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Pre-service Teachers' Motivation in Using Digital Technology

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Abstract: Digital technology (DT) has a significant role to play in modern education. This study examined motivational goals of student teachers in initial teacher education in Singapore and the influences of goals on their use of DT personally and in the classroom. The participants (N=312) responded to a survey about their motivational goals (learning vs. performance) and DT application (personal vs. classroom application). Results showed that personal use of DT, especially for younger teachers, was clearly more than classroom application. Females were found to have higher performance goal. Structural equation modelling found that learning goals were positively related to both personal use and classroom application, but performance goals were not positively related to either outcome. As performance goals were found to be unrelated to classroom application of DT, teacher education should focus more on the development of learning goals so as to encourage teachers, especially females, to use DT for teaching.

In educational settings, digital technology (DT) has attracted tremendous attention. Its significant role in modern education has been emphasized in many policy documents worldwide (e.g., Department of Education USA, 2010; Ministry of Education New Zealand, 2006-07; Ministry of Education Singapore, 2008). The ability to effectively use DT has become a basic requirement for pre-service teachers in teacher education programs in most countries including Australia (Moran, Vozzo, Reid, Pietsch, & Hatton, 2013) and Singapore (Yeung, Taylor, Hui, Lam-Chiang, & Low, 2012), for example. DT in education refers to various digital software and hardware that can be applied in the learning and teaching processes. This term is broader than other terms such as information and communication technology (ICT) because of its wider coverage of various kinds of technologies with digital functions (Lee & Winzenried, 2009; Davidson & Goldberg, 2009). As such, DT includes a variety of media that teachers could employ to optimize pedagogical effects. In school settings, the most often used digital media include: computers and computer-related media such as computer games, e-books, scanners, online chats and social networks, digital cameras, etc., and other technologies such as audio and video recorders (Annetta, 2008; Roland, 2010). For many teachers, apart from classroom applications, digital technology (e.g. calculators, smart phones, global position systems (GPS)) is also widely used in their personal daily life. Similar to classroom applications,

personal use of DT is likely to be influenced by different motivational factors. Investigating the differential effects of such motivational factors would be helpful in informing teacher education practices in terms of strengthening teachers' technological competence in teaching in purposeful and effective ways. In addition, it would also be interesting to examine the relation between teachers' personal use of DT and their classroom applications. Although previous research has suggested a positive correlation between the two factors (e.g., Mumtaz, 2000; Rakes et al., 1999, 2006), this relation has not been tested in a Singaporean context.

Digital Technology in Singapore

Singapore is one of the countries that strives continually to integrate DT into the curriculum, pedagogy, and assessment to help students develop the necessary competencies to succeed in the 21st century. To fulfil such a goal, Singapore employs an integrative approach that involves the Ministry of Education (MOE), National Institute of Education (NIE), which is the sole provider of initial teacher education, and schools. The role of MOE is to develop nationwide policies and initiatives to drive the use of ICT in education. This is well represented by the three *ICT Masterplans* introduced in 1997, 2003, and 2009 respectively. The *First Masterplan* (1997-2002) aimed to provide the basic ICT infrastructure and to equip teachers with the basic skills in teaching. It focuses on establishing a strong foundation for teachers and schools to harness ICT. Building on the foundation, the *Second Masterplan* (2003-2008) was introduced to improve the effectiveness and pervasiveness of ICT use in education. Most recently, the *Third Masterplan* (2009-2014) continues "to enrich and transform the learning environments of our students and equip them with the critical competencies and dispositions to succeed in a knowledge economy" (MOE, 2008). Significant advancements of ICT integration in education have been achieved since the introduction of the *First Masterplan*. For example, according to the *Global competitiveness report 2001-2002* from the World Economic Forum (Schwab *et al*., 2002), Singapore was ranked 2nd among 75 countries in the world in terms of availability of internet access in schools. For teachers, extensive teacher training on the use of DT in teaching has been provided to every teacher in every school to upgrade their ICT skills (MOE, 2008).

Researchers in Singapore have also emphasised DT integration in education and the indispensable role that teacher education plays. As argued by Teo (2010), the groundwork of ensuring teacher's use of DT in school should be laid at initial teacher education (ITE). ITE in Singapore is implemented via the NIE. The program aligns its curriculum design with MOE policies and is continually adjusted to meet the changing needs of student teachers. student teachers are encouraged to use DT throughout ITE in various ways: (1) taking compulsory courses on pedagogical application of DT, which integrates technological knowledge, pedagogical knowledge, and content knowledge; (2) using e-learning portals for course information, administration, and online discussions; (3) role modelling by teacher educators; (4) using computers for assessment purposes; and (5) asking each student teacher to maintain an e-portfolio that documents his/her entire learning and achievement over time (Chai, Koh, & Tsai, 2010; NIE, 2009; Teo, Lee, & Chai, 2008).

