Exploring the potential of the will, skill, tool model in Ghana: Predicting prospective and practicing teachers' use of technology

Article *in* Computers & Education · January 2011

DOI: 10.1016/j.compedu.2010.08.017 · Source: DBLP

2 authors:

Douglas Darko Agyei
University of Cape Coast

Joke Voogt
University of Amsterdam

Computers & Education xxx (2010) 1–10

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Exploring the potential of the will, skill, tool model in Ghana: Predicting prospective and practicing teachers' use of technology

Douglas D. Agyei [a], Joke M. Voogt [b,*]

[a] University of Cape Coast, School of Physical Sciences, Department of Mathematics & Statistics Cape Coast, Republic of Ghana
[b] Department of Curriculum Design and Educational Innovation, Faculty of Behavioural Sciences, University of Twente, Postbus 217,7500AE Enschede, The Netherlands

ARTICLE INFO

Article history:
Received 10 February 2010
Received in revised form
15 July 2010
Accepted 17 August 2010

Keywords:
Country specific developments
Improving classroom teaching
Media in education
Pedagogical issues
Evaluation methodologies

ABSTRACT

Research has shown that *will* (positive attitudes), *skill* (technology competency), and *tool* (access to technology tools) are all essential ingredients for a teacher to effectively integrate information technology into classroom practices. This study focuses on the *will*, *skill* and *tool* as essential measures for the predictability of technology integration, reported by the study participants and measured by stages of adoption of teachers in Ghana. Attempts are made to explore the extent to which these parameters differ among the teachers and also influence technology integration. Furthermore, the parameters are proposed for use in modelling the process of technology integration for these teachers. Well validated instruments spanning the areas of attitudes, competencies, access and technology integration proficiencies were used to collect data from 120 mathematics prospective teachers and 60 practicing mathematics teachers from Ghana. The data was analyzed using regression analysis. The results indicated that lack of teacher anxiety was the most important dimension of attitudes, and that skill is the strongest predictor of classroom integration of technology for the teachers. Significant differences existed between practicing and prospective teachers' computer anxieties, competencies, and access levels.

1. Introduction

Integration of technology in education has increasingly become an important concern in education not only in developed countries, but in developing countries as well. Tilya (2008) analyzed the development of technology in education policies in Sub-Saharan Africa. He found out that majority of Sub-Saharan Africa countries have a national policy on technology in education, including an implementation plan. In addition, some of these countries have organizational structure in place responsible for technology implementation. Ghana is one of the Sub-Saharan African countries with a national policy and implementation plan for technology in education. The government of Ghana considers technology literacy as an engine for accelerated development outlined in the Ghana Information and Communication Technology for Accelerated Development (Ghana ICT4AD Policy document, 2003). Ghana introduced technology into the school curriculum in September 2007 following the recommendations of the ICT4AD document and the Anamuah-Mensah National Education Review Committee Report (2002). Both documents highlight the importance of integrating technology into the curriculum at all levels. The government and other institutions have invested huge sums of money in procurements of computers and establishment of computer labs in most senior high schools. Computer literacy is not only introduced as a new subject in the curriculum, but also as a tool to enhance teaching and learning. The new curriculum in mathematics at the senior high school (Ministry of Education, Science and Sports, 2007) encourages teachers to make use of the calculator and the computer for problem solving and investigations of real life situations, in order to help students acquire the habit of analytical thinking and the capacity to apply knowledge in solving practical problems (MOE, 2000). However, to realize this new orientation to teaching and learning including the use of computers by teachers more needs to be done than recommendations contained in syllabuses. Therefore important questions such as "what can teachers do with computers to promote integration of technology in the curriculum or to extend instructional methods?" and "what can teachers do with computers to improve students' outcomes?" still remain. Many studies have shown that teachers have a decisive role in the integration of technology in the teaching and

* Corresponding author. Tel.: +31 53 489 3594; fax: +31 53 489 3759.
E-mail addresses: d.d.agyei@utwente.nl (D.D. Agyei), j.m.voogt@gw.utwente.nl (J.M. Voogt).

0360-1315/$ – see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.compedu.2010.08.017

learning process (Law, 2008; Mumtaz, 2000; Voogt, 2003). Therefore teachers' responses to the questions posed above are critical for the implementation of technology in the classroom. With the recent impetus of technology, it is imperative that teacher education programs, policy makers and researchers understand how teachers in Ghana relate to technology in particular with respect to teachers' attitudes and competencies. In this study we focus on mathematics teachers in particular as the study is part of an ongoing study about the development of an appropriate professional development program for mathematics teachers to use technology in their classrooms. This study aims at contributing to a better understanding of mathematics teachers' attitudes and competencies towards technology.

2. A conceptual framework for the study: The will skill tool model

There is no doubt that the use of computers in classrooms remains a challenge for most teachers in spite of many studies, which have focused on integrating technology in classroom teaching (Pamuk & Peker, 2009; Smarkola, 2008; Tekinarslan, 2008). Since the early days of computer usage in schools back in the 1980s and 1990s teacher attitudes were considered an important factor for technology acceptance (Marshall & Cox, 2008; Myers & Halpin, 2002; Woodrow, 1992). In addition to teacher attitudes large scale international assessments of technology in education (e.g. Law, Pelgrum, & Plomp, 2008; Pelgrum & Anderson, 1999) found that teachers' technology competencies also are a basic condition for technology use in education. Pelgrum and Anderson (1999) concluded that an increasing number of teachers have been introduced to basic technology competencies, but most of them lack competencies related to the pedagogical use of technology.

