

## *The impact of persuasive SMS on students' self-regulated learning*

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### **Abstract**

This paper presents the outcome of an experimental design to investigate the impact of persuasive short messaging service (SMS) on students' self-regulated learning strategies while attending an introductory information systems course over a 12-week trimester. The participants were undergraduate students enrolled in INFO 101 at a tertiary institution in New Zealand. The instrument used in this study was the original motivated strategies for learning questionnaires (MSLQ) developed by Pintrich. MSLQ measures three general types of strategies: cognitive, meta-cognitive and resource management. The findings of the research identified that several aspects of students' learning strategies had been improved for the experiment group while the Time and Study Environment Management dimension of MSLQ had been significantly lowered for the control group who received no SMS intervention. The study demonstrates a positive impact of persuasive SMS on students' learning and suggests that the intervention is able to improve students' self-regulated learning effort compared to the control group. Moreover the study shows that students who received SMS intervention performed better than students who did not receive SMS intervention. Most importantly, the study shows that SMS intervention enables Māori and Pacific students, who historically have a lower performance than the main cohort, to perform better than the main cohort and to a significant level higher than those Māori and Pacific students who did not receive any SMS intervention. This study suggests that practitioners should consider the adoption of the persuasive SMS intervention by using the principles of persuasive technology for sending SMS messages especially for the high risk students.

### **Practitioner Notes**

What is already known about this topic

- Persuasive technology is the adoption of computing technology in an attempt to change attitudes and behaviour.
- This technology is widely used in the preventive health care industry and social organizations for their and social marketing campaigns.

What this paper adds

- The study shows that students who received persuasive short messaging service (SMS) intervention performed better than students who did not receive any SMS intervention.
- The study demonstrates a positive impact of persuasive SMS on students' learning and suggests that the intervention is able to improve students' self-regulated learning effort.

Implications for practice and/or policy

- Practitioners should consider the adoption of the persuasive SMS intervention.
- Practitioners should adopt the seven principles of persuasive technology for sending SMS messages.
- Practitioners should also target the persuasive SMS intervention to high risk students.

### **Introduction**

Higher education can be an expensive investment for some stakeholders. It was reported (TEC, 2010) that in 2009, the course completion rate at levels 5–6 (Diplomas and Graduate Certificates) and at levels 7–8 (Degrees, Postgraduate Diplomas and Honours) were 74% and 84%, respectively, in New Zealand's universities. Given the total number of equivalent full-time students reported in 2009 was 118 918 in New Zealand tertiary institutions and, assuming a conservative cost of \$500 per course, the amount of lost "investment" can be very substantial. Apparently, local universities are taking steps to minimise such a problem in order to compete with universities worldwide for high-quality international students, as well as for government funding.

Various student support services currently provide learning support such as peer tutoring, learning strategies workshops and examination preparation in order to motivate and encourage students' cognitive and noncognitive learning. Some of these student learning support services are specifically targeted towards Māori and Pacific students. For example, the Manaaki Pihipihinga programme focused on academic achievement within the cultural framework of cooperative learning through the provision of one-to-one mentoring support (VUW, 2011a). Other screening methods to identify high-risk learners at the beginning of a semester and provide them with additional enrichment programmes are frequently used. One such method that could differentiate between high- and low-achieving students is to look at their capacity to use self-regulated strategies (Pintrich & DeGroot, 1990; Watson, McSorley, Foxcroft & Watson, 2004). This strategy is reliable as it has been extensively researched and is grounded in learning theory. Self-regulation refers to self-regulated thoughts, feelings and behaviour that are oriented to attaining goals (Pintrich, 1995; Zimmerman, 2002). Various studies have consistently confirmed a significant correlation between academic performance and self-regulated learning (Chang, 2005; Pintrich & DeGroot, 1990; Pintrich, Smith, Garcia & McKeachie, 1993; Watson *et al.*, 2004). A study by

Bergin, Reilly and Traynor (2005) examining the role of self-regulated learning on introductory programming course performance revealed that students who performed well in programming used more meta-cognitive and resource management strategies than weaker students.

A study by Kosnin (2007) on academic achievement measured by the students' grade point average (GPA) showed that resource management strategies, test anxiety, meta-cognitive learning strategies and self-efficacy were significant predictors of learning achievement. Kosnin investigated further by separating the students into high achievers and low achievers groups. For the high achievers group, the use of resource management strategies and control of learning beliefs were found to be positively influencing GPA. For the low achievers group, the use of meta-cognitive learning strategies and test anxiety were found to be positively influencing GPA.

Hence, measuring students' self-regulated learning capacity can be a good predictor for academic performance and can be used to measure the effectiveness of interventions deployed during students' learning processes. The aim of this study is to investigate the effectiveness and impact of persuasive short messaging service (SMS) on students' self-regulated learning strategies.

## **Background**

### *Student support and intervention programmes*

Interventions such as developmental programmes are commonly introduced during student orientation. The disadvantages of this type of intervention programme are its limited impact and duration. After the orientation, students tend to forget about the skills learned. Programme such as the Āwhina, Manaaki Pihipihinga and the Tuākana (University of Auckland, 2011; VUW, 2011b) offer mentoring support to Māori and Pacific students. These kinds of interventions are commonly found in New Zealand's universities. These programmes have demonstrated their usefulness in creating a more culturally sensitive environment but may require considerable resources.