A good example to illustrate Singapore's integrative approach on DT use in education is the redesign of classrooms and practices. For the purpose of holistic education, new design norms for classrooms are employed in schools as well as teacher education

programs. MOE provides schools with a rich array of facilities and technologies that facilitate the creation of learning environments that can support collaborative learning and independent learning (MOE, 2010). Correspondingly, NIE has revamped its teaching facilities and encourages the "application of a wider repertoire of pedagogical approaches" (NIE, 2009, p. 89) to simulate various classroom environments in schools. To facilitate sharing of good practices, MOE has also recognised some schools as Futureschools@ Singapore and LEAD ICT@schools, where ICT has been successfully integrated into the classroom to transform teaching and learning (MOE, 2008).

However, the task of DT integration in teaching is immensely challenging because of the constantly changing nature of DT as well as other individual and contextual factors that affect DT usage (Hammond et al., 2009; Lim et al., 2010). In spite of the investment on infrastructure and training, research has shown that in general the use of DT is still peripheral (Teo et al., 2008). School teachers often fall back to very simple use of DT (e.g. Powerpoint slides) (Teo, Chai, Hung, & Lee, 2008), and some do not seem to have the motivation to apply DT at all.

Having a proper motivation is critical for teachers to integrate technology effectively into the school curriculum. The purpose of the present study is to examine the motivation of student teachers in teacher education programs to use DT. Individuals in learning situations may adopt different motivation goals. Those who adopt a learning goal (with the purpose of perfecting the self) aim at mastery of new knowledge and skills whereas those who adopt a performance goal aim at demonstrating ability and outperforming others (Elliott & Dweck, 1988; Grant & Dweck, 2003). Teachers, like anyone else, would have both goals, each of which may be related to their DT applications personally and in classroom activities. Our aim was to scrutinize the relations between these goals (learning vs. performance) (Dweck, 2000) and teachers' DT applications (personal use vs. classroom application). The findings would enable teacher education to better understand how different motivational factors influence teachers' use of DT in teaching so as to incorporate significant features that may optimally enhance pre-service teachers' use of DT when they start teaching. This understanding is important in order for teacher educators to facilitate pre-service teachers to use DT optimally, that is, in a balanced way that is commensurate with their instructional practices (Edmunds, 2008), and complementary to their development of curriculum (Sandholtz & Reilly, 2004).

Digital Technology in Teacher Education

The use of DT is strongly encouraged in teacher education programs, for which the primary expected outcome is that pre-service teachers will integrate technology in their teaching when they enter schools. However, the diffusion of DT in schools is not evident in most countries (Warschauer & Grimes, 2008). At least some teachers do not seem to be motivated in using it for teaching. Even when DT is used in classroom situations, the activities may be superficial, leading to neither substantial gains in academic knowledge (Warschauer & Grimes, 2008) nor significant changes in teacher role and class environment (Baran, Correlia, & Thompson, 2013). This has led to researchers asking "why don't teachers innovate when they are given computers?" (Zhao, Pugh, Sheldon, & Byers, 2002, p. 482).

In a study on teacher education in the United States, Brown and Warschauer (2006) revealed a "peripheral role of technology in teacher preparation experience" (p. 599). They found that the student teachers had insufficient exposure to technology integration even

though technology appeared to be a prominent element in the teacher education program. Similarly, in an earlier study, Kovalik (2003) reported that "instructional units integrating DT" designed by undergraduate students in a teacher education program in Ohio "reflected traditional teacher-centered strategies, used technology in predictable, low-level ways, and were disjointed instead of being learner-centered, technologically innovative, and cohesive." (p. 73). The results in Kovalik's study indicated that the student teachers had difficulty in transferring and applying knowledge and skills across courses. This also reflects that some DT elements in teacher education may not be effective in promoting student teachers' DT application. Lambert, Gong, and Cuper (2008) further reported that "a single course greatly impacts perceived computer ability but not general computer attitudes" (p. 385), which suggests that a one-off intervention may not be sufficient to promote DT application for teaching purposes.

Nevertheless, at least some studies did yield positive findings. Fleming, Motamedi, and May (2007) reported that as pre-service teachers observed more models of DT use, and had more hands-on experience, they had a higher self-perception of their own skills. Consistent with Fleming et al. (2007), Collier, Weinburgh, and Rivera (2004) recommend "integrating deliberately scaffolded hands-on experiences and increased modeling of technology" on the basis of results showing that they help to "elevate future teachers' ability to select and use appropriate technologies in the instructional setting" (p. 447).

Emphasizing future teachers' DT abilities, the National Institute of Education (NIE) requires all student teachers to take a course that covers DT generically. Overt instructions involving DT are also infused in teaching method courses for various subject disciplines. NIE, where the present study was conducted, not only equips the campus with DT facilities to support learning and teaching, but every student teacher is provided with a laptop on loan from the MOE throughout the course of their study. Given the rich technological environment and support, it is imperative to identify and understand essential factors that would promote actual use of DT in the classroom.

Motivation Goals

Of the many factors that may promote DT application, two easily conceivable 'concrete' factors for success are the availability of relevant hardware and software. Nevertheless, whether available hardware and software are utilized to an optimal extent is ultimately dependent on 'human' factors. When considering human factors, besides the ability of the teacher in using DT, the teacher's *motivation* to use DT is often a decisive factor. Recent theories of motivation have emphasized the goals of an individual because they provide people with a purpose for action (Seifert, 2004). In a competitive learning environment, however, there may be the tension between a goal of acquiring new knowledge and skills and a goal of demonstrating ability relative to others. Dweck (2000) has distinguished between these paradoxical motivational constructs, which she termed *learning goals* and *performance goals*.