Christensen and Knezek (2002, 2008) developed the Will Skill Tool model (WST model), in which teachers' will, skill and access to technology tools are all postulated to be necessary components for effective integration of technology into the teaching and learning environment of the classroom. The models' key elements are: will (which Christensen & Knezek conceptualize as *computer attitude*) of the teacher, skill (which they conceive as *technology competence*), and tools (which needs to be understood as *access* to technology tools). The WST model predicts the level of technology integration as a function of attitude, competence and access to technology. Christensen and Knezek (2002) tested the model in 1999 with 39 teachers from the USA (Texas) using regression analysis, and they could explain 84% of the variance in technology integration. Morales (2006) used the WST model to predict integration of technology by teachers in a study of Mexican and US teachers. He found that measures of *Will*, *Skill* and *Tool* together were able to account for 90% of level of classroom technology use. In addition the Mexican teachers' access to technology (tool) was most important, while for the US teachers competence explained most of the variance. Since Ghana is, similar to Mexico (Ávila Muňoz, 2008), a beginner of use of technology in education, the authors wanted to explore to what extent the WST model also would be useful to study teachers' integration of technology into the classroom in the context of Ghana.

Two research questions guided the study: "How do prospective and practicing mathematics teachers differ in their attitudes (will), competencies' (skill), access (tool) and their levels of technology integration?" and "To what extent do attitudes (will), competencies (skill) and access (tool) predict mathematics teachers' technology integration levels?". The best model fit involving these measures for the data set is also determined.

To discuss the components of the WST model, studies from European countries and the United States were used to review literature, provided it could be assumed that the arguments were relevant in the Ghanaian context as well.

2.1. Computer attitudes (will)

The concept attitude can be divided into three components: affective, cognitive, and conative (Fishbein & Ajzen, 1975). Attitudes towards computers influence teachers' acceptance of the usefulness of technology, and also influence whether teachers integrate technology into their classroom (Meelissen, 2008; Paraskeva, Bouta, & Papagianna, 2008). Huang and Liaw (2005) also stated that among the factors considered to influence the successful integration of computers in the classroom, teachers' attitudes towards computers is a key factor. The study pointed out that no matter how sophisticated and powerful the state of technology is, the extent to which it is implemented depends on users having a positive attitude towards it (Huang & Liaw, 2005). Many research studies confirmed that there are several factors affecting computer attitudes such as gender, socio-economic status and age. Recent studies about the effect of age on attitude towards computers have shown that younger people tend to have more positive attitudes towards the use of computers than their older peers (Christensen & Knezek, 2006; Meelissen, 2008). This gives an indication that younger teachers are probable to use technology in instruction than the older ones. Other related studies that have been conducted into attitudinal and motivation/personality factors towards technology in education contained attitude surveys consisting of questions about fear of computers, extent of liking technology, attitudes towards using technology in school, enjoyment in using computers, productivity/utility of computer, computer use for e-mails have shown strong links between pupils' and teachers' attitudes and the effect on technology use and learning (Marshall & Cox, 2008). For example a number of studies have found "*Computer anxiety*" to be a consistent measurable construct present in teacher data sets on teachers' attitudes towards computers (Christensen & Knezek, 2000a, 2001). According to Pamuk and Peker (2009) *computer anxiety* is the most important dimension of attitude towards computer scale; indicating that teachers who are anxious about computers tend to develop negative attitudes towards computers and express opposition to their use. Several research studies (e.g. Bozionelos, 2001; Durndell & Haag, 2002) evaluated *computer anxiety* as a separate construct and found a high relationship between attitudes towards computers and *computer anxiety*. Few researches have also supported the view that *computer enjoyment* (see Bagozzi, Davis & Warshaw, 1992) has positive effect on the intention to use technology in classrooms. Other studies have demonstrated that the cognitive component of attitude is an important one. For example, Vankatesh (1999) and Davis and Wiedenbeck (2001) found that perceived usefulness of computers has a positive effect on computer attitudes. This is important in an individual's assessment of his/her productivity and describes the extent to which performance of an activity is instrumental in achieving valued outcomes (Vankatesh, 1999). The effect of the conative component of computer attitudes on computer use is also well addressed by some studies. Marshall and Cox (2008) found teachers with Internet access at home demonstrate more positive attitudes towards computers, and feel a greater need for computers in their lives. Christensen and Knezek (2001) found a similar trend and further confirmed that teachers without access to the Internet at home seldom become high integrators of technology in their classrooms.

2.2. Technology competency (skill)

Competence is usually defined as having the ability to perform a specific task. Research into computer competencies, also indicated with the terms computer performance, computer ability, or computer achievement, is in contrast to the large attention of studies in computer attitudes (Meelissen, 2008). Teachers' competencies in computer use is usually measured through self-report. One might argue that therefore teachers' competencies should be conceived as self-efficacy measures, which is defined as "confidence in one's competence" (Bandura, 1977). Numerous studies have showed that computer competencies are positively correlated with an individual's willingness to choose and participate in computer-related activities, expectations of success in such activities, and persistence or effective coping behaviors when faced with computer-related difficulties (Looney, Valacich & Akbulut, 2004; Sang, Valcke, van Braak, & Tondeur, 2010; Smarkola, 2008). Teachers with higher levels of technology competencies used computers more often and experienced less computer-related anxiety. On the other hand, teachers with lower levels of technology competencies become more frustrated and more anxious, and hesitate to use computers when they encounter obstacles (Sang et al., 2010). More recent studies about teachers' technology competencies differentiate between basic technology competencies and pedagogical technology competencies (Law et al., 2008). Also Smarkola (2008) argued that for effective integration of technology, teachers must move beyond being "computer literate" to "technology competent". Smarkola added that being technologically competent allows teachers to use computers as part of the curriculum and as a tool for authentic student engagement and learning. Research shows that computer competencies influence expectations and emotional reactions regarding the effective use of modern technologies (Looney et al., 2004). Thus attitudes towards information technology are linked to computer competencies since they are deemed to be significant factors in the interpretation of the frequency and success with which individuals use computers (Khorrami-Arani, 2001). Competencies and attitudes are clearly interrelated and there appears to be a universal agreement that competency in the use of technology is a predicting factor to successful employing technology in teaching and learning.