Massey University piloted an extramural student peer mentoring project in 2008 in response to a high rate of failure and noncompletion among the 1st-year students (Pukepuke & Nash, 2009). Overall, the peer mentoring interventions are reported to have positive outcomes in terms of achievement and retention. However, it was found that such schemes are not only time-consuming and resource-intensive, but require clear goals and a plan of interventions customised for the needs of students. The "Success for all" intervention programmes developed by the University of Auckland intend to improve Māori and Pacific students' success in degree-level studies (Airini *et al.*, 2008). The focus is on nonlecture teaching activities that are useful for Māori and Pacific students. No quantitative data have been provided on achievement or retention so far.

Recently, a pilot intervention programme at Victoria University looked at ways to proactively identify academically at-risk students, collaboratively define the support they require and assist them to develop strategies to achieve a better passing grade (Chong, 2011). It was reported that the outcome of the intervention was rather disappointing even though the targeted at-risk students (core BCA "E" graders) were encouraged by their tutors to set realistic goals. Further, Māori, Pacific and Asian students were found to be overly represented in the at-risk group. It is clear that these interventions and support systems are too resource-intensive. Perhaps other more economical and sustainable strategies such as persuasive SMS reminder messages (Maheshwari, Chatterjee & Drew, 2008; Trappey & Woodside, 2005; Wickramanayake & Schlosser, 2006) that have been found to be useful in health, advertising and education should be explored.

### *Persuasive SMS intervention system*

The SMS intervention system consists of a mobile phone connected to a laptop computer through a USB cable. MyPhone explorer software was used to send and receive SMS text messages. The

software allows students to be grouped according to their timetable. This allows the instructor to customise the SMS messages for different categories of students and to organise messages according to the persuasive technology principles. Similar approach had been adopted by Kim and Keller (2008) with their motivational and volitional email messages (MVEM). They showed that personalised MVEM can have a positive impact on students' motivation and confidence.

Persuasive technology is the adoption of computing technology in an attempt to change attitudes and behaviour (Fogg, 2003). This technology is not limited to the health-care industry or social organisations that frequently use it in their preventive and social marketing campaigns (Prentice-Dunn, Floyd & Flournoy, 2001). In the education sector for example, Revelle, Reardon, Betancourt and Kotler (2007) used mobile phones to deliver educational materials to improve literacy among pre-school children. The project focused on sending persuasive SMS and audio messages with Sesame Street characters to parents so as to assist their children with learning the alphabet. Their study demonstrated that using mobile technology to motivate parents and children to boost literacy levels is an effective way to assist learning. For the present study, the messages sent to students were constructed using the concept of persuasive principles as suggested by Fogg (2003). Fogg identified various persuasive principles that can be used to effect behaviour change. These practical principles were adopted in this study. The *principle of simplification* focuses on reducing a complex task to a simpler task by removing steps in the process. In this study, we used txt terminology and the English language to communicate important notices like assignment due dates to students. Txt terminology is easier for students to read, comprehend and respond to. In addition, these messages reduce the need for students to login to their Blackboard account and navigate through various notices and folders in order to retrieve the right information. This is because SMS messages are stored in their mobile phone, which is readily available, thus making complex information retrieval tasks simple. Fogg (2003) asserts that this principle makes an action easier to perform and increases the benefit of the behaviour.

The *principle of tailoring or personalisation* looks at using relevant personalised information as part of the intervention message to individuals for modifying behaviour and attitudes. The SMS sent to students were tailored to students. The messages reminded them about the specific times and rooms for tutorials, lectures and workshop sessions. The SMS were also tailored to influence Māori students using proverbs in te Reo and motivational messages in English, and a mix of the two was used for other participants.

The concept of *persuasion through personalisation* creates the perception that information has been tailored to suit them. It can be applied to motivational messages that are time- and situation-sensitive to encourage students to turn in their assignment a few hours before the due date. When individuals think that messages have been personalised for them, they tend to pay more attention. Fogg (2003) asserts that timing is essential in order for persuasive technologies to be effective.

The *principle of suggestion* proposes that interventions should be performed at the most opportune moments, ie, when people have the ability and motivation to respond (Ferebee, 2010). In other words, people are more inclined to be persuaded if a suggestion is made at the right time. In this study, sending a persuasive SMS reminder to review a chapter or a case study in the morning before a student's tutorial is more likely to encourage the student to review the material than if the reminder was sent only to remind him/her to attend the tutorial.

The *principle of conditioning* uses praise or positive reinforcement to change or influence behaviour. In this study, this principle was followed by sending out simple encouraging messages like "ka pai/good work! You have reached week five of the term." This encouraged the students to go on with the course as they felt that they received personal praise for continued attendance. Fogg (2003) asserts that the gentler the intervention used to obtain the desired behaviour, the better the outcome in the long term.

The *principle of tunnelling* is the use of a sequence of tasks, one at a time, to ensure completion. This means guiding users through a series of actions, giving opportunities to achieve goals along the way. This principle is used in constructing periodic SMS messages for students to encourage them to adequately prepare for their assignments and hand them in on time. All the previously mentioned principles were used in this study, some sample messages are depicted in Appendix A.