According to Dweck (2000), performance goals are focused on "winning positive judgment of your competence and avoiding negative ones", while learning goals are characterized by a desire to develop "new skills, master new tasks or understand new things" (pp. 16-19). While both goals are 'normal and universal', they are often in conflict; and the problem faced by learners in the modern world is often the difficulty of maintaining a healthy balance between the two. For example, recent studies have suggested that students who have a strong performance goal and aim to obtain high achievement in examinations to the exclusion of other outcomes are likely to curtail their engagement in DT (Tan & McWilliam, 2008). This

is because they perceive the application of DT as a distraction to their exam performance. However, as commented by Tan and McWilliam (2008), this very narrow focus on achievement outcomes does not match expectations of modern education and definitely falls short of requirements in the modern workplace.

Based on Dweck's (2000) conceptualization of the learning and performance goals, we would expect that individuals with a performance goal would focus on social comparison processes. In contrast, those with a strong learning goal would not mind exerting their effort to gain new knowledge and skills, sometimes at the expense of achievement scores. For students taking an initial teacher education course, they play dual roles as teachers and students. While they need to emphasize the acquisition of new knowledge and skills, they are also subject to assessments of a norm-referenced nature, which put them in a competitive situation that requires a strong performance goal. When their application of DT is concerned, an important question to ask is whether their respective goals (learning vs. performance) (Dweck, 2000) would have different relations with DT applications for various purposes (e.g., personal vs. classroom use).

Who Would Use Digital Technology?

Most young people today are highly literate in a digital sense. Young teachers today belong to the "digikid" generation (Graham, 2008) but they may use DT for a variety of purposes. Interestingly, people who use DT a lot do not always make optimal use of it for academic purposes. In fact, Kennedy, Krause, Judd, Churchward, and Gray (2006) found that many students in the first year of their university degree struggled to make DT work effectively for academic purposes despite their proficiency in DT for other purposes. This finding with a sample of Australian undergraduates was also consistent with Kvavik and Caruso's (2005) study with a US sample. There are reasons to believe that younger individuals are more likely to use DT. Nevertheless, the application may only be limited to personal rather than academic purposes.

Even for those who can use DT for academic purposes, their motivational goals may differ. For those who focus on the acquisition of knowledge and skills, a learning goal will prevail. This goal may lead to more intense use of DT for personal development. For those who focus on performance, the use of DT may be perceived as time-consuming, inefficient, and unproductive because it will not result in higher scores in tests and assignments any more than reviews of materials provided by their lecturers. Hence we can expect that university students who are high in their learning goals would be more likely to use DT than those who are high in their performance goals. For similar reasons, students undergoing initial teacher education who adopt higher learning goals are expected to use DT for teaching more than those who adopt higher performance goals. Allowing students to explore new knowledge with DT and play with new ideas requires the teachers' willingness to take risks and allow students to take risks as well. Teachers who use technology in class have to prepare to learn new technologies and new knowledge that they have never come across (Hartnell-Young, 2009). For those teachers who adopt a higher performance goal, less use of technology is probably perceived to be more productive. To achieve performance goals, they will avoid taking risks (Elliot & Dweck, 1988). To achieve quick results of student performance, they will revert to traditional forms of teaching (Sacristán, Sandoval, & Gil, 2007), and make students remember the essential materials for scoring better in assessments.

Gender Issues

Researchers have attempted to examine whether females differ from males in some motivational variables. Some of the differences found in research may be explained in terms of gender-role stereotypes. For example, boys are likely to be more motivated in science and math and hold higher ability perceptions than girls although their achievement scores may not actually be higher (Klapp Lekholm & Cliffordson, 2009). In contrast, females may be more motivated and have a greater sense of competence than males in verbal areas (e.g., Kurtz-Costes, Rowley, Harris-Britt, & Woods, 2008). When motivation goals are considered in general, however, males seem to have a higher level of mastery (i.e., learning) goal orientation (Midgley, Kaplan, & Middleton, 2001). That is, in Dweck's (2000) terms, males may be expected to be higher than females in their learning goals. However, the literature has not provided strong evidence for performance goal for us to predict any gender differences. What we do know as a general pattern is that individuals tend to report higher mastery (i.e. learning) goals than performance goals (e.g., Yeung & McInerney, 2005).

The Present Investigation

We developed a survey to ask student teachers of NIE in Singapore about their motivation to use DT. Confirmatory factor analysis (CFA) was conducted to serve two purposes: (1) to ensure the survey was actually assessing the constructs we intended to measure, and (2) to answer an important research question in teacher education: which student teachers would use DT? The findings have potential implications for teacher education to promote DT applications for pedagogical purposes more effectively. We hypothesized that: (1) learning goals would have stronger relations with DT applications (both personal use and classroom application) than would performance goals, and (2) younger teachers would use DT more than older teachers, but not necessarily in the classroom. We also attempted to examine whether there would be any gender difference in these variables, which is unclear in the existing literature.