2.3. Access to technology tools (tools)

In many developed countries, access to computers seems to be no longer a relevant issue (Meelissen, 2008; Morales, 2006). Therefore discussion about the relation between computer access, computer competencies and computer attitudes seems to have been shifted from computer access to the 'quality' of computer experience (McIlroy, Bunting, Tierney, & Gordon, 2001). This is an indication that access to technology tools is not a strong predictor in determining teachers' use of technology in instruction in these countries. This argument cannot be implied for developing countries. Gurcan-Namlu and Ceyhan (2003) discuss variables such as computer access level, usage frequency, computer ownership and amount and breadth of time in the use of computers as indicators of an individuals' level of technology use of computers. Only a small proportion of the African population has access to computers (Murphy, Anzalone, Bosch & Moulton, 2002) and 4% has access to the Internet (Resta & Laferrière, 2008). Aguti and Fraser (2006) in a study to integrate technology in Distant Education Program at the Makerere University of Uganda reiterated that lack of ready access to technologies by teachers is a key barrier to technology integration in most developing countries. Thus access levels could be influential factor in determining a teachers' use of technology in most African countries. Tekinarslan (2008) investigated computer anxiety and accessibility of personal computers between two groups of Dutch and Turkish students. The results of the study showed that the Dutch students had lower computer anxiety levels and for that matter higher levels of technology use than the Turkish students. This was explained by the relatively high levels of computer access and computer usage frequencies of the Dutch participants. These findings are consistent with findings of other studies (eg., Christensen & Knezek, 2001; Gurcan-Namlu & Ceyhan, 2003). Thus in general, accessibility of technology as mentioned in the will skill tool model tends to affect attitudes and competencies and has a positive relationship with the level of technology use.

2.4. Technology integration

Adoption of technology by teachers is considered a measure for technology integration. Adoption of technology is conceived as a process that develops through different stages. From being aware and informed about the possibilities of technology in education to a more routine utilization of technology in classroom practice and finally to creative uses of technology for teaching and learning (Christensen, 1997; Christensen & Knezek, 2002; Sandholtz, Ringstaff, & Dwyer, 1997).

3. Methods

3.1. Respondents

3.1.1. Teachers

A total of 60 mathematics teachers (52 males and 8 females) who were purposively sampled from 16 Senior High Schools participated in this study. Schools ranging from government, mission, private and international schools, which had a reasonable number of mathematics teachers as well as some kind of technology infrastructure, were selected. The average age of the teachers was approximately 39 ranging between 25 and 59 years. The average teaching experience was approximately 12 years ranging from as low as 1 year to 37 years.

3.1.2. Prospective teachers

Second and third year prospective mathematics teachers from the Teacher education programme at the University of Cape Coast participated in the study. During their lessons, students were asked whether they wanted to participate in the research. As a result, 120 prospective teachers volunteered to fill out the questionnaire. There were 95 males and 25 females aged between 19 and 43 years with an average age of nearly 26 years. Out of the 120 prospective teachers, 72 of them were Certificate *A* holders meaning they were basic school teachers and had some teaching experience already in lower secondary education.

Please cite this article in press as: Agyei, D. D., Voogt, J. M., Exploring the potential of the will, skill, tool model in Ghana: Predicting prospective..., Computers & Education (2010), doi:10.1016/j.compedu.2010.08.017

3.2. Research instruments

A questionnaire was used to collect data for this study. The questionnaire had several sections. The first section of the questionnaire was used to collect data for demographical characteristics such as age, gender and experience or year of study. Following were sections about attitudes towards computers, technology skills and competencies, levels of technology access and technology integration. The instruments used in the different sections are presented below.

3.2.1. Teachers' attitudes towards computers (TAC)

The TAC has been developed based on existing computer attitudes scales (Christensen & Knezek, 2000b). The TAC questionnaire is a 95–199 item Likert Differential instrument for measuring teachers' attitudes towards computers up to about 20 sub-scales. These measurement instruments are confirmed to be reliable by previous research (Knezek & Christensen, 1998). Fifty items of the TAC Questionnaire (Knezek & Christensen, 1998; Christensen & Knezek, 2000b) were slightly modified and used to explore the attitudes of the practicing and prospective teachers in the study. Thirty-four of them were selected as high loadings on the extracted factors after an exploratory factor analysis. In all, 6 sub-scales were used: *enjoyment* (the pleasure someone experiences when using and talking about computers), *anxiety* (fear to use and talk about computers), *benefit* (perceived advantages of using computers in the class), *interaction* (willingness to use possible applications of computers for information dissemination), influence of computer use on the *instructional productivity* of users and possible *professional enhancement* in the use of computers. For all six sub-scales, a five-point Likert scale (1 = strongly disagree, 5 = strongly agree) was used. The scores are interpreted as follows: 1 is the lowest possible score, which represents a very strong negative attitude, while the 5 is the highest possible score which represents a very strong positive attitude. Rescaling of some items of the anxiety scale was done, so that a high score on computer anxiety could be interpreted as lack of anxiety. The TAC was administered to 120 prospective and 60 practicing teachers. Table 1 shows the internal consistency reliabilities for the TAC sub-scales and the factor loadings for the selected items as reported by the teachers.

3.2.2. Technology in education competency survey (TECS)

The TECS (Knezek, Christensen, Miyashita & Ropp, 2000) is a self-report measure of technology competence. The TECS was adopted to measure the self-efficacies of the respondents on a four point Likert scale ranging from 1 (not at all) to 4 (a lot). This instrument is a quick and reliable self-report measure for use in assessing teacher technology competencies. Christensen and Knezek (2000a) reported a Cronbach's α of 0.92. In this study TECS was used to determine practicing and prospective teachers' technology competencies. Two sub-scales: *general purpose* (application of technology for general purposes) and *instructional purpose* (application of technology to support teaching and learning) were used. Cronbach's α for TECS items were 0.89 and 0.90 respectively. The instrument items are presented in the results section, Table 3.

Table 1
Internal consistency reliability for six sub-scale of the TAC.

