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# SUCCESS AND LEARNING STYLE ALIGNMENT IN INTRODUCTORY BUSINESS COMPUTING

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## Abstract:

In this paper, three-year study conducted with first year undergraduate business computing students enrolled at a New Zealand higher education institution is considered. Results suggest that there is an educational challenge in higher education at entry level. One hundred and eighty five students from seven different ethnic backgrounds using a seven-dimension learning style scale were tested. Using a comparison of student learning style results against instructor learning style result, and student final grade, the observed learning style score resulted in an identifiable group of first-year students. Further, there is a procedure to enhance success for this group.

**Keywords** Introductory Business Computing, Ethnicity, Gender, Learning styles, LSI

## I. INTRODUCTION

A continuing educational challenge in introductory business computing classes is to cater to students from diverse ethnic backgrounds and a mixed level of English language achievement. Knowing how to teach effectively, knowing how to design effective curriculum, and knowing how to communicate effectively across this spectrum to meet a diversity of learning styles is an even greater challenge with the globalization of computing education. The three-year study reported in this paper addresses this educational challenge by considering a combination of factors, rather than single variable analysis.

The structure of this paper is as follows: firstly, a definition of learning styles used in this study is presented in the definitions section (II). Next, a limited literature review is presented in section III. This is followed by the methods section (IV) in which research scope, ethnic background, the main research question addressed and data gathering methods are presented. Results from the analysis conducted are presented in Section V. In the discussion section (VI), implications from this study are compared to previous studies and the paper concludes with limitations section (VII), an implications section (VIII), further research (IX) and a conclusion (section X).

## II. DEFINITIONS

### Learning Styles

Learning styles are various approaches to the ways in which people learn. The memletic learning styles chosen for this study (Visual, Aural, Physical, Social, Solitary, Verbal and Logical) are defined in Table 1 (Advanogy.com, 2004). Earlier research (Fielden & Comins, 2008) using a three-point learning style index (LSI) test supported by Wyman (2005) indicated that there may have been factors that were not being considered. This three-point learning style considered only Visual, Aural and Physical styles. By moving to this seven-dimension LSI, the authors were able to identify a more meaningful range of preferences, in particular the social element. This freely available online test provided a time-efficient means of testing students in class.

## III. LITERATURE REVIEW

Brown et al. (2009) describe learning as the process of creating knowledge by the transformation of experience. However, it would appear from the literature (Kinshuk, Liu, & Graf, 2009) the area

of learning styles is complex and there does not appear to be a clear definition of learning styles or even a comprehensive model that describes the most important learning style preferences. Educators agree (Charlesworth, 2008; Gantasala & Gantasala, 2009; Kinshuk, Liu & Graf, 2009) that consideration of learning styles can improve individual student performance. It is also noted that awareness of learning styles by both instructor and students is an important factor for self-reflection and knowledge about one's own learning processes.

### Learning styles defined

One method of categorizing learning style instruments is to categorize them into three groups: (i) instructional and environmental learning; (ii) personality related learning preferences; and (iii) information processing learning preferences (Hickcox, 1995). The seven point Learning Styles Index used in this study (Advanogy.com, 2004) adheres to this paradigm with visual, aural and physical belonging to the first grouping of instructional and environmental, social and solitary learning fitting the second grouping of personality related learning preferences, and verbal and logical learning style belonging to the third group of information processing learning preferences.

Learning dimension/ Factors	Visual	Aural	Physical	Social	Solitary	Verbal	Logical
<b>Sense</b>	Uses external & internal imagery	Hears externally & internally	Feels experience eternally & internally	Prefers to learn in groups	Prefers to work alone & uses self study	Prefers using words	Prefers using logic, reasoning & concepts
<b>Acquires knowledge</b>	Detailed notes	Reading aloud	By doing	Relies on others to jog memory	By self	Talking & writing words	Reasoning
<b>Remembers by</b>	Image-rich writing	Verbalizing to self	Experience	Group discussions	Relies on self	something written down	Reasoning things out
<b>Bored</b>	With aural & physical types	Hums or talks to self	Tinkers with things	By self	By discussions	With numbers	With writing
<b>Communicates by</b>	Writing	Talking	Touch	Talking to others	Infrequently	Words	Diagrams, concepts & logic
<b>Preference</b>	Visual presentations	Audio presentations	Activities	Group activities	To be alone	Written exercises	Logical exercises
<b>Believes</b>	Audio & physical people don't learn	physical people don't listen	Auditory & visual people are insensitive	Solitarys don't learn	Has trouble with noise created by socials	Can't comprehend how logicals learn	Has difficulty understanding verbals
<b>Encouragement</b>	Written	Aural	Physical expression	Group	One on one	Written	Logical