#### *Motivated strategies for learning questionnaires*

Motivated strategies for learning questionnaires (MSLQ) has been used extensively to measure the impact on students' beliefs in different teaching environments and contexts. Chang's (2005) study on self-regulated learning strategies in web-based instruction revealed that students became more responsible for their own learning, more intrinsic goal-oriented and more challengeable. They tended to value the learning content more and became more confident in content understanding and class performance. In a study of foreign-language learning, Huang (2008) suggested that there is little difference between second language learning and other subjects in the school environment, and the MSLQ is capable of measuring second language related studies. In a study by Sungur and Tekkaya (2006) on the use of problem-based learning (PBL) strategies, students showed higher levels of intrinsic goal orientation, task value, use of elaboration learning strategies, critical thinking, meta-cognitive self-regulation, effort regulation and peer learning compared with normal non-PBL students. Recently, Aarsal (2010) studied the effect of diaries on the self-regulation strategies of pre-service science teachers. The study revealed that intrinsic motivation, task value, meta-cognition, self-efficacy, elaboration, effort regulation and time-management strategies of the experimental group were significantly higher than those of the control group. These recent examples clearly support the use of MSLQ as an instrument for measuring impact on students' learning strategies as it can be applied to different learning situations, such as the current SMS intervention used in this study.

## **Methodology**

### *Research questions*

In the education sector, SMS technology has been deployed to provide "mobile scaffolding" to support and guide students towards independent self-management (Stone, 2004). Generally, SMS learning support has been found to be useful and enjoyable for students (Cavus & Ibrahim, 2009; Chen, Hsieh & Kinshuk, 2008). However, most researchers have not identified how SMS support actually influences learning. Therefore, the purpose of this study is to identify the effectiveness and impact of a persuasive SMS intervention on students' self-regulated learning in an information systems course. Specifically, this study investigates the following three questions:

1. What are the impacts on self-regulated learning of attending a 1st-year information systems course (over a trimester of 12 weeks) without an SMS intervention?
2. What are the impacts on self-regulated learning of attending a 1st-year information systems course (over a trimester of 12 weeks) when an SMS intervention is introduced?
3. What are the impacts on Māori and Pacific students' self-regulated learning of attending a 1st-year information systems course (over a trimester of 12 weeks) when an SMS intervention is introduced?

### *Participants and course*

The participants in the study were recruited from an introductory course. The course used in the study is INFO 101. The course has three modules and each module is taught by a different instructor. The course assessment requirements include six tutorial submissions, completion of eight workshops, tutorial participation, a web assignment and a web design test, a database assignment, and a database design test. In the final examination, students are required to attain a mark of at least 40%. Participation was voluntary and after the pre-survey the participants

were separated into a control group and an experiment group. Historically, Māori and Pacific students have not performed as well as the main cohort in INFO 101. Therefore, all Māori and Pacific students were included in the experiment group to ensure sufficient data while the remaining participants were split into control or experiment group randomly. A total of 92 students participated in the initial study, but only 57 students managed to complete both the pre-survey and the post-survey. As a result, 25 students remain in the control group while 32 students remain in the experiment group after the post-survey. Only the experiment group received SMS reminder texts with persuasive and encouraging phrases. The number of messages sent during a week and the expected MSLQ outcomes for each message is depicted in Appendix A.

### *Instrument and procedure*

The SMS reminders mainly encouraged students to attend lectures, tutorials and workshops, as well as to complete assignments. The experiment was conducted for 9 weeks, from week 3 to week 11. A pre-survey was conducted at the beginning of the experiment and a post-survey was conducted in week 12. Both surveys used the full original MSLQ as the measuring instrument. Full MSLQ was used, as the impact due to intervention and different learning environment can influence other self-regulated components (Arsal, 2010; Sungur & Tekkaya, 2006). The MSLQ has undergone three major psychometric developments. The total reliability of the Motivation Scales was found to be 0.79 and the total reliability for the Learning Strategy Scales was found to be 0.89, thus confirming good internal consistency (Pintrich *et al*, 1993). MSLQ can be organised into 15 sub-scales. The motivation scales include Value, Expectancy and Affective components. The subscales are Intrinsic Goal Orientation (IGO), Extrinsic Goal Orientation (EGO), Task Value (TV), Control of Learning Beliefs (CLB), Self-Efficacy for Learning and Performance (SELP) and Test Anxiety (TA). The learning strategies scales include Cognitive strategies, Meta-cognitive strategies and Resource management. The subscales are Rehearsal (RH), Elaboration (EL), Organisation (OR), Critical Thinking (CT), Meta-cognitive Self-Regulation (MSR), Time and Study Environment Management (TSEM), Effort Regulation (ER), Peer Learning (PL) and Help Seeking (HS). MSLQ consists of motivation and learning strategy components (Duncan & McKeachie, 2005). The motivation components comprise 31 items that measure the students' goals for and value beliefs about a course, as well as their beliefs about their ability to succeed in a course. The learning strategy components also consist of 31 items measuring the students' use of different cognitive and meta-cognitive strategies, and 19 items measuring student's skill in resource management. In total MSLQ consists of 81 items. These items are scored on a 7-point Likert scale from 1 (*not at all true of me*) to 7 (*very true of me*).

## **Findings and discussion**

### *Demographics*

Both the pre-survey and post-survey used the MSLQ instrument. The demographic distribution of the participants is shown in Table 1. The control group has 19 females (76%) and 6 males (24%), while the experimental group has 18 males (56.2%) and 14 females (43.7%). The majority of the students were 1st- and 2nd-year students aged between 16 and 25 years old. These are mainly students who have just graduated from high school and have limited university learning experience.