Sub-scale	Cronbach's alpha	Items ($N = 180$)	Factor loadings
Lack of Anxiety	0.75	Working with a computer makes me nervous	0.75
		Using a computer is very frustrating	0.71
		Computers are difficult to use	0.68
		I think that it takes a long time to finish a task when I use a computer	0.65
		I get a sinking feeling when I think of trying to use a computer	0.63
Instructional Productivity	0.86	Computers could enhance remedial instruction	0.71
		Computers can help accommodate different teaching styles	0.70
		Computer can be used successfully with courses which demand creative activities	0.67
		Computers help to incorporate new teaching methods	0.65
		Teacher training should include instructional applications of computers	0.62
		Computers will relieve teachers of routine duties	0.61
		Computers can help incorporate new ways of organizing student Learning	0.61
		Computers can help teachers provide more individualized feedback to students.	0.57
		I believe that the roles of schools will be dramatically changed because of the internet	0.54
Professional Enhancement	0.86	If there is a computer in my future classroom, It would help me to be a better teacher.	0.70
		I would like to have a computer for use in my classroom	0.67
		If there was a computer in my classroom it would help me to be a better teacher	0.63
		I believe that the more often teachers use computers, the more I will enjoy school	0.56
Enjoyment	0.65	I concentrate on a computer when I use one	0.74
		I enjoy doing things on a computer	0.72
		The challenge of learning about computers is exciting	0.69
		I enjoy lessons on the computer	0.62
		I enjoy using new tools for instruction	0.55
		I believe that it is very important for me to learn how to use a computer	0.52
Interaction	0.67	I prefer e-mail to traditional class handouts as an information disseminator	0.79
		E-mail is an effective means of disseminating class information and assignments	0.76
		The use of e-mail provides better access to instructor	0.72
		Improvement of communication and interaction between instructors and students, and among students	0.66
Benefit	0.87	Lesson delivery is improved and enhanced (efficiency)	0.77
		Enhances students learning (effectiveness)	0.73
		Students can access courses, assignments, course outlines etc. regardless of location and time (flexibility in education)	0.71
		Improvement of feedback to students	0.66
		Provision of a better learning experience	0.59
		The relationship between theory and practice is strengthened (e.g. through simulations)	0.53

Please cite this article in press as: Agyei, D. D., Voogt, J. M., Exploring the potential of the will, skill, tool model in Ghana: Predicting prospective..., Computers & Education (2010), doi:10.1016/j.compedu.2010.08.017

Table 2
Differences in attitudes based on TAC scores of practicing and prospective teachers: (*M*, SD, *p*-value and effect size).

Subscale	Practicing teachers		Prospective teachers		Sig	Effect size
	M	SD	*M*	SD		
Lack of anxiety	4.15	0.80	3.90	0.90	0.04*	0.29
Instructional productivity	4.28	0.54	4.34	0.54	0.50	−0.11
Professional enhancement	4.48	0.66	4.48	0.65	0.97	0.00
Enjoyment	4.32	0.54	4.35	0.46	0.69	−0.06
Interaction	3.78	0.85	3.99	0.78	0.10	−0.26
Benefit	4.19	0.60	4.32	0.52	0.13	−0.23
Overall attitude	*4.20*	*0.39*	*4.23*	*0.41*	*0.41*	*−0.08*

* $P < 0.05$ – analyzed with *t*-test.

3.2.3. Access to technology

Three variables indicating level of access to technology tools were used in the study. These were (prospective and practicing teachers) access to Internet connectivity at school or in their office, whether or not they had access to a computer either in the office or at the computer laboratory or whether or not they had access to computers at staff common room or the library. Respondents were supposed to indicate either "yes" or "no" to whether they had access to each of the items. The instruments items are presented in the results section, Table 4.

3.2.4. Stages of adoption of technology (SoA)

SoA was used to measure the teachers' technology integration levels. The SoA provides a measure of the teachers' stage of adoption of technology use in educational practice (Christensen & Knezek, 2000b, 2008).This instrument is a quick and reliable self-report measure for use in assessing technology integration. Since the SoA is a single item survey, internal consistency measures cannot be calculated for data gathered through it, however a high test–retest reliability estimates (0.91–0.96) was obtained from validation studies (Hancock, Knezek & Christensen, 2007). The six stages related to adoption of technology are: Stage 1(Awareness), Stage 2 (Learning the process), Stage 3 (Understanding and application of the process), Stage 4 (Familiarity and confidence), Stage 5 (Adoption in other contexts) and Stage 6 (Creative applications in new contexts).

3.3. Data collection and data analysis procedures

The questionnaire was distributed to the prospective teachers during the school after a lecture. For the practicing teachers it was sent to them in their various high schools with the help of the principals and department heads. To analyze the data descriptive statistics, independent *t*-tests, correlation analysis and regression analysis were used. Effect size was calculated using Cohen's *d* (Cohen, 1969). Cohen (1969) provided tentative benchmarks for the interpretation of effect sizes. He considers $d = 0.2$ a small, $d = 0.5$ a medium and $d = 0.8$ a large effect size.

4. Results

4.1. Descriptive statistics

A comparison between the two groups of participants was conducted in terms of their computer attitudes. The overall attitudes (*practicing teachers* $M = 4.20$, *prospective teachers* $M = 4.23$) seem to suggest high positive attitudes of the teachers towards computers. The *t*-test results shown in Table 2 indicated no significance difference in overall computer attitudes between the two groups. Very low effect size differences were observed for the various sub-scales. A significant difference was found with practicing teachers scoring higher on lack of anxiety (effect size $d = 0.29$).

The TECS variables that were used to measure the teachers' technology competency revealed fairly low competencies. The practicing teachers in general seemed to be more competent or skilful in the use of technology than the prospective teachers. Table 3 shows an overall significant difference ($p < 0.001$) with a medium effect size of 0.56 between the levels of competencies of the two groups. Particularly very large effect size ($d = 1.02$) was recorded for the differences in competencies which had to do with instructional purposes.