**Table 1. Based on Memletic Learning styles (Advanogy.com, 2004)**

### Gender, learning styles and success

Studies conducted by Bernold, Spurlin, and Anson (2007), Fielden and Comins (2008) and Demirbas and Demirkan (2007) all suggest that it is important to consider gender and learning styles at the same time in looking for success criteria for passing first year computing courses. Charlesworth (2008) and Fielden and Comins (2008) suggest that ethnicity is a contributing factor for success.

### Age, learning styles and success

Choy and Delahaye (2003) suggest that current youth learners at that time (aged between 18 to 24 years) are a neglected group in learning for an unknown future. They assert that the generation of students considered in their research learn best by experience; they require support

and feedback; want all work (including education) to be meaningful; prefer unstructured – but directed learning - and do not like being controlled. Choy and Delahaye also claim that this group of students were IT literate, and that students expect immediate feedback. In their findings, Choy and Delahaye stated that youth learning is complex and different for each student and that this provides a challenge for educators. Findings from this study suggest that more young people are using kinaesthetic learning styles. Educators however are teaching and providing feedback differently. Fielden and Comins (2008) state that age and learning style are contributing factors in successful outcomes, with mature-age learners more likely to be successful because their learning style more closely matches the educators' teaching styles.

### **Mismatched Learning Styles**

Mismatched learning may happen between student and course (Kinshuk et al., 2009), student and delivery style (Li et al., 2008), and between student and instructor (Bernold et al., 2007).

Kinshuk et al. (2009) believe that students may learn in courses that do not support their learning styles. Some educational theorists also believe that students should be using these less-preferred learning styles (Gantasala & Gantasala, 2009). Students and trainees in general learn effectively with teaching pedagogy that matched their learning style preferences (Li et al., 2008). There is ample research in studying the influence of learning styles (Coffield et al., 2004; Reynold & Vince, 2007; Welsh et al., 2007; Herbert & Stenfors, 2007; Sievers, 2007; Kayes A.B., 2007; Garcia et al., 2007; Demirbas & Demirkan, 2007; Armstrong & Mahmud, 2008; Gantasala & Gantasala, 2009).

Bernold et al. (2007) suggest that academics should be aware of different ways that students process and retain information. These authors challenge academia to learn about learning, to consider students as partners, and to nurture strengths and weaknesses.

Tzu-Chien and Graf (2009) have identified that learners in mismatched courses adopt different learning strategies in coping with the mismatch. This helps in obtaining a better understanding about how students with varying performance records learn with respect to their learning styles.

Mismatches in learning can also occur between students and/or instructors because of a complex interplay of factors including gender, culture, age, socioeconomic status, personality type, motivation, IQ, emotional quotient (EQ) and engagement as well as learning style mismatches (Gantasala & Gantasala, 2009).

Lewandowski and Morehead (1998) suggest that learning material be made available to more students by teaching methods that cater for all learning styles. Bennedsen and Caspersen (2008) suggest that students who pass a course have a statistically significant higher self-esteem than those who do not, and Bernold et al (2007) state that learner-centred institutions have higher success rates because they provide an environment that pays careful attention to knowledge, skills, attitudes, and beliefs of learners.

Some researchers have identified small clusters of factors that contribute to student success. Goldfinch and Hughes (2007) state that the most significant combination of factors in explaining success in the first year was a low score on the activist learning style scale (defined as physical on the memletic learning style scale used in this study) and high initial confidence in the skills of self-reliance, time management and teamwork. Howles (2009) on the other hand, considered factors including class size, technology in the classroom, and active learning environments in looking at student success and persistence and found that student success could be attributed to a complex set of factors.