Method

Participants

A total of 638 student teachers were invited to participate in the survey. The study here used the responses from 312 participants who provided complete data for the analysis. These student teachers were undertaking initial teacher education programs at NIE, Singapore. They were: student teachers doing a one-year Postgraduate Diploma in Education for secondary teachers (PGDE) (51%, age range = 22-48, mean = 28) and Year 3 student teachers from the 4-year undergraduate programs (49%, age range = 21-29, mean = 22). There were 58% females (n = 95) and 42% males (n = 68) from PGDE, and 74% females (n = 119) and 26% (n = 41) males from the degree program. Singapore, being a cosmopolitan society, has four official languages (English, Mandarin, Malay, and Tamil), but English is the commonly used language for communication and is the medium of instruction in NIE and all schools in Singapore.

Material

The participants responded to a survey asking about their motivation goals (learning vs. performance) (Dweck, 2000) and two variables about DT applications (personal use vs. classroom application) on a scale of 1-6 on 16 items forming four factors, with the items randomized in the survey. Table 1 shows these factors and sample items, together with the Cronbach's alpha reliability estimate for each factor, reflecting how well the multiple items within each factor serve as indicators of that specific factor. The SPSS software was used for the analysis (IBM SPSS, 2013).

Scale	Sample Items	Alpha
Learning goal	The opportunity to do challenging work is important to me.	.73
Performance goal	I prefer to do things that I can do well rather than things that I do poorly.	.79
Personal use	I use digital technology at home.	.88
Classroom use	I allow students to use digital technology during lessons.	.83

Table 1. Factors and Reliabilities

Learning goal. Four items were used to form the learning goal factor reflecting the motivation of the teachers to master new knowledge and skills. The items were adapted from Tan's (2009) study on how students in an urban Australian boys' school "evaluate and account for the constraints and affordances of contemporary digital tools when they engage with them as part of their conventional schooling" (p. 8).

Performance goal. This factor was again adapted from Tan's (2009) study. Four items were used.

Personal use of DT. Four items asked the respondents how often they used DT personally in their daily life.

Classroom application of DT. Four items asked the respondents how often they used DT in the classroom to facilitate learning and teaching.

Procedures

Procedures approved by the university's institutional review board (IRB) were followed. The data collection was done through an online survey. An announcement was made in the Student Portal on the university's website to the targeted participants alerting them of the up-coming online survey. Then the URL for the survey response was given in individual emails for students to log on and respond at their own time.

Statistical Analysis

Participants' responses were coded such that higher scores represented more favourable responses. In initial analysis, we analysed the descriptive statistics and the alpha reliability of each *a priori* factor formed by respective items in the survey. Then CFA was used to test the ability of the items to form the factors.

Confirmatory factor analysis. We first examined the factor structure of a full measurement model with the 16 items forming four factors. Then we tested a single-factor model in order to compare against the four-factor model. The conduct of CFA has been described elsewhere and is not further detailed here (see Jöreskog & Sörbom, 2005). The CFA was conducted with the LISREL software. We used widely accepted criteria for assessing model fit, that is, CFI and TLI values of .90 or above and RMSEA values of

below .08 were used as indication of acceptable model fit (Bentler, 1990; Browne & Cudeck, 1993).

Path model. On the basis of the four latent variables derived from the CFA model, structural equation modelling (SEM) was applied to test the hypothesis of differential relations between motivation goals and application outcomes. Specifically, the two goals (learning and performance) were used as predictors from which paths leading to the two application outcomes (personal and classroom) were examined. The path model would provide further information about the relative strengths of the predictors in predicting the outcomes when considered together.

MIMIC model. Descriptive statistics were reported using the mean scale scores by averaging the items for each scale. To statistically examine any group differences, a multiple-indicator-multiple-indicator-cause (MIMIC) model was tested (Yeung et al., 2012). The MIMIC approach is a special application of SEM that is similar to a multiple regression model (Jöreskog & Sörbom, 2005) but it has the advantage of having the latent variables corrected for measurement error (Marsh, Tracey, & Craven, 2006). The MIMIC model would examine the paths from discrete grouping variables (e.g., age, gender, and age × gender interaction in the current study) on the four latent variables. In the present study, we constructed three grouping variables: (a) age (from 17 to 45), (b) gender (1 = female, 2 = male), and (c) age × gender interaction.

Results

CFA

The scale means and alpha estimates are given in Table 1. All four factors had acceptable reliabilities ($\alpha > .70$). CFA was conducted (Table 2). Model 1 tested the ability of 16 items to form four distinct factors. The model provided a good fit (TLI = .93, CFI = .94, RMSEA = .06). The parameter estimates are presented in Table 3. In contrast, Model 2 testing a single-factor model with 16 items (Table 1) did not provide a good model fit (TLI = .42, CFI = .50, RMSEA = .18). Hence Model 1 was selected as a better model. In Model 1, the factor loadings were all acceptable (all > .50). The correlations among the latent constructs were reasonable, ranging from -.02 to .39. These low to moderate correlations indicate that all four latent variables were clearly distinguishable from one another.