Table 4 shows the distribution of the differences of the level of access across the teachers. It is apparent that the practicing teachers have higher level of access to technology compared to the prospective teachers. This is more pronounced in the difference ($d = 1.04$, $p = 0.03$) with accessibility to Internet connectivity. Although the means (practicing teachers = 1.40, prospective teachers = 1.20) do not show high access of technology, the difference ($d = 0.50$, $p < 0.001$) is quite significant.

Table 5 shows the results on practicing teachers and prospective teachers' stages of adoption of technology. The overall difference in means of the stages of adoption for the practicing teachers ($M = 3.92$, $SD = 1.45$) and prospective teachers ($M = 3.28$, $SD = 1.27$) was

Table 3
Differences in technology in education competencies of practicing and prospective teachers; (*M*, SD, *p*-value and effect size).

TEC	Practicing teachers		Prospective teachers		Sig	Effect size
	M	SD	*M*	SD		
General purpose	2.55	1.03	2.07	0.96	0.002*	0.48
Instructional purpose	2.39	0.98	1.78	0.79	0.000*	1.02
Overall mean	*2.56*	*0.96*	*2.05*	*0.85*	*0.000**	*0.56*

Scale: 1= not at all, 2 = a little, 3 = somewhat, 4 = a lot; * $P < .05$.

Please cite this article in press as: Agyei, D. D., Voogt, J. M., Exploring the potential of the will, skill, tool model in Ghana: Predicting prospective..., Computers & Education (2010), doi:10.1016/j.compedu.2010.08.017

Table 4
Differences in accessibility of technology of practicing and prospective teachers; (*M*, SD, *p*-value and effect size).

	Practicing teachers ($n = 60$)		Prospective teachers ($n = 120$)		Sig	Effect Size (d)
	M	SD	*M*	SD		
Access to computers (office/computer lab)	1.23	0.43	1.19	0.40	0.21	0.11
Access to computers (staff common room/library)	1.20	0.40	1.10	0.30	0.00*	0.28
Internet connectivity	1.77	0.43	1.31	0.46	0.03*	1.04
Overall mean	*1.40*	*0.42*	*1.20*	*0.39*	*0.00**	*0.50*

Scale: 1= no, 2 = yes; * $p < 0.05$.

significant with ($p = 0.003$) and a medium effect size ($d = 0.47$). Thus, the practicing teachers seem to be higher than the prospective teachers when it comes to the levels of technology use. Interestingly 8.3% each of the total respondents for both practicing teachers and prospective teachers indicated that they were at the "*awareness*" (stage 1) stage of adoption of technology. At higher stages of technology adoption (Stages 5 and 6), the practicing teachers seem to be more than the prospective teachers; however at lower stages (1 and 2), the prospective teachers are more than the practicing teachers.

4.2. Stages of adoption and teachers' related attitude (will), competencies (skill) and access (tool) to technology

Fig. 1 illustrates the relationship between the attitude scales measured by the TAC, as teachers advance from lower to higher stages of adoption of technology. There seems to be a strong relationship between lack of anxiety and stage of adoption. Perhaps this is an indication that lack of anxiety is a possible predictor of classroom integration for these teachers. The relationship between the other attributes and the stages of adoption seem not to be clearly defined (see Fig. 1).

A Pearson product–moment correlation was calculated between the various attributes of computer use and the stages of adoption of technology. Correlations were significant for "*lack of anxiety*" ($r = 0.43$, $p < 0.001$) and "*enjoyment*" ($r = 0.16$, $p = 0.03$) at 0.01 and 0.05 levels of significance respectively.

However the product–moment correlation between the overall computer attitudes and the stages of adoption ($r = 0.1$, $p = 0.181$) was found to be very weak. This seems to suggest that the overall attitudes of the respondents had a very weak correlation with the stages of adoption of technology. The two sub-scales (lack of anxiety and enjoyment) which had significant relation with the stages of adoption also had a significant correlation ($r = 0.41$, $p < 0.001$) with the stages of adoption when they were combined. A significant association ($r = 0.63$, $p < 0.001$) was found between technology competencies and stages of adoption of these teachers. Although there seems to be a week and linear association between the teachers' technology access and stage of adoption, the correlation ($r = 0.23$) was significant at the 0.01 level of significance.

4.3. A predictive model of technology integration using the will–skill–tool concept

A regression analysis model was used to explore how well will, skill and technology tools could predict an individuals' stage of adoption. The following are the results:

4.3.1. Impact of will

The R^2 for the stage of adoption (0.01) predicted from the TAC attitude scales shows that only 1% of the variance in stage of adoption was found to be attributable to the "will" measures of the respondents. The *F* test: $F = (1178) = 1.80$, $p = 0.181$ ($p > 0.01$) associated with the independent variable was not significant indicating that the independent variable does not predict the dependent variable if only the "*will* "was considered in the model.

4.3.2. Impact of will and skill combined

Adding skill measures to the equation, the R^2 for Stages of adoption predicted from the TAC attitude and TECS measures increased from 0.01 to 0.40. This means that the predictability of stages of adoption of technology increases from 1% to approximately 40% when the skill measure is added. The *F* test: $F\,(2,177) = 59.69$, $p < 0.001$ was significant for the model.

4.3.3. Impact of will, skill and tool on technology integration

Adding measures of tool of technology for the respondents increased the predictability of stages of adoption from 40% to 41%. The regression equation with all the three predictors was significantly related to the stage of adoption index, $R^2 = 0.41$, adjusted $R^2 = 0.40$, *F*

Table 5
Comparison of Stages of Adoption of technology between practicing and prospective teachers.