### **Learning Styles inconsistencies**

Coffield et al (2004) identified 71 different learning style theories from which they selected the 13 most favoured for closer study, stating that learning style theories need to be validated adequately and that there are inconsistencies in basic measures from one learning style to the next. For instance, there were inconsistencies in definition of visual, auditory and kinesthetic preferences. These authors also find that matching teaching and learning styles is questionable when the goal is to investigate student success. Whilst these inconsistencies need to be

considered, testing and raising awareness of learning styles is beneficial for both students and instructors (Dunn et al., 2009).

#### IV. METHOD

##### Research scope

This research project used a survey to investigate the factors affecting retention, success and learning style alignment of students enrolled in an introductory business computing class at a New Zealand higher education institution. This introductory business computing class, designed to give students an understanding of the business environment is a compulsory class for all undergraduate students enrolled in the computing degree. Students also gain knowledge about major IT functions within organizations and the uses of information technology to implement business strategies. Topics included information needs, typical information systems used by business, and modelling data flows that occur in typical business processes. Blended mode instruction includes in-class instruction as well as online delivery.

##### Ethnic Background

The ethnic backgrounds used in this study were those selected by the students on enrollment that included Pakeha (European origin and born in New Zealand), Maori (New Zealand first nation people), Pacifica (People from Pacific island nations resident in New Zealand), Chinese, Indian, Other Asian, and Other. People in these ethnic groups may be permanent residents having immigrated to New Zealand, or be born in New Zealand but still belong to the particular ethnic group (Tables 2 and 3). These ethnic groups align with the national categories used by Statistics New Zealand to gather demographic data.

##### Research Question

The main research question for this study was:

What are the factors in relation to learning style preferences that influence student success in a first year undergraduate computing class?

##### Data Gathering

For the six semesters (2007-2009) all students (185) in this introductory business computing class completed an online learning styles test in the second week of semester according to the instruction sheet supplied. The lecturer collected test results from each student, all of whom gave consent for their data to be used in this research activity of participating in the online learning style test.

Grade	Pass		Fail		(DNC) Did not Complete		Total		
	>25 yrs	<=25 yrs	>25 yrs	<=25 yrs	>25 yrs	<=25 yrs	>25 yrs	<=25 yrs	
<b>Pakeha</b> <sup>1</sup>	3	5	0	0	1	0	4	5	9
<b>Maori</b> <sup>2</sup>	2	4	0	0	0	0	2	4	6
<b>Pacifica</b> <sup>3</sup>	1	3	0	5	0	0	1	8	9
<b>Chinese</b>	1	0	2	0	0	0	3	0	3
<b>Indian</b>	1	2	0	2	0	0	1	4	5
<b>Other Asian</b>	0	1	0	0	0	0	0	1	1
<b>Other</b>	3	2	1	0	0	0	4	2	6
<b>Total 39</b>	<b>11</b> <b>28.2%</b>	<b>17</b> <b>43.59%</b>	<b>3</b> <b>7.69%</b>	<b>7</b> <b>17.95%</b>	<b>1</b> <b>2.56%</b>	<b>0</b> <b>0%</b>	<b>15</b> <b>38.46%</b>	<b>24</b> <b>61.54%</b>	<b>39</b>
<sup>1</sup> Pakeha = New Zealand born of European origin <sup>2</sup> Maori = New Zealand first nation people <sup>3</sup> Pacifica = People from Pacific island nations resident in New Zealand									

**Table 2: All Female Grades (first attempt)**

The students received immediate feedback of their resulting scores. The lecturer also supplied the students with extra resources so that they could use personal results to change, improve, or confirm techniques that would help them individually. Students received a simple explanation of their LSI score, and advice on how to find out more if they wished.

At the end of each semester, the results were collated into a spreadsheet that recorded student Id, semester enrolled, gender, ethnicity, age and final grade (from central student services); and the seven learning styles scores for visual, aural, physical, social, solitary, verbal and logical gathered earlier in the semester (this spreadsheet is not shown here). The number of attempts to pass the course was also recorded.