### *MSLQ impact evaluation*

Impacts on students' self-regulated learning without SMS intervention

In this research, we asked the question: *what are the impacts on students' self-regulated learning without an SMS intervention?* A series of *t*-tests and a General Linear Modelling analysis of covariance method adjusted for the pre-survey score were performed to evaluate any significant difference in self-regulated learning components between the control and experiment groups. The

Table 1: Participant demographics

	Control	%	Experiment	%
Male	6	24.0	18	56.3
Female	19	76.0	14	43.7
Total	25	100	32	100
Age				
16–20	20	80.0	22	68.8
21–25	5	20.0	9	28.1
>40	0	0.0	1	3.1
University				
1st year	15	60.0	24	75
2nd year	7	28.0	7	21.9
3rd year	1	4.0	1	3.1
4th year	2	8.0	0	0.0
Ethnicity				
1: Māori	0	0.0	11	34.4
2: New Zealand/Pakeha	23	92.0	9	28.1
3: Pacific islanders	0	0.0	5	15.6
4: Asian	2	8.0	5	15.6
5: Indian	0	0.0	2	6.3

Table 2: Comparing the control and experiment groups' pre course experience on MSLQ

QID	Items	Sub-scale	Scale	Pre		Pre		SIG
				Control n = 25		Experiment n = 32		
				M	SD	M	SD	
29	I expect to do well in this class.	SELP	Expectancy	4.96	1.098	5.66	1.096	0.021
40	When I study the readings for this course, I outline the material to help me organize my thoughts.	OR	Cognitive strategies	4.13	1.424	5.03	1.596	0.032
49	When I become confused about something I'm reading for this class, I go back and try to figure it out.	MSR	Meta-cognitive	5.00	1.414	5.70	1.055	0.042

results show that there were significant differences ( $p < .05$ ) initially from 3 out of 81 items as shown in Table 2. The mean scores indicate that the experiment group has a slightly higher score in these items. These items are from the sub-scales of SELP, OR and MSR. When compared within the control group, the results reveal that two items and one sub-scale from the resource management were significantly different ( $p < .05$ ). Table 3 shows the  $t$ -test on the control group between the pre- and post-course experience. The score for ER and TSEM were significantly degraded. One would expect that without the intervention, the majority of the 1st-year students will find it challenging to manage their time and effort in learning. During the learning process, 1st-year students can easily “lose” control over their management of time. Previous research has indicated that TSEM is an important factor that high achievers possess; hence, deficiency in such an important scale means the control group is likely to underperform.

Table 3: Comparing control group pre and post course experience on MSLQ

				Pre		Post		
				Control n = 25		Control n = 25		
		Sub-scale	Scale	M	SD	M	SD	SIG
	Overall impact on sub-scale	TSEM	Resource management	4.84	0.875	4.30	0.759	0.025
QID 45	Specific items I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do.	ER	Resource management	3.75	1.260	4.56	1.417	0.040
81	I attend this class regularly.	TSEM	Resource management	6.71	0.550	5.28	1.696	0.000

Table 4: Comparing experiment group pre and post course experience on MSLQ

				Pre		Post		
				Experiment n = 32		Experiment n = 32		
QID	Specific items	Sub-scale	Scale	M	SD	M	SD	SIG
41	During class time I often miss important points because I'm thinking of other things.	MSR	Meta-cognitive	4.16	1.568	4.94	1.544	0.049
68	When course work is difficult, I either give up or only study the easy parts.	ER	Resource management	2.84	1.483	3.94	1.966	0.015
81	I attend this class regularly.	TSEM	Resource management	6.75	0.672	6.06	1.722	0.039

Impacts on students' self-regulated learning with SMS intervention

The second research question is what are the impacts on students' self-regulated learning in a 1st-year information systems course over a trimester of 12 weeks when an SMS intervention is introduced? By introducing a persuasive SMS reminder service, we compared the responses to MSLQ. Table 4 shows the *t*-test on the experiment group between the pre- and post-course experiences. Interestingly, Table 4 indicates that only three items from the experiment group were significant ( $p < .05$ ). These items are from the ER, MSR and TSEM sub-scales. However, when compared with the control group post MSLQ, five items from the sub-scales of TV, EGO, ER, MSR and TSEM were found to be significant difference with positive gain except ER ( $p < .05$ ) (see Table 5). The overall impact on sub-scale TSEM had been lowered in the control group but not in the experiment group (see Tables 3 & 4). Though Table 5 did not show any difference between the control and experiment group on the entire TSEM sub-scale, the intervention introduced to the experiment group is likely to have a positive effect on the group's TSEM but yet to reach the



Table 5: Comparing the control and experiment groups' post course experience on MSLQ

QID	Sub-scale	Scale	Post		SIG		
			Control n = 25			Experiment n = 32	
			M	SD		M	SD
12	TV	Value	4.67	1.373	5.43	0.923	0.020
15	TV	Value	4.56	1.530	5.71	1.189	0.003
68	EGO	Value	4.72	1.768	5.87	1.258	0.010
73	ER	Resource management	3.17	1.465	3.94	1.966	0.013
86	TSEM	Resource management	4.54	1.560	5.31	1.674	0.034
	MSR	Meta-cognitive	3.96	1.645	4.91	1.510	0.037

significance level of .05. From Table 5, the SMS intervention showed a significant positive impact on the TV sub-scale. This finding is similar to that of Arsal (2010), where the use of diaries improved the task value for the experiment group but not in the control group. It is possible that this improvement is triggered by the improvement in the experiment group's resource management components.