Stage of adoption	Practicing teachers ($n = 60$)		Prospective teachers ($n = 120$)	
	Freq	%	Freq	%
Awareness	5	8.3	10	8.3
Learning the process	3	5.0	29	24.2
Understanding and application of the process	17	28.3	20	16.7
Familiarity and confidence	11	18.3	44	36.7
Adaptation to other contexts	15	25	13	10.8
Creative application to new contexts	9	15	4	3.3

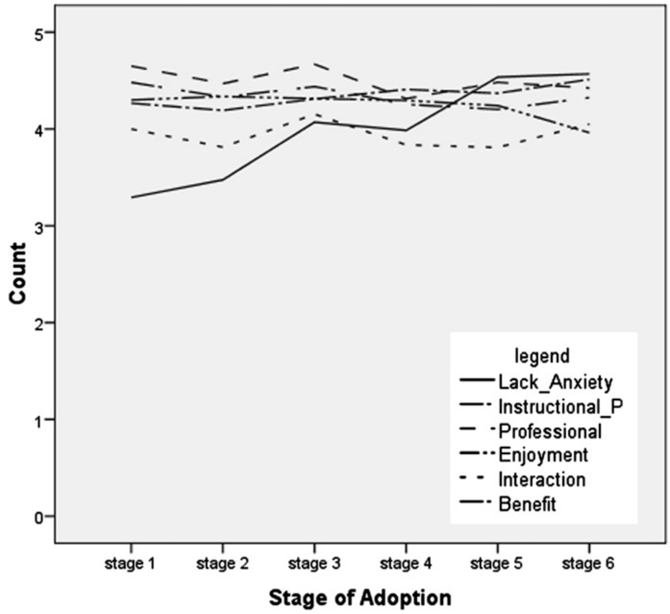

Fig. 1. Teacher attitudes toward computers by stage of adoption of technology.

(3,176) = 40.71, $p < 0.001$.The standardized coefficients of the various predictors were 0.04, 0.61 and 0.09 for the will, skill (self-efficacy) and tool measures respectively.

According to the standardized coefficients the regression model 1 is as follows:

$$SOA_{predicted} = 0.04will + 0.61skill + 0.09tool$$

As shown in the model, *skill* appeared to be a strong predictor of classroom integration for these teachers; *tool* quite acceptable and *will* ($r = 0.1$, $p = 0.181$) was a weaker and perhaps an unacceptable predictor. A second model was investigated to further explore the extent of the teachers' computer attitude (particularly *lack of anxiety* attitude) as a predictor in the model. This analysis explored the relationship between teachers' *lack of anxiety* which had a significant association with the stage of adoption ($r = 0.43$, $p < 0.001$) as teachers' *will* as against the other measures: *skill* and *tool*. Table 6 gives an over view of the results.

The regression analysis verified that approximately 18% of the variance in the stage of adoption is attributable to "*will*" measures of the teachers. Adding *skill* measures to the equation increased the predictability of the stages of adoption of technology from roughly 18% to approximately 42%. Further more, predictability increased to approximately 43% when measures of *tool* were added to the equation. At all levels of the model, the *F*-values were significant indicating that the independent variables predict the dependent variable. According to the standardized coefficients the regression equation for this second model was:

$$SOA_{predicted} = 0.16will + 0.55skill + 0.06tool$$

Table 7 shows the results when the process is repeated for computer *enjoyment* attitude ($r = 0.16$, $p = 0.032$; no significant associations were found between the other *TAC* sub-scales and *SOA*) as an indicator of the teachers' "*will*" as against the other measures in the model.

The regression model 3 is as follows:

$$SOA_{predicted} = 0.03will + 0.61skill + 0.09tool$$

5. Discussion

The study was designed to explore the computer attitudes, competencies, access and technology integration of prospective and practicing mathematics teachers in Ghana, using the will (attitudes towards computers), skill (technology competency), tool (access to technology tools) model. Prospective and practicing teachers demonstrated a positive attitude towards computers. But contrary to findings in other studies that younger people tend to have more positive attitudes towards the use of computers than their older peers (Christensen &

Table 6
Coefficients of Predictors (*Lack of anxiety* (*Will*) against *Skill* and *Tool* measures of technology integration).

	R	*R*-square	*F* (Sig)	Standardized coefficients	*t*	Sig
Impact of will (*Lack of anxiety*)	0.43	0.18	39.76(0.000)*	0.43(*L*)	6.31	0.000
Impact of will and skill combined	0.65	0.42	65.09(0.000)*	0.17(*L*)	2.64	0.009
				0.55(*S*)	8.61	0.000
Impact of will, skill and tool on technology integration	0.65	0.43	43.82(0.000)*	0.16(*L*)	2.43	0.016
				0.55(*S*)	8.38	0.000
				0.06(*T*)	1.07	0.284

* $p < 0.05$; *L* = Lack of anxiety, *S*= Skill, *T* = Tool.

Please cite this article in press as: Agyei, D. D., Voogt, J. M., Exploring the potential of the will, skill, tool model in Ghana: Predicting prospective..., Computers & Education (2010), doi:10.1016/j.compedu.2010.08.017

Table 7
Coefficients of Predictors (Computer *Enjoyment* (*Will*) against *Skill* and *Tool* measures of technology integration).

	R	*R*-Square	*F* (Sig)	Standardized coefficients	*t*	Sig
Impact of will (*Computer enjoyment*)	0.16	0.03	4.69(0.032)	0.16(*E*)	2.17	0.032
Impact of will and skill combined	0.63	0.40	59.49(0.000)	0.03(*E*)	0.50	0.615
				0.63(*S*)	10.55	0.000
Impact on will, skill and tools on technology integration	0.64	0.41	40.67(0.000)	0.03(*E*)	0.53	0.581
				0.61(*S*)	9.94	0.000
				0.09(*T*)	1.49	0.138

Note $p < 0.05$; $E =$ Enjoyment, $S=$ Skill, $T =$ Tool.