Table 2 shows pass, fail and 'did not complete' results for female students broken down by ethnicity and age. Table 3 illustrates the distribution for male students. Tables 2 and 3 show the seven ethnic groupings for all students in these classes.

Grade	Pass		Fail		(DNC) Did not complete		>25 yrs	<=25 yrs	Total
	>25 yrs	<=25 yrs	>25 yrs	<=25 yrs	>25 yrs	<=25 yrs			
Pakeha <sup>1</sup>	7	21	3	13	0	0	10	34	44
Maori <sup>2</sup>	1	4	0	5	0	0	1	9	10
Pacifica <sup>3</sup>	2	6	2	4	2	0	4	10	14
Chinese	6	12	2	12	0	0	8	24	32
Indian	1	11	1	3	0	0	2	14	16
Other Asian	3	3	1	7	0	0	4	10	14
Other	3	7	0	5	0	1	3	13	16
<b>Total</b>	<b>23</b>	<b>64</b>	<b>8</b>	<b>49</b>	<b>1</b>	<b>1</b>	<b>32</b>	<b>114</b>	<b>146</b>
<b>%</b>	<b>15.75%</b>	<b>43.84%</b>	<b>5.48%</b>	<b>33.56%</b>	<b>0.68%</b>	<b>0.68%</b>	<b>21.92%</b>	<b>78.08%</b>	

<sup>1</sup> Pakeha = New Zealand born of European origin  
<sup>2</sup> Maori = New Zealand first nation people  
<sup>3</sup> Pacifica = People from pacific island nations resident in New Zealand

**Table 3: All Male Grades (first attempt)**

As discussed below in the next section, the seven learning dimensions have been grouped as follows: visual, aural and physical; social and solitary; and verbal logical.

## V. ANALYSIS

For this analysis, abductive reasoning has been used (Peirce, 1902; Shank, 1993). Abductive logic provides the ability to advance an inquiry, to shed further light on the problem at hand by reasoning from the data to the results to obtain hypotheses that can change as new information emerges. Ryder (1997) believes that abductive reasoning is a critical skill in this information-rich age.

This analysis uses abductive reasoning in the following manner:

1. In the first pass of the data, three categories of learning styles were established: (Visual, Aural, Physical), (Social, Solitary) and (Verbal, Logical) thus modifying the Memletic learning style inventory. These categories were chosen as most commonly grouped across a number of learning styles (Li, Chen, & Tsai, 2008);
2. From neuroscience comes the notion that verbal reasoning skills develop before logical reasoning skills. Jensen (2008) states that age-related groupings of <=25 and >25 are appropriate;
3. As other authors have found, gender- based analysis was appropriate (Haggis, 2006; Varma, 2009);

4. There is also a body of literature on learning styles that considers different ethnic backgrounds including Haggis (2006);
5. Because New Zealand now has both permanent residents as well as new immigrants, it was necessary to consider both groups. This is translated as one subsection in Hypothesis (H2) into “have English as a second language or have another ethnic background”;
6. Considering differences between students’ learning style clusters and the instructor’s learning style preferences together with students who scored low on the online learning style test; and
7. In depth individual analysis for this cluster of factors has been applied to those male students <= 25 years who fail this introductory business computing class at the first attempt (Table 5-13). No evident patterns emerged for students who passed on their first attempt, apart from those students who gained an A grade. The inference in this case, therefore, is that those students who passed at their first attempt have mastered their own ability to learn taking into account the many factors involved. The first hypothesis then becomes:

**H1:** Students who pass on the first attempt have developed their own learning strategies.

**Pass Rates**

As shown in Table 4, the total pass rate female students over 25 years was 73.33% and for male students over 25 was 69.70%. Older students therefore are not an ‘at risk’ group. The total pass rate for all students <= 25 years was 58.69%. The total pass rate of all students over 25 years who are also Pakeha (of European origin, born in New Zealand) was 71.43%. The biggest discrepancy by age and gender therefore is between non-Pakeha students with 80% over 25 passing at the first attempt and only 49.10% <= 25 passing at the first attempt.