Model	χ^2	*df*	TLI	CFI	RMSEA
1. 4-factor model	220.32	98	.93	.94	.06
2. 1-factor model	1129.69	104	.42	.50	.18
3. Path model	220.32	98	.93	.94	.06
4. MIMIC model	262.81	134	.93	.94	.06

Note: *N*=312. CFI = Comparative fit index. TLI= Tucker-Lewis index. RMSEA = Root mean square error of approximation.

Table 2. Goodness-of-fit Summary

We hypothesized that learning goals would have stronger relationships with DT applications than would performance goals (hypothesis 1). The correlations of learning goals with both personal ($r = .39$) and classroom applications ($r = .22$) were found to be positive and statistically significant ($p < .05$). In contrast, the correlations of performance goals with both personal ($r = .18$) and classroom applications ($r = -.02$) were smaller. Thus there was preliminary support for hypothesis 1.

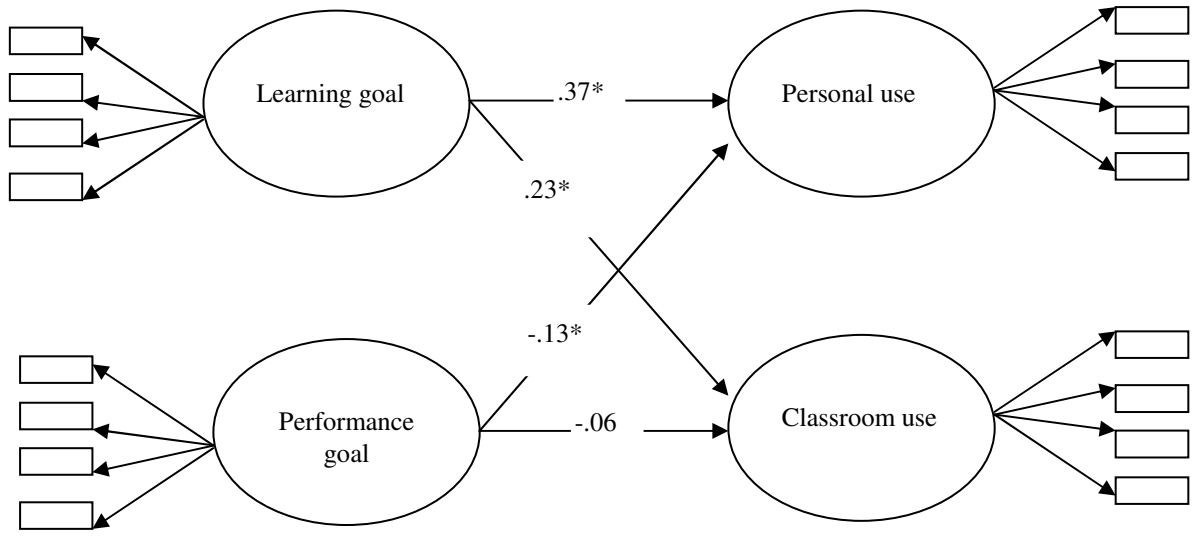
	Learning	Performance	Personal	Classroom	Uniqueness
Variable	***Factor Loadings***				
Learning1	.55 *				.69*
Learning2	.50*				.77*
Learning3	.83*				.31*
Learning4	.72*				.48*
Performance1		.63*			.61*
Performance2		.77*			.40*
Performance3		.70*			.51*
Performance4		.71*			.49*
Personal1			.87*		.25*
Personal2			.86*		.27*
Personal3			.87*		.24*
Personal4			.66*		.56*
Classroom1				.72*	.49*
Classroom2				.61*	.63*
Classroom3				.84*	.30*
Classroom4				.80*	.35*
Factor Correlations					
Performance	.15*				
Personal	.39*	.18*			
Classroom	.22*	-.02	.39*		

Note: *N*=312. * *p*<.05.

Table 3. Parameter estimates

Path Model

To provide a stronger test of hypothesis 1, we tested a path model (Model 3 in Table 2) using the motivation goals (learning and performance) as predictors of application outcomes (personal and classroom). The paths from learning goal to both personal use (= .37) and classroom use (= .23) were found to be significantly positive (Figure 1). In contrast, the paths from performance goal were both negative (s = -.13 and -.06, respectively). Hence when considered together, learning goal had much stronger influence on both personal and classroom applications of DT than did performance goal, supporting hypothesis 1.

