multiple assignments from other courses taken concurrently, it became difficult to maintain the level of preparedness needed to ensure a fruitful experience in a flipped class. Online tutorials and office hours provided great flexibility for those who were unable to attend face to face office hours. However, given that the online sessions were recorded, approximately only 20% of the class showed up online. Students accessed the recorded session on YouTube after it was posted.

In summary, we are of the view that three key success factors are at the heart of our experience with TEL: 1) the flexibility in the choice to engage with different learning support tools (YouTube videos, online meetings, Facebook groups, etc.); 2) asynchronous learning - allowing students to learn at their own pace (MindTap, YouTube lecture videos, recorded tutorials), and 3) the availability of a virtual learning commons (Facebook groups, Padlet) where students can meet and provide peer support. While we have yet to fully entrench Padlet, we believe that using Padlet as an aggregation point for student engagement within the course will allow for all three success factors to co-exist while minimizing the distraction that going to Facebook brings. It is our intent therefore to make full use of Padlet going forward.

## 6. Suggestions for Future Research

In any one semester between 5 and 7 sections of business statistics are usually taught. While the course curriculum is the same in all sections, instructors choose their own teaching methodology. We are not aware of the use of TEL in any of the sections taught by other instructors. While we believe that the average course marks may not be strongly dissimilar, we do believe the greatest impact is in reducing the overall course failure rate and increasing student engagement. For future research we will analyze the relationship between failure rate and the use of TEL in all sections of undergraduate business statistics at the university.

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## 8. References

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