	Total Pass Rate		> 25 years		<=25 years	
<b>Pakeha</b>	36/53	67.92%	10/14	71.43%	26/39	66.67%
<b>Non-Pakeha</b>	79/132	59.85%	24/30	80%	55/102	49.10%
<b>All Females</b>	28/39	71.79%	11/15	73.33%	17/24	84.56%
<b>All Males</b>	87/146	59.59%	24/33	69.70%	63/113	56.64%
<b>Pass Rate</b>	115/185	62.16%	34/47	72.34%	81/138	58.69%

**Table 4. Total Pass Rates for All Students (first attempt)**

**At Risk Students**

Tables 5-13 show clustered factors for the young male students who failed at their first attempt at this class, and who also fitted the criteria for Hypothesis 2 as reported in Table 3 below.

Ethnicity /LSI	Pakeha	Maori	Pacifica	Chinese	Indian	Other Asian	Other
	A So Ve	A So L	A So Ve	A So Ve	A SoSI L*	A So Ve*	A So L*
	A So Ve	A SI Ve	A So Ve	A So Ve	Vi SI L*	A So Ve*	ViASoVe*
	A So VeL	Vi So Ve	A So Ve	A So VeL	ViSoVeL*	A So Ve*	P So Ve*
	A SI Ve	ViPSoVe*	AP So Ve	P So L*		A So L*	Vi So Ve*
	A So L	P So Ve		P So L*		Vi So L*	A Si L*
	A So L			Vi So L		Vi So L*	ViA So L*
	A SI VeL			Vi So L*		Vi So L*	
	AP SI VeL			Vi So L*			
	Vi So Ve			Vi SI L			
	Vi So L*			ViA So L*			

	Vi So L* P So Ve P SI Ve			ViA So Ve* ViP SI L*			
Total %	13/34 32.5%	5/9 56%	4/10 40%	12/24 50%	3/14 21%	7/10 70%	6/12 50%
* denotes difference from tutor or low LSI score (Tutor = ViPSoL) H1: students <= 25 years <b>AND</b> Male <b>AND</b> (have English as a second language <b>OR</b> Have another ethnic background other than Indian or (European, New Zealand born)) <b>OR</b> (Have a different learning style to the instructor or have low learning style scores) are most likely to fail							
LSI Learning styles (A=Auditory, Vi=Visual, P=Physical), (So=Social, SI=Solitary), (Ve= Verbal, L =Logical)							

**Table 5: All Males <= 25 years failing course on first attempt**

The sole instructor for this class had a learning style score in which visual and physical learning styles scores were balanced, and the aural learning style score was low in the first learning style cluster of visual, aural, and physical. In the second pair the instructor was predominantly social (social and solitary), and strongly logical compared to verbal in the third pair of scores. Using the LSI styles, where LSI Learning styles (A = Auditory, Vi = Visual, P = Physical), (So = Social, SI = Solitary), (Ve = Verbal, L = Logical), the instructor's style was coded as ViP SoL as noted in Table 5.

Unpacking Table 5 by ethnicity (Tables 6-13) shows detailed results.

Table 6 shows that at-risk male Pakeha students had a predominantly auditory style in the first cluster of factors (8/13), social rather than solitary in the second cluster (10/13) and mixed verbal/logical results.

Pakeha/ LSI score	No of students	Auditory, Visual	Physical, Solitary	Social Solitary	Verbal Logical
	2	Auditory *		Social	Verbal*
	1	Auditory *		Social	Verbal, Logical
	1	Auditory *		Solitary*	Verbal*
	2	Auditory *		Social	Logical
	1	Auditory *		Solitary*	Verbal, Logical
	1	Auditory *, Physical		Solitary*	Verbal, Logical
	1	Visual		Social	Verbal*
	2	Visual**		Social	Logical
	1	Physical		Social	Verbal*
	1	Physical		Solitary*	Verbal*
Total	13	13/34 (32.5%)			
* denotes difference from tutor (Tutor = Visual/Physical, Social, Logical) **denotes low LSI score					

**Table 6: Male Pakeha <= 25 years failing course on first attempt**

Of note in the young male Maori students that failed shown in Table 7, is the predominance of social rather than solitary (4/5) and verbal rather than logical (4/5), with only one student scoring low on the online test.