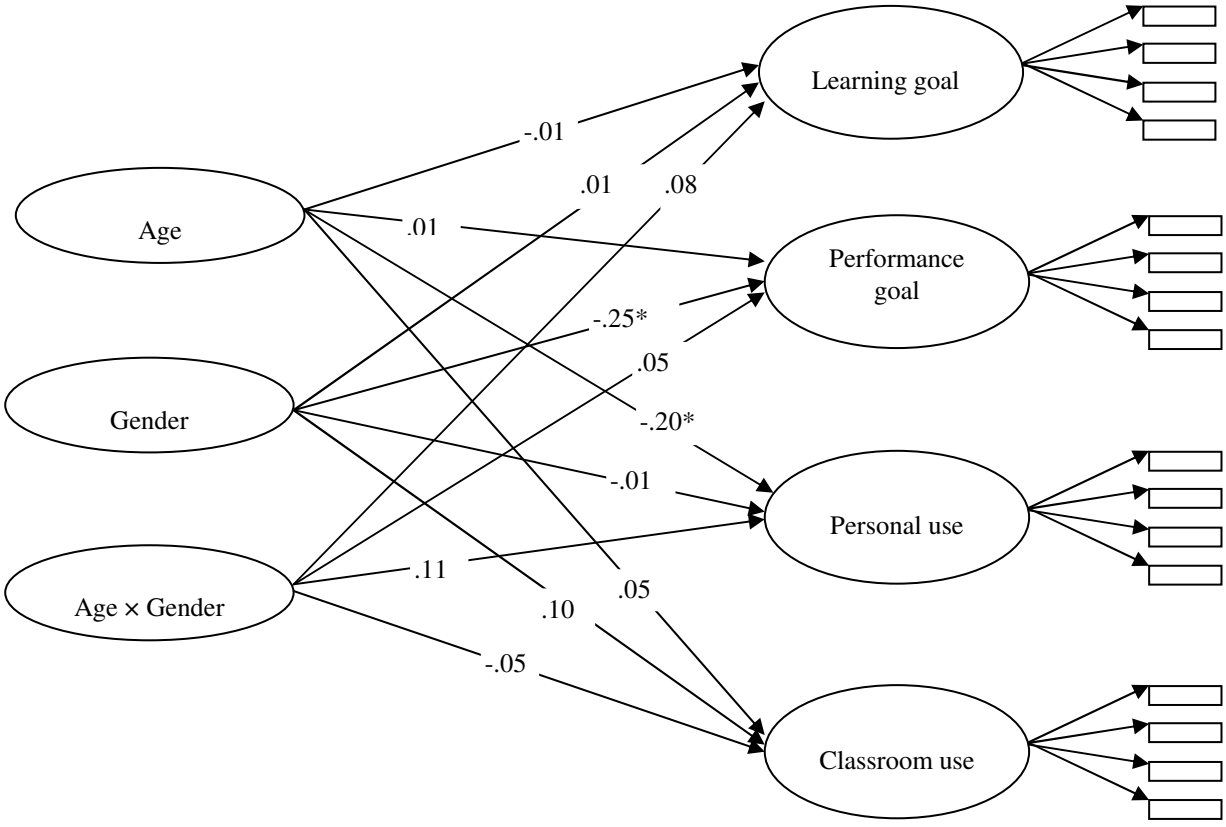


Note: * *p*<.05.

Figure 1. Paths from motivational goals to outcome variables

Group Means and MIMIC Model

The results of the MIMIC model (Table 2) are presented in Figure 2. The path from age to personal use was negative and statistically significant (= -.20), indicating that younger participants tended to engage themselves in personal use of DT more frequently (supporting hypothesis 2). The path from gender to performance goal was also negative and statistically significant (= -.25), indicating that females had higher performance goal than males. All the other paths were not statistically significant, including the paths from the age × gender interaction variable to the four latent variables. An inspection of the mean scores for females and males separately (Table 4) found that gender differences were small except for performance goal (M = 4.59 for females as compared to M = 4.36 for males). However, for all four latent variables, both females and males had remarkably high scores (all scores > 3.5 on a 6-point scale), although personal use (Ms = 5.25 and 5.06, respectively) clearly occurred more frequently than classroom use (Ms = 3.70 and 3.86, respectively).



Note: * p<.05.

Figure 2. MIMIC model

Means and (Standard Deviations) of Variables by Gender		
Variable		
	Female	**Male**
N	206	106
Learning goal	4.63 (0.51)	4.68 (0.59)
Performance goal	4.59 (0.73)	4.36 (0.77)
Personal use	5.25 (0.81)	5.06 (0.82)

Classroom use	3.70 (0.93)	3.86 (1.02)

Table 4. Means and (Standard Deviations) of Variables by Gender

Discussion

Our attempt was to examine the motivation goals of student teachers in initial teacher education programs and elucidate the relations between these goals and their applications of DT. We set out to examine the validity of a four-factor model through CFA based on which we tested two hypotheses. In support of our hypotheses, we found that:

(1) Learning goals had relatively stronger positive relations than performance goals with both personal use and classroom application of DT.

(2) Younger teachers used DT more frequently than older teachers, but the difference was found only in personal use and not in the use of DT in the classroom.

In examining gender differences, we found small differences between males and females for most variables. However, females had higher performance goals than did males.

Overall, the participants in the present study displayed high scores in both learning and performance goals. As suggested in the literature, these motivational goals form the basis of achievement behaviours and as such, those displaying high learning and performance goals are expected to have strong motivation to achieve (Dweck, 2000). However, our sample's personal use of DT was clearly more frequent than their classroom applications. The correlation between the latent factors of learning and performance goals was found to be small (r = .15). This low correlation implies that although an individual may have both learning and performance goals simultaneously (Dweck, 2000), it is unlikely that both goals are similarly strong. In contrast, the correlation between personal use of DT and application of DT for classroom activities was found to be significantly positive (r = .39). This indicates that those participants who used DT personally were more likely to also use it in the classroom. As such, one possible way to increase the rate of DT applications in the classroom is to encourage pre-service teachers to use DT for personal purposes. The impact of teachers' personal use of DT on their classroom DT applications cannot be underestimated. Previous research (e.g., Mumtaz, 2000; Rakes et al., 1999; Rakes et al., 2006) suggest that the more teachers use technologies in their personal life, the more they are likely to use it in classrooms to facilitate the creation of constructivist learning environments. A plausible explanation is that personal use of DT strengthens teachers' technology skills, which in turn would provide teachers the comfort of using DT to support their instructional practices (Rakes et al., 2006).