#### Impacts on Māori and Pacific students' self-regulated learning strategies when an SMS intervention is introduced

The impact of the intervention on Māori and Pacific students was examined. In particular we investigated: what are the impacts on Māori and Pacific students' self-regulated learning of attending a 1st-year information systems course over a trimester of 12 weeks when an SMS intervention is introduced? Four items on the Expectancy scale, and one item each on the Meta-cognitive, Cognitive strategies and Resource management scales were significantly ( $p < .05$ ) different from the control group initially as shown in Table 6. The higher expectancy scores suggest that Māori and Pacific students perceived themselves to have considerable ability and confidence in the skills they need in order to accomplish tasks compared to the control group, and they seem to organise their thoughts better and were more able to stick to a study schedule. They have high expectations for themselves.

After one trimester of learning and periodic interventions through SMS, the experiment group showed some impact on their self-regulated learning strategies as shown in Table 7. Notably, one item each from Rehearsal (RH) and Critical Thinking (CT) have improved. Over the trimester, the experiment group has improved on their scores in Cognitive strategies. They also appreciate different ideas of the course more. It is likely that there were more effects on the self-regulated learning strategies due to the interventions, but they may not have been strong enough to show significant difference within the experiment sub-group.

However, when compared to the control group, the post-intervention learning experience of the experiment sub-group showed stronger and substantial improvement in Value, Expectancy, Cognitive strategies, Resource management and Meta-cognitive strategies, as shown in Table 8. Nine items within these scales have significant higher scores than those of the control group. It is more likely that the periodic interventions have developed a positive time management mindset in the learners and a greater desire for value and expectancy components and these in turn increased their needs for cognitive and meta-cognitive strategies in order to fulfil their value components. Without the intervention, the control group may have made slight changes in some of these components, but it was not substantial enough to show significant differences within the control group.

For the Māori and Pacific students sub-group, the use of cognitive strategies such as RH and EL was more prevalent. The use of effective resource management such as peer learning and help seeking was rather limited and not significant, while the use of value components was greater. Similar findings were also reported by Arsal (2010).

#### *Learning performance evaluation*

##### SMS and non-SMS group

To compare grade performance, letter grades were translated to numerical values using the mid-point value for each letter grade. The range between two mid-points is five points. We compare students who received SMS intervention and students who did not receive SMS intervention for the entire cohort. The cohort consists of 1199 students in which 142 are Māori and Pacific students. *t*-test analysis shows that the students who received SMS intervention outperformed those students who did not receive SMS. The difference is significant at the .05 level ( $t(33.938) = 2.657$   $p = .012$ ; Mean SMS = 70.66,  $SD = 16.628$ ; Mean non-SMS = 62.67,

Table 6: Comparing control and experiment Māori and Pacific students sub-groups' pre-course experience on MSLQ

QID	Sub-scale	Scale	Pre					
			Control n = 25		Experiment n = 16			
			M	SD	M	SD	SIG	
	Overall impact on sub-scale	SELP	Expectancy	4.82	0.896	5.50	0.867	0.022
26	Specific items If I try hard enough then I will understand the course material.	CLB	Expectancy	5.87	0.757	6.44	0.814	0.032
28	I'm confident I can do an excellent job on the assignments and tests in this course.	SELP	Expectancy	4.76	1.012	5.56	1.031	0.018
29	I expect to do well in this class.	SELP	Expectancy	4.96	1.098	6.00	1.033	0.004
37	I'm certain I can master the skills being taught in this class.	SELP	Expectancy	4.92	1.100	5.81	0.981	0.012
40	When I study the readings for this course, I outline the material to help me organize my thoughts.	OR	Cognitive strategies	4.13	1.424	5.13	1.500	0.040
49	When I become confused about something I'm reading for this class, I go back and try to figure it out.	MSR	Meta-cognitive	5.00	1.414	5.98	0.998	0.027

Table 7: Comparing experiment Māori and Pacific students sub-group pre and post course experience on MSLQ

QID	Specific items	Sub-scale	Scale	Pre		Post		SIG
				Experiment n = 16		Experiment n = 16		
				M	SD	M	SD	
74	I try to play around with ideas of my own related to what I am learning in this course.	CT	Cognitive Strategies	3.94	1.692	5.19	1.424	0.031
80	I make lists of important items for this course and memorize the lists.	RH	Cognitive Strategies	3.75	1.000	4.88	1.628	0.025

$SD = 21.617$ ). For the control group, there was a strong correlation between *Resource management* and final course grade ( $r = .551$ ,  $n = 25$ ,  $p = .006$ ) as shown in Table 9. Resource management is mainly due to *Peer learning* and *Help seeking*. For the experiment group, we were not able to identify components significantly correlated with final grade performance.