Maori/ LSI score	No of students	Auditory, Visual	Physical, Solitary	Social Solitary	Verbal Logical
	1	Auditory *		Social	Logical
	1	Auditory *		Solitary*	Verbal*
	1	Visual **		Social	Verbal*
	1	Visual, Physical**		Social	Verbal*
	1	Physical**		Social	Verbal*
Total	5	5/9 (56%)			
* denotes difference from tutor (Tutor = Visual/Physical, Social, Logical) ** denotes low LSI score					

**Table 7: Male Maori <= 25 years failing on first attempt**



Young Pacifica male students who failed on their first attempt all exhibited the same learning style elements of Auditory, Social and Verbal. For these students three out of the four clustered learning style dimensions are different from the instructor.

Pacifica/ LSI score	No of students	Auditory, Visual	Physical, Social	Social Solitary	Verbal Logical
	3	Auditory *		Social	Verbal*
	1	Auditory *, Physical		Social	Verbal*
Total		<b>4/10 (40%)</b>			

\* denotes difference from tutor (Tutor = Visual/Physical, Social, Logical)  
\*\* denotes low LSI score

**Table 8: Male Pacifica <= 25 years failing on first attempt**

Of the young male Chinese students who fail on the first attempt 7/12 scored low on the online learning style test. Studying the cluster patterns closely shows that there is a more complex situation with these students. None of the students had the same predominant learning style clusters as the tutor and there was a mix of test results. It is this set of results in particular that give rise to the complicated nature of the second hypothesis.

Chinese/LSI score	No of students	Auditory, Physical, Visual	Social Solitary	Verbal Logical
	2	Auditory *	Social	Verbal
	1	Auditory *	Social	Verbal, Logical
	2	Physical *	Social	Logical
	4	Visual	Social	Logical
	1	Visual, Auditory *	Social	Verbal
	1	Visual, Auditory*	Solitary	Logical
	1	Visual, Physical *	Solitary	Logical
Total	12	<b>12/24 (50%)</b>		

\* denotes difference from tutor (Tutor = Visual/Physical, Social, Logical)  
\*\* denotes low LSI score

**Table 9: Male Chinese <= 25 years failing on first attempt**

Only 3/14 Indian students failed and in each case, the cluster of scores was different from the tutor.

Indian/LSI score	No of students	Auditory, Physical, Visual	Social Solitary	Verbal Logical
	1	Auditory *	Social, Solitary	Logical *
	1	Visual	Solitary*	Logical *
	1	Visual	Social	Verbal, Logical *
Total		<b>3/14 (21%)</b>		

\* denotes difference from tutor (Tutor = Visual/Physical, Social, Logical)  
\*\* denotes low LSI score

**Table 10: Male Indian <= 25 years failing on first attempt**

For the 'Other Asian' group of young male students who failed on the first attempt (7/10), All scored low on the LSI test and had different LSI clusters from the tutor.

Other Asian /LSI score	No of students	Auditory, Physical, Visual	Social Solitary	Verbal Logical
	3	Auditory *	Social	Verbal *
	1	Auditory *	Social	Logical **
	3	Visual	Social	Logical **
Total	<b>7</b>	<b>7/10 (70%)</b>		

\* denotes difference from tutor (Tutor = Visual/Physical, Social, Logical)

\*\* denotes low LSI score

**Table 11: Male Other Asian <= 25 years failing on first attempt**

All young male students classified as 'Other' also scored low on their LSI test and displayed a different set of clusters from the tutor.