Importance of Learning Goals

As expected, the hypothesis of a strong positive relation of learning goal with each of the application outcomes was supported. In the "digikid" generation (Graham, 2008), no individual could do without DT. However, not every individual would use DT successfully for academic purposes (Kvavik & Caruso, 2005; Kennedy et al., 2006). In fact, some individuals may not even be motivated to use DT in learning situations. This is consistent with recent studies suggesting that students who have a strong performance goal would aim at high achievement in examinations, and are likely to curtail their engagement in DT that may not have any direct bearing on achievement scores (Tan & McWilliam, 2008). Therefore, the development of young teachers' learning goals is essential if we want to see more engagement of young teachers in using DT to teach. Our finding shows that an emphasis on performance goals will only lead to even less frequent use of DT, both personally and for teaching. What further highlights the importance of learning goal is the fact that it is strongly correlated with personal use of DT, which in turn is associated with teachers' classroom applications of DT.

Teachers who hold a strong emphasis on competitiveness and performance are less likely to play with new ideas and are unlikely to allow their students to take risk in learning. In fact, teachers who hold a high performance goal will probably avoid taking risks (Elliot & Dweck, 1988) and revert to traditional teaching, which is more promising for immediate results in achievement scores (Sacristán, Sandoval, & Gil, 2007). Therefore, the importance of nurturing learning goals that are known to have positive influences in most learning situations (Dweck, 2000; Elliot & Dweck, 1988; Grant & Dweck, 2003) is definitely relevant in teacher education preparing student teachers to use DT in their teaching career.

Age and Gender Issues

As expected, the data showed higher frequency of personal use of DT for younger individuals. The development of various DTs is so fast that many of them have become part of a young person's daily life. These technologies are being used for a variety of purposes: for fun, entertainment, or for obtaining information; and indeed, younger people are unlikely to be able to do without any DT for a single day. Therefore, compared to older people, younger people would use more and become more competent in a variety of DTs (Graham, 2008; Kvavik & Caruso, 2005; Kennedy et al., 2006). In contrast, as some older teachers may be less adequate in DT skills (Russell, Finger, & Russell, 2000), initial teacher education should tailor the program contents and delivery to the needs of older groups of student teachers who need help. Technical support for older groups of student teachers can also be provided to reduce the barrier of DT usage.

Between females and males, differences in motivation may be more apparent in specific curriculum domains (Klapp Lekholm & Cliffordson, 2009; Kurtz-Costes et al., 2008). However, where motivation in general is concerned, gender difference may be minimal. Our sample reported higher learning goal than performance goal irrespective of gender. This is consistent with previous research showing that students' mastery orientation tends to be higher than their performance orientation (e.g., Yeung & McInerney, 2005). However, females' learning goals ($M = 4.64$) were found to be equally high as males' ($M = 4.68$), which contrasts with Midgley, Kaplan, & Middleton's (2001) study that found higher mastery orientation for males. Furthermore, it is interesting to find a relatively higher performance goal for females ($M = 4.59$) than for males in our sample ($M = 4.36$). Whether this gender difference is specific to the Singapore context or to the teacher profession is yet to be further explored. Nevertheless, given the non-positive association found between performance goal and use of DT, the high performance goal especially for female teachers implies their stronger tendency of holding back their DT applications. From Figure 2, we know that female students tend to be higher in their performance goals compared to male students. From Figure 1, we know that performance goals have a negative influence on personal use of DT, which means that the higher the performance goal a person holds, the less likely the person is to use DT at the personal level. Given the higher performance goal of female teachers, it is likely that they would use DT less than their male counterparts. Given the fact that females form the majority of the teaching profession in Singapore, the stronger performance goals for female teachers may imply suboptimal DT application in school environments. Hence, teacher educators may need to consider ways to address this issue.

Unless the teacher is ready to allow students to explore new knowledge and is prepared to be challenged with the uncertainty of problems and answers arising from unexpected sources of information, it is unlikely that the teacher will be comfortable using DT in teaching (Hartnell-Young, 2009). In a competitive environment where performance scores are the only important assessable outcome, DT is unlikely to be one of the top priorities. The

emphasis on learning goals and a willingness to take risks in facing uncertainty in the learning and teaching process may therefore make a difference in teachers' practices of using DT in teaching.

Implications and Limitations

To some, the obvious way to ensure that DT is used in the classroom is for the relevant authorities (Ministry of Education, school board, etc.) to come up with policies or regulations that demand teachers to dedicate a specific amount of time using DT in teaching. In line with this notion, the Ministry of Education in Singapore in its first Masterplan for ICT in Education required that "targets [be] set for all schools to have ICT-enabled lessons for up to 30% of curriculum time" (see Ng, 2008) and subsequently, as part of the third Masterplan for ICT in Education, increased the target to 50% of curriculum time by 2014 (MOE, 2009).