Knezek, 2006; Meelissen, 2008); the prospective teachers in this study showed more anxiety than the practicing teachers. The study reported fairly low technology competencies for the teachers. However, the practicing teachers were more technology competent than prospective teachers. The lower competencies, which was considered as a self-efficacy measure, of the prospective teachers coupled with their higher anxiety is consistent with findings of previous studies which suggest that computer skills and competencies are positively correlated with an individual's willingness to choose to participate in computer-related activities, and that teachers with higher levels of competencies experienced less computer-related anxiety than teachers with lower levels of technology competencies (Looney et al., 2004; Sang et al., 2010). A number of reasons might have accounted for the higher competencies of practicing teachers and the higher anxiety of the prospective teachers. One possible reason for this situation could have been the fact that the practicing teachers had more access to technology compared to the prospective teachers. Numerous studies have revealed that increase in computer experiences such as computer access, and computer usage frequencies leads to lower computer anxiety and higher technology competencies (Christensen & Knezek, 2001; Gurcan-Namlu & Ceyhan, 2003; Tekinarslan, 2008). Another reason which could explain why practicing teachers had higher technology competencies and showed less anxiety than prospective teachers could be attributed to in-service training organised for practicing teachers as was reported by school principals (Author, submitted for publication). Level of access and participation in in-service training could also explain the difference between prospective and practicing teachers in the levels of technology use. A body of literature on teachers' competencies and use of computers in instruction shows that teacher training programs play a vital role in making teachers less anxious and more confident about the use of computers in instruction. Teachers who are more familiar with computers are more confident about using them for instruction and report more positive attitudes about the instructional effectiveness of computers (Christensen & Knezek, 2008; Khorrami-Arani, 2001; Pamuk & Peker, 2009).

In the study the overall attitudes of the teachers did not correlate with their SoA contrary to previous studies which suggest that teachers' attitude play a key role in determining computer use as a learning tool and determining the likelihood that the computer will be used in the future for teaching or learning (Huang & Liaw, 2005; Paraskeva et al., 2008; Teo, 2008). Teachers' enjoyment and lack of anxiety towards computers in particular correlated significantly with SoA. This is in line with multiple studies (Christensen & Knezek, 2001; Teo, 2008) which have been able to show a consistent decline in computer anxiety as teachers advance to higher SoA of technology. Teachers' technology competencies and access correlated significantly with their stages of adoption.

Finally, the findings of the study reported the extent to which the parameters will, skill and tool contribute to predicting teachers' classroom integration of technology. In predicting the stages of adoption, structured equation modelling (Knezek, Christensen, Hancock & Shoho, 2000) would have been a better option; however it was not used because a much larger sample would have been needed. For this reason linear regression was used. Linear regression was applied on the whole data set, because similar patterns were observed when the data were treated for practicing and prospective teachers separately. Three models were discussed. The study showed that in all these models the "skill" of the teachers appeared to be the strongest predictor of classroom integration of computer use. This is different from the Mexican teachers (Morales, 2006) for whom access to technology explained most of the variance in technology integration. As already discussed the will of teachers, measured by their overall attitudes towards computers, showed no significant association with stage of adoption. This indicates that the first model was not the best fit for the data. In the second and the third models, the will of the teachers: "lack of anxiety" and "enjoyment" both showed significant association with teachers' stages of adoption with the former showing a much stronger correlation coefficient, indicating that the second model is the best fit for the data. This model explains 43% of the variance in stages of adoption of technology. This is consistent with literature that computer anxiety is the most important dimension of attitudes towards computers (Pamuk & Peker, 2009). A number of studies (Bozionelos, 2001; Durndell & Haag, 2002) have evaluated it as a separate construct and found a high relationship between attitudes and computer anxiety.

6. Practical implications

Several implications for professional development and teacher support for technology integration can be inferred from this study. The results of this study suggest that increasing teachers' technology competencies and decreasing their anxiety should be an integrated part of the design of professional development arrangements for prospective and practicing teacher education. It is believed that such arrangements can play a vital role in making teachers less anxious and consequently more confident about use of computers. Regarding technology integration by mathematics teachers in Ghana, attempts should be made to provide extensive professional development opportunities that focus on training practicing teachers to acquire skills on how to integrate technology effectively in their instruction – taking the context of the available technology infrastructure into account – and not just the acquisition of basic technology skills. Also teacher education institutions need to include courses on pedagogical issues related to technology integration in their curriculum. In this way prospective teachers' competencies will be enhanced and their experience to integrate technology in their future classes will increase. This will ensure that trained teachers are less anxious and sufficiently prepared for new teaching methods which are flexible and involve appropriate use of technology. The government of Ghana has put in place support systems in schools to facilitate access to computers. However, access probably will continue to be an issue in secondary schools in the coming years. In order to support government efforts, other stakeholders

Please cite this article in press as: Agyei, D. D., Voogt, J. M., Exploring the potential of the will, skill, tool model in Ghana: Predicting prospective..., Computers & Education (2010), doi:10.1016/j.compedu.2010.08.017

such as the Parent Teachers' Association, School Management and Boards must also put priority on the provision of technology facilities in schools to facilitate and increase access of teachers. Easy access to technology will certainly contribute to teachers' use of computers in the schools.

7. Limitation and further research

This study was not without some limitations. The best model had only 43% of the variance in stages of adoption of technology being accounted for by the latent variables as compared to over 90% from results of previous studies (Morales, 2006). This gives an indication that there could be other highly reliable indicators of technology integration in this context which have not been explored in the study.

The fact that findings from a sample of mathematics teachers have been used is a limitation for the generalization of the findings. Although mathematics teachers form the highest number of all teachers in the senior high school (mathematics is taught both as a core subject for all students and as an elective subject for some programs in the sciences, business and arts), involving other subject teachers in the study could have enhanced the extension of the findings and conclusions. The study which was conducted with only 60 practicing teachers from 16 schools which were sufficiently endowed with technology and 120 prospective teachers from one teacher education program provides no evidence to shed light on whether the findings of this study reflect the situation in the whole country.