Other /LSI score	No of students	Auditory, Physical, Visual	Social Solitary	Verbal Logical
	1	Auditory *	Social	Logical *
	1	Visual, Auditory *	Social	Verbal *
	1	Physical	Social	Verbal *
	1	Visual	Social	Verbal *
	1	Auditory *	Solitary	Logical *
	1	Visual, Auditory *	Social	Logical *
Total	<b>6</b>	<b>6/12 (50%)</b>		

\* denotes difference from tutor (Tutor = Visual/Physical, Social, Logical)  
 \*\* denotes low LSI score

**Table 12: Male Other <= 25 years failing on first attempt**

Of note is that regardless of ethnicity, having predominantly aural and verbal learning styles for young male students may be a problem. It can be seen from Table 13 that 10/13 young male Pakeha students, 3/5 Maori students, 4/4 Pacifica students, 8/12 Chinese students, 7/7 other Asian students and 6/6 other students who failed had either low LSI scores or had a predominantly different learning style from the tutor.

All Male students	Total		Different from tutor or low scores
Pakeha	13/34	32.5%	10
Maori	5/9	56%	3
Pacifica	4/10	40%	4
Chinese	12/24	50%	8
Indian	3/14	21%	3
Other Asian	7/10	70%	7
Other	6/12	50%	6
Total	<b>50/113</b>	<b>43.48%</b>	

**Table 13: All male students <= 25 years failing on first attempt**

In addition, if a young male student has either low learning style scores regardless of what these scores are or has a cluster of scores that are different from the instructor this is also contributes to the factors that tend to indicate failure in this class at the first attempt. Arising from these observations is H2:

**H2:** students most likely to fail on the first attempt at this first year introductory business computing class are:

(i) <= 25 years

**AND**

(ii) Male

**AND**

(iii) ((have English as a second language **OR** have another ethnic background (not, New Zealand born of European origin))

**OR**

(iv) (Have a different learning style to the instructor

**OR** have low learning style scores)).

H2 means that complex conditions apply for students in this class. The important points to note are that those most likely to fail at the first attempt are young male students with cultural factor that could either have English as a second language or from another ethnic background. New Zealand has many permanent residents from other countries. Some students from other ethnic backgrounds now have English as a first language. It is also important to note that the student's own learning style or the difference between the student and the instructor learning style are only two elements in this hypothesis.

### **High achieving students**

All students in this sample who achieved an A grade had a logical rather than a verbal learning style, so the third hypothesis becomes:

**H3:** Students who achieve an A grade have a logical (rather than verbal) learning style.

## **VI. DISCUSSION**

In a previous study conducted by the authors (Fielden & Comins, 2008) in which a three-point learning styles test was administered over 10 semesters it was found that the way in which this first year business computing class was presented did not suit the largest subgroup of students (non-Pakeha male students). Grouping ethnic subgroups showing similar results allowed previous research results to be fine-tuned. The only non-Pakeha group of young males to perform well was young Indian students. In this study, slightly different results have been obtained where a possible explanation for this result is that New Zealand now has a growing permanent-resident population that has all received schooling in New Zealand.

In the previous study conducted by the authors, the instructor learning style was important for the 'at risk' students who have not developed their own effective learning styles. The research reported in this study substantiated these results.

When the characteristics of physical learners are considered, more hands-on experiential laboratory work, flexible seating arrangements (so students can move around), smaller exercises to accommodate shorter attention spans, frequent breaks during the class, relating first year computing to everyday experiences through classroom activities and frequent positive tactile feedback would be worth trialling for first year computing students. It is also important to note that students now learn in a more 'social' environment, both within the physical classroom and online through learning management sites, social networking sites and mobile telephony.

Auditory students need to sit where they can hear the tutor, and the time to internalise and verbalise what they have heard. Presentations of solutions to the rest of the class help auditory students acquire knowledge by speaking aloud about what they have learned. Classroom flexibility is also required for auditory students who need to talk to themselves during class. Auditory students prefer to listen than to experience, so there is a need in classes to provide opportunities to listen to the tutor. Auditory students also need to talk to others about what they are learning and benefit from group work.

Traditional teaching techniques appeal most to visual students, who performed best in this sample.