Nevertheless, for teachers who rated highly on performance goals, such a numerical target would probably translate into DT applications that they are familiar with (e.g., Powerpoint presentations), which may not be the best pedagogy for desirable outcomes. Given the higher performance goal of female teachers found in our data (Figure 2), and the generally high proportion of females in the teaching profession in Singapore and many other countries, the likelihood of using DT at a superficial level could be a concern.

Three implications can be drawn from our research, especially if the target of 30% - 50% technology-enabled curriculum is to be met with optimally effect. First, the assessment of students' learning outcomes has to go beyond the assessment of performance in a traditional sense (i.e., achievement scores). Assessment needs to extend to conceptual understanding and perhaps also to psychosocial outcomes such as having positive affect on learning. When 'performance' is not limited to achievement scores, teachers with a high performance goal will be more inclined to take the initiative in the right direction and with the right spirit. It is important to acknowledge that the education policies in Singapore are heading towards this direction. For example, the alignment of curriculum, pedagogy, and assessment has become a centrepiece in the *Third Masterplan*. It aims to achieve "greater alignment of students' learning outcomes in the syllabi, national examinations, and classroom experience to 21st century skills" (MOE, 2008). The tasks that students were asked to do with DT has become more sophisticated including looking for information, synthesising reports, giving feedback on each other's work and collaborating with peers within and outside school (MOE, 2008). Assessment tasks that integrate these skills are likely to trigger teachers and students to take a learning orientation towards the use of DT. This is because in these assessments, DT is no longer a simplistic tool for transferring information, but has become a facilitator that can enhance the learning processes and stretch students' learning potential.

With the change of assessment in schools, teacher education should also move in tandem. In the case of Singapore, assessment in teacher education is undergoing significant changes. Under the Teacher Education Model for the 21st century in NIE, key processes that enable both teacher educators and teachers to employ innovative assessment practices *as*, *of* and *for* learning are being identified and scaled up. A new assessment literacy course is being introduced in July 2014 to ensure all student teachers are given a firm grounding in assessment practices.

Together, the education policies and teacher education curriculum emphasising DT might have created a mandatory sense for the use of DT in teaching (Teo et al., 2008; Yeung et al., 2012). However, policy and/or curriculum requirements would not be sufficient to motivate teachers to use DT in teaching (Yeung et al., 2012). Teachers are more likely to

apply DT in classroom if they recognise and value of DT and have the competence to apply it effectively (Teo et al., 2008; Yeung et al., 2012). For this, a learning goal is essential because if a teacher possesses a strong learning goal, he or she will be more willing to take risks and challenges in applying DT. Consequently, teachers will not only discover more effective ways to facilitate the learning process, but will also build up their competencies as they try out innovative ways. Further research could test whether stronger learning goal would lead to higher perceived value of DT and higher competencies in applying DT for teaching.

The practical implication from our research is that the enhancement of learning goals should be a priority in teacher education (initial and in-service), which should be constantly strengthened so as to increase teachers' application of DT for educational purposes. It is inevitable for teachers functioning in a very competitive education system to adopt a strong performance goal orientation. Teacher educators in such a system need to be patient in promoting a learning goal orientation in the next teacher generation whose performance goal orientation has unfortunately prevailed through years of competition in the education system. In the light of increasing DT skills and the need for quick updates of knowledge about DTs in today's world, the development of a learning goal orientation can be a key strategy for enhancing teacher learning, professional growth, and pedagogical advancement. To facilitate teachers' ability to grow, adapt, take challenges and develop in the fast changing world that is increasingly essential to teacher effectiveness, teacher educators have an important role in cultivating a learning goal orientation in future teachers.

We suggest that teacher education should be a process whereby teacher educators and student teachers work together to promote positive motivations toward DT. Studies have suggested that in order to nurture students' learning goal orientation, it is of critical importance that their teachers also share the same orientation (Dweck, 2010). With a shared orientation, teacher educators are more likely to provide sufficient opportunities and psychological support for student teachers' development. Hence the first step to promote positive motivations toward DT is that teacher educators develop higher learning orientations within themselves and serve as a role model.

Future research into the motivations of both pre-service and serving teachers as well as teacher educators in the use of DT together with their actual classroom DT application behaviours would help confirm if these implications can be generalized across different teacher samples. Our study has exactly this limitation; that is, the findings with our sample of pre-service teachers are mostly based on what they would do in their classrooms as a beginning teacher. These practices and intentions may not be generalized to more experienced teachers in their career or to teacher educators in teacher education programs. Therefore, data from serving teachers and teacher educators will be important to help us understand better how teachers' motivation changes and grows beyond the initial teacher education phase.

To conclude, because learning goal orientation was found to be positively related to the use of DT, both personally and in the classroom, the enhancement of this orientation is crucial. By strengthening learning goal orientation in initial teacher education, it is likely to increase teachers' application of DT for educational purposes.

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