#### Māori and Pacific students' group

Historically, Māori and Pacific students have not performed as well as the main cohort in INFO 101. We compare the mean final grade score of Māori and Pacific students (non-SMS group) and the remaining cohort (non-SMS and non-Māori and Pacific students). The mean final grade score for Māori and Pacific students is significantly lower than the main cohort ( $t(1165) = -3.764$ ,  $p = .000$ ; Cohort Mean = 63.48,  $SD = 21.623$ ; Māori and Pacific Mean = 55.80,  $SD = 20.39$ ). However, when we compare the Māori and Pacific students who received SMS intervention with the main cohort who received no intervention, the mean final grade scores for the Māori and Pacific students were higher than those of the main cohort and significant at the .05 level ( $t(19.042) = 2.288$ ,  $p = .034$ ; Cohort Mean = 62.67,  $SD = 21.617$ ; Māori and Pacific Mean = 68.83,  $SD = 11.11$ ). This shows an improvement. Thus, the interventions strengthened various aspects of the self-regulated learning strategies of the Māori and Pacific students and elevated their grade performance to a level higher than the main cohort.

We further compare Māori and Pacific students who received SMS with Māori and Pacific students who did not receive SMS intervention. The result showed that Māori and Pacific students who received SMS intervention achieved significantly higher scores than Māori and Pacific students who did not receive SMS intervention ( $t(36.482) = 4.079$ ,  $p = .000$ ; SMS Mean = 68.83,  $SD = 11.11$ ; Non SMS Mean = 55.80,  $SD = 20.39$ ). While the impact of the intervention has been shown to be positive and desirable, it is the change of attitude and regulated learning strategies that are most important.

For the experiment sub-group, we were not able to identify components significantly correlated with final grade performance. It is also possible that the experiment group contains different student profiles utilising multiple strategies to attain good performance (Kosnin, 2007).

#### Reflection on research

The persuasive SMS messages are a viable and effective approach for maintaining, improving and enhancing students' self-regulation strategies. Moreover, practitioners can complement this approach with other motivational interventions to enhance students' learning experiences, especially for 1st-year courses and students. The SMS intervention is not only easy to implement, it is also very responsive. It can provide a more immediate response than email. Moreover,

Table 8: Comparing control and experiment Māori and Pacific students sub-groups' post course experience on MSLO

QID	Sub-scale	Scale	Post		Post (sub-group)			
			Control n = 25		Experiment n = 16			
			M	SD	M	SD	SIG	
	Overall impact on sub-scale	TV RH EL	Value Cognitive Cognitive	4.67 4.29 4.92	1.373 0.809 0.684	5.45 5.03 5.40	0.891 1.247 0.774	0.018 0.042 0.049
	Specific items	CLB	Expectancy	6.08	0.759	6.63	0.619	0.023
10	If I study in appropriate ways, then I will be able to learn the material in this course.	TV	Value	4.56	1.530	5.69	1.138	0.010
12	I think I will be able to use what I learn in this course in other courses.	TV	Value	5.76	1.451	6.31	0.602	0.045
18	It is important for me to learn the course material in this class.	SELP	Expectancy	4.40	1.633	5.31	0.946	0.042
23	I'm confident I can understand the most complex material presented by the instructor in this course.	CLB	Expectancy	5.72	0.792	6.50	0.632	0.005
26	If I try hard enough then I will understand the course material.	OR	Cognitive	3.76	1.855	4.81	1.834	0.044
57	I make simple charts, diagrams, or tables to help me organize course material.	TSEM RH	Resource management Cognitive	4.60 3.64	1.555 1.469	5.56 4.88	1.672 1.628	0.036 0.015
73	I have a regular place set aside for studying.	MSR	Meta-cognitive	3.96	1.645	5.19	1.377	0.020
80	I make lists of important items for this course and memorize the lists.							
86	When I study for this class, I set goals for myself in order to direct my activities in each study period.							

Table 9: Control group and experiment groups' MSLQ sub-scale correlate with performance

	Scale	Correlation	Significant
Control	Resource management	.551	.006
	PL		
	HS		
Experiment	None		
Māori and Pacific	None		

mobile phone SMS messaging is already a widely adopted communication channel for students. As the research has demonstrated, MSLQ is rather dynamic in nature. The dynamic nature of the items within MSLQ could possibly explain various inconsistencies, negative correlations or poor explanation power when correlated with academic performance (Chen, 2002; Kosnin, 2007). Therefore, we suggest practitioners who intend to implement an intervention system using MSLQ should perform multiple surveys at different time interval to obtain more reliable data and derive methods to determine factors that can predict academic performance more consistently.

One of the main difficulties we faced during the course of the experiment was to get sufficient participation from Māori and Pacific students. This has limited our sample size, which will otherwise allow stronger generalisation. It seems that Māori and Pacific students were less enthusiastic in seeking assistance from support such as the SMS intervention. A similar observation was made by Chong (2011) in his report, which revealed that although learning support for Māori and Pacific students are available and well advertised, at-risk Māori and Pacific students frequently cited "not knowing where to get help" as the main reason for their failure. One option we will consider in the future is to make participation in the MSLQ survey a course requirement, as voluntary participation may have bias towards students who are already motivated towards learning. We tend to believe that SMS intervention is most suitable for 1st-year students who just graduated from high school because their time management and self-regulated learning skills may not be as mature as those of the senior students.