## **VII. LIMITATIONS**

This extended case study was not statistically significant, therefore, the results from this study cannot be generalised. However, the results add to the pool of knowledge about learning challenges for first year computing students in a globally oriented education market. Whilst cultural differences in learning style were considered, there has been no attempt to consider the anglosization of education (Vandermensbrugge, 2003) in this study. The cultural mix of students attending this particular higher education institution over this three-year period has fluctuated, influenced by a number of factors including demographic, immigration, international student arrivals and a strong IT labour demand.

## **VIII. IMPLICATIONS**

Arising from these results are some interesting points:

1. There is an identifiable 'at risk' group of students who may fail the first time enrolled in this class;
2. There is a learning style test that can identify this group of students, together with the demographic data: age, gender and ethnicity which is easy to administer;
3. Those students who pass the course on their first attempt have developed their own successful learning strategies.
4. Identifying contributing factors for student success in first year computing subjects is complex. Contributing factors include age, gender, preferred learning styles, learning style alignment with the instructor (as factors identified in this study) plus aptitude for the subject, engagement in the learning process, intelligence level, individual personal differences, family dynamics, societal and economic factors and cognitive maturity. Recent findings from neuroscience (Howard-Jones, 2009) suggest that children problem solve verbally and adults pattern match or engage in logical reasoning.
5. Students who achieve an A pass are, in the main learning logically rather than verbally. There were fourteen out of sixteen students who gained an A pass and whose main learning style in this cluster was logical. It would seem therefore, that these students had made the switch to adult learning styles in this cluster of logical/verbal learning styles.

## IX. FURTHER RESEARCH

The field of neuroscience applied to education and learning offers exciting research opportunities. Dimoka and Davis (2008) in applying neuroscience techniques to technology adoption gained very useful results by studying which areas of the brain were activated by various web sites. This study was a first attempt to explore the use of neuro-imaging in an Information Systems discipline area. This provides an opportunity to test the hypothesis that young male students are using different neural pathways. Further research by conducting surveys across the same institution for all computing classes and across institutions would provide validation for this method.

## X. CONCLUSION

To improve first-year undergraduate pass rates there is a need to evolve both curriculum and teaching methods to accommodate a wide range of student ethnicities, age, gender and learning styles. There is a need to be more inclusive of all students regardless of race, culture and gender, and a need to maximise the appropriate blend of face-to-face and online learning. The national government funding strategy is increasingly to fund tertiary institutions on success rather than equivalent full time students. Therefore, this research adds to the knowledge pool about factors that impact on retention and success. Retention and success are high on the national government's funding directions. In today's world of global internationalised education with a high demand for IT graduates, increasing pass rates is paramount.

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**Appendix 1**  
**Instructions for Personal Learning Style Test**  
**Introductory Business Computing Course**

**Doing the Test**

Work through the following steps at your workstation....

1. Login as normal, and start up a browser.
2. Enter the URL... [www.learning-styles-online.com](http://www.learning-styles-online.com)
3. Select the Learning Styles Inventory, then select the "New Users" link. (**free online learning styles inventory**)
4. Work through the test items – leave as zero if it doesn't apply to you, enter "1" if partially true, and "2" if it really does apply.  
**NOTE:** For the item relating to the Roller Coaster – the question is really about does it physically affect you, either positively or negatively.
5. For the Registration, enter just the mandatory details, so that you can get to your test results.
6. Record your Scores on both sheets of paper. You can do a print (3 pages) but I suggest you copy the image of the graph into a word document, add your name, and print that (*if you want to keep a copy*).

**Recording your Score**

Simply copy the scores to this box...

	Score		Score
Visual		Verbal	
Social		Solitary	
Physical		Logical	
Aural			

***Please make sure that we obtain a copy of your scores, by completing all the Consent Form details.***

**Interpretation**

The higher the score, the more strongly you prefer that learning style. Similar or matching scores in two categories simply means that you are able to learn in more than one style.

Knowing how you rate can be helpful, because then you can adopt a personal range of strategies that will assist your learning, rather than persevere with someone else's strategies, that work for their particular learning style strengths.

Do continue to use the web site to view strategies for your strongest scores, and then use these to improve your learning. Optionally, you can register in full to buy their book.