The experiment has demonstrated the positive impact of SMS intervention on self-regulated learning strategies and achievement. It would be better if we were able to identify which dimensions of self-regulated learning strategies actually influence achievement. This would allow more specific interventions to be used in a more efficient way. Unfortunately we were not able to identify those specific dimensions. Another difficulty in the experiment was that we were not able to eliminate other influencing factors such as the number of courses each participant took during the experiment. This factor is important as it directly influences the resource management of each individual and potentially affects overall achievement.

### Conclusions and recommendations

This study has demonstrated the usefulness and effectiveness of a simple SMS intervention in engaging and stimulating students' self-regulated learning. Improvement in self-regulated learning is shown to be positively correlated to higher academic performance. This research explores the use of SMS technology as a persuasive tool to improve engagement and participation amongst undergraduate students at Victoria University. This study uses Fogg's persuasive principles as an underpinning conceptual framework. The study demonstrated the capability of an SMS intervention for stimulating students' self-regulated learning through better time management and improved extrinsic and intrinsic goals, cognitive and meta-cognitive strategies and values. The

impacts on students' academic achievement were very encouraging with significant improvement in final course grades. Unlike other intervention programmes targeted at Māori and Pacific students, we used a validated and theory-grounded instrument to measure the learning strategies' outcomes. Unlike other intervention programmes, the SMS intervention is able to demonstrate the dynamic nature of students' learning strategies and motivation reflected by MSLQ responses and the potential strategies for modifying students' self-regulated learning capacity.

We recommend a few areas for practitioners to consider when implementing such a system. Firstly, practitioners should consider the impact on other courses when SMS intervention is applied to a specific course to ascertain that the benefits gained from one course did not compromise other courses. Likewise, practitioners should ascertain whether such interventions are more effective for students with a specific learning problem. Next, with the increasing use of social media such as Facebook and Twitter, practitioners should consider using these tools as a form of intervention similar to SMS intervention and apply MSLQ to measure the impact. Lastly, from a culturally responsive perspective, practitioners can enlist parents to send SMS messages.

### Acknowledgements

This research was supported by Ako Aotearoa New Zealand's National Centre for Tertiary Teaching Excellence and also in collaboration with the National Science Council, Taiwan, under the contract numbers: NSC99-2511-S-110-004-MY3, NSC100-2911-I-110-503 and NSC99-2631-S-011-002.

### References

- Airini, Rakena, T. O., Curtis, E. T., Sua-Huirua, T., Townsend, S. & Savage, T. *et al.* (2008). *Success for all: improving Māori and Pasifika student success in degree-level studies*. Paper presented at the New Zealand Association for Research in Education conference, Palmerston North.
- Arsal, Z. (2010). The effects of diaries on self-regulation strategies of preservice science teachers. *International Journal of Environment Science Education*, 5, 1, 85–103.
- Bergin, S., Reilly, R. & Traynor, D. (2005). Examining the role of self-regulated learning on introductory programming performance. In *Proceedings of the First international Workshop on Computing Education Research* (Seattle, WA, USA, October 01–02, 2005). ICER '05. ACM, New York, 81–86.
- Cavus, N. & Ibrahim, D. (2009). M-Learning: an experiment in using SMS to support learning new English language words. *British Journal of Educational Technology*, 40, 1, 78–91.
- Chang, M.-M. (2005). Applying self-regulated learning strategies in a web-based instruction—an investigation of motivation perception. *Computer Assisted Language Learning*, 18, 3, 217–230.
- Chen, C. S. (2002). Self-regulated learning strategies and achievement in an introduction to information systems course. *Information Technology, Learning, and Performance Journal*, 20, 1, 11–25.
- Chen, N. S., Hsieh, S. W. & Kinshuk (2008). Effects of short-term memory and content representation type on mobile language learning. *Language Learning & Technology*, 12, 3, 93–113.
- Chong, E. (2011). *Supporting academically at risk students: a proactive approach*. Retrieved April 5, 2011, from <http://www.utdc.vuw.ac.nz/resources/landtfund/2010/reports/Chong.pdf>
- Duncan, T. G. & McKeachie, W. J. (2005). The making of the motivated strategies for learning questionnaire. *Educational Psychologist*, 40, 117–128.
- Ferebee, S. (2010). Successful persuasive technology for behavior reduction: mapping to Fogg's gray behavior grid. In T. Ploug, P. Hasle & H. Oinas-Kukkonen (Eds.), *Persuasive technology—lecture notes in computer science*, Vol 6137 (pp. 70–81). Berlin: Springer.
- Fogg, B. J. (2003). *Persuasive technology. Using computers to change what we think and do*. New York: Morgan Kaufmann Publishers.
- Huang, S. (2008). Assessing motivation and learning strategies using the motivated strategies for learning questionnaire in a foreign language learning context. *Social Behavior and Personality*, 36, 4, 529–534.
- Kim, C. & Keller, J. M. (2008). Effects of motivational and volitional email messages (MVEM) with personal messages on undergraduate students' motivation, study habits and achievement. *British Journal of Educational Technology*, 39, 1, 36–51.

- Kosnin, A. M. (2007). Self-regulated learning and academic achievement in Malaysian undergraduates. *International Education Journal*, 8, 1, 221–228.
- Maheshwari, M., Chatterjee, S. & Drew, D. (2008). Exploring the persuasiveness of “just-in-time” motivational messages for obesity management. In H. Oinas-Kukkonen, P. F. V. Hasle, M. Harjumaa, K. Segerståhl & P. Øhrstrøm (Eds), *Persuasive, lecture notes in computer science*, Vol 5033 (pp. 258–261). Berlin: Springer.
- Pintrich, P. R. (1995). Understanding self-regulated learning. *New Directions for Teaching and Learning*, 1995, 63, 3–12.
- Pintrich, P. R. & DeGroot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, 82, 1, 33–40.
- Pintrich, P. R., Smith, D. A. E., Garcia, T. & McKeachie, W. J. (1993). Reliability and predictive validity of the motivated strategies for learning questionnaire (MSLQ). *Educational and Psychological Measurement*, 53, 801–813.
- Prentice-Dunn, S., Floyd, D. L. & Flournoy, J. M. (2001). Effects of persuasive message order on coping with breast cancer information. *Health Education Research*, 16, 1, 81–84.
- Pukepuke, T. & Nash, S. (2009). *Peer mentoring of at-distance students: a resource for tertiary institutions*. Retrieved April 5, 2011, from <http://akoaootea.ac.nz/ako-hub/ako-aotea-central-hub/resources/pages/peer-mentoring-distance-students-resource-tertiary-0>
- Revelle, G., Reardon, E. G., Betancourt, M. M. & Kotler, J. (2007). The use of mobile phones to support children's literacy learning. *Lecture Notes in Computer Science*, 4744, 253–258.
- Stone, A. (2004). Mobile scaffolding: an experiment in using SMS text messaging to support first year university students. In Proceedings of the *IEEE International Conference on Advanced Learning Technologies, IEEE, Joensuu, Finland, 2004*, 405–409.
- Sungur, S. & Tekkaya, C. (2006). Effects of problem-based learning and traditional instruction on self regulated learning. *The Journal of Educational Research*, 99, 307–317.
- TEC (2010). *Educational performance at individual tertiary providers*. Retrieved September 20, 2011, from <http://www.tec.govt.nz/Reports/2009/Victoria-University-of-Wellington.pdf>
- Trappey, III, R. J. & Woodside, A. G. (2005). Consumer responses to interactive advertising campaign coupling short-message-service direct marketing and TV commercials. *Journal of Advertising Research*, 45, 4, 382–401.
- University of Auckland (2011). *Tuākana*. Retrieved April 5, 2011, from <http://www.auckland.ac.nz/uoaeo-tuakana>
- VUW (Victoria University of Wellington) (2011a). *Manaaki Pihipihinga Māori & Pacific students mentoring programme*. Retrieved September 20, 2011, from <http://www.victoria.ac.nz/tpa/>
- VUW (Victoria University of Wellington) (2011b). *Te Rōpū Awhina*. Retrieved April 5, 2011, from <http://www.victoria.ac.nz/science/awhina/>
- Watson, M., McSorley, M., Foxcroft, C. & Watson, A. (2004). Exploring the motivation orientation and learning strategies of first year university learners. *Tertiary Education and Management*, 10, 3, 193–207.
- Wickramanayake, D. & Schlosser, C. (2006). A comparison of group and individualized motivational messages sent by SMS and e-mail to improve student achievement. *Special Issue of the International Journal of the Computer, the Internet and Management*, 14, SP1, 29.1–29.8.
- Zimmerman, B. J. (2002). Becoming a self-regulated learner: an overview. *Theory into Practice*, 41, 2, 64–70.



**Appendix A**

<i>Message</i>	<i>Weekly number of SMS</i>	<i>Expected MSLQ outcome</i>
Text: kia ora, this is going 2 b a tough wk bt u can make it there! Begin ur 101 Access assignment do not delay. Tink not of d labour rather reflct on d completN.	2	Value, Expectancy, Resource Management
Text: B-) Do you know these Terms: TCP/IP, Domain Name, Client-Server, DSL, IPV6, DNS, DHCP, VoIP You will find ur answers in today's 101 lecture. TUT3 due Sunday.	2	Expectancy, Meta-cognitive, Resource Management
Text: Kia Ora Hope u have a gd break. INFO101 lectures cover "Sys Development". You shd check up WS5 it may be something new for u. "Ka whati te tai ka pao te torea".	2	Meta-cognitive, Resource Management
Text: Kia Ora, 25 Days till 101Access Assig Due D gr8 dividing line btwen success and failure can be expressed in five words; "I did not have time." ~ Franklin F.	3	Value, Expectancy, Resource Management
Text: Kia ora, reminder for info101, memba u have ur tutes this week, submission 2 is due, dont 4get 2 read case study "racing board" keep up the good work! ka kite	2	Value, Cognitive strategies, Meta-cognitive, Resource management
Text: Kia Ora Kotou, no tutorials this week, member 2 attend all lectures & workshops so ur on top of access and this week topic. Keep up the good work! Po marie:-)	2	Value, Resource management
Text: "In d PAST, nobody had a watch but evryone had time. Now evryone has a watch but NOBODY has time." ~Go for ur 101 lecture 2day and submit TuT5 by sunday~	2	Value, Expectancy, Resource management, Cognitive strategies
Text: Kia ora Don't forget to prepare for INFO101 HTML Practical Test next week and submit your CyberCV by sunday. Is not too late to start working on it.:-]	2	Value, Affective, Cognitive strategies, Resource management
Text: kia ora katoa! best of luck for your info101 final exam! All the best and thank-you for being apart of this research. Aroha mai God bless, Po marie. :-)	1	Value, Affective, Resource management