8. Conclusion

The purposes of the study reported here were achieved in the modification and adoption of some measures: attitudes, competencies, access as predicting factors of level of technology use of prospective and practicing teachers. The prospective teachers in this study showed more anxiety and were less technology competent than the practicing teachers. Computer anxiety was identified as the most important dimension of attitudes towards computers consistent with literature of previous studies. The study showed that skill (competencies) was the strongest predictor of classroom integration of computers by these teachers. Not withstanding the limitations, findings of this study provide directions for policy and practice about next steps that are necessary for a successful integration of technology in secondary education in Ghana. In addition the findings of this study may also inform similar initiatives on prospective and practicing teachers' use of technology in other sub-Sahara African countries.

References

Aguti, J. N., & Fraser, W. J. (2006). Integration of information communication technologies in the distance education programme, Makerere university, Uganda. *Turkish Online Journal of Distance Education, 7*(3), 89–104.

Anamuah-Mensah National Education Review Committee Report. (2002). *Report of the President's committee on review of education reforms in Ghana*. Accra, Ghana: Ministry of Education.

Author. *ICT use in the teaching of mathematics: Implications for professional development of pre-service teachers in Ghana*, submitted for publication.

Ávila Muñoz, P. (2008). ICT and educational policy for the Latin American and Caribbean regions. In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education* (pp. 1133–1143). New York: Springer.

Bagozzi, R. P., Davis, F. D., & Warshaw, P. R. (1992). Development and test of a theory of technological learning and usage. *Human Relations, 45*(7), 660–686.

Bandura, A. (1977). Self-efficacy: towards a unifying theory of behavioral change. *Psychological Review, 84*(2), 191–215.

Bozionelos, N. (2001). Computer anxiety: relationship with computer experience and prevalence. *Computers in Human Behavior, 17*, 213–224.

Christensen, R. (1997). *Effect of technology integration education on the attitudes of teachers and their students*. Doctoral dissertation, University of North Texas. [Online]. Available: http://courseweb.unt.edu/rhondac.

Christensen, R., & Knezek, G. (2000a). *Internal consistency reliability for the technology in education competency survey*. Presentation to the Preparing Tomorrow's Teachers Evaluator's Workshop, American Educational Research Association Annual Meeting, New Orleans, LA, April 25, 2000.

Christensen, R., & Knezek, G. (2000b). Internal consistency reliabilities for 14 computer attitude scales. *Journal of Technology in Teacher Education, 8*(4), 327–336.

Christensen, R., & Knezek, G. (2001). Profiling teacher stages of adoption for technology integration. *Computers in New Zealand Schools, 13*(3), 25–29.

Christensen, R., & Knezek, G. (2002). Instruments for assessing the impact of technology in education. *Computers in the Schools, 18*(2), 5–25.

Christensen, R., & Knezek, G. (2006). Findings from the spring 2006 Irving laptop surveys for teachers. http://iittl.unt.edu/irving/index.htm Retrieved May 12, 2009 from.

Christensen, R., & Knezek, G. (2008). Self-report measures and findings for information technology attitudes and competencies. In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education* (pp. 349–366). New York: Springer.

Cohen, J. (1969). *Statistical power analysis for the behavioral sciences*. New York: Academic Press.

Davis, S., & Wiedenbeck, S. (2001). The mediating effects of intrinsic motivation, ease of use and usefulness perceptions on performance in first time and subsequent computer users. *Interacting with Computers, 13*, 549–580.

Durndell, A., & Haag, Z. (2002). Computer self-efficacy, computer anxiety, attitude to the Internet and reported experience with the Internet, by gender, in an East European sample. *Computers in Human Behavior, 18*(5), 521–535.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*. California: Addision-Wesley Publishing Company.

Ghana ICT4AD Policy. (2003). *A policy statement for the realization of the vision to transform Ghana into an information-rich knowledge-based society and economy through the development, deployment and exploration of ICT's within the economy and society*. Accra, Ghana: Ministry of Education.

Gurcan-Namlu, A., & Ceyhan, E. (2003). Computer anxiety: multidimensional analysis on teacher candidates. *Educational Sciences: Theory and Practice, 3*(2), 401–432.

Hancock, R., Knezek, G., & Christensen, R. (2007, June). *Cross-validating measures of technology integration: A first step toward examining potential relationships between technology integration and student achievement*. Paper presented at the National Educational Computing Conference, Atlanta, GA.

Huang, H. M., & Liaw, S. S. (2005). Exploring users' attitudes and intentions toward the web as a survey tool. *Computers in Human Behavior, 21*(5), 729–743.

Khorrami-Arani, O. (2001). Researching computer self-efficacy. *International Education Journal, 2*(4), 17–25.

Knezek, G., & Christensen, R. (1998). Internal consistency reliability for the teachers' attitudes toward information technology (TAT) questionnaire. In S. McNeil, J. D. Price, S. Boger-Mehall, B. Robin, & J. Willis (Eds.), *Technology and teacher education annual 1998, Vol. 2*. Charlottesville, VA: Association for the Advancement of Computing in Education.

Knezek, G., Christensen, R., Hancock, R., & Shoho, A. (February 2000). *Toward a structural model of technology integration*. Paper presented at the Hawaii Educational Research Association Annual Conference, Honolulu, HI.

Knezek, G., Christensen, R., Miyashita, K., & Ropp, M. (2000). *Instrument for assessing educator progress*. Denton, TX: Texas Center for Educational Technology.

Law, N. (2008). Teacher learning beyond knowledge for pedagogical innovations with ICT. In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education* (pp. 425–435). New York: Springer.

Law, N., Pelgrum, W. J., & Plomp, T. (2008). *Pedagogy and ICT use in schools around the world. Findings from the IEA SITES 2006 study. CERC Studies in comparative education*. Hong Kong: Comparative Education Research Centre, The University of Hong Kong, and Dordrecht: Springer.

Looney, C., Valacich, J., & Akbulut, A. (2004). Online investment self-efficacy: Development and initial test of an instrument to assess perceived online investing abilities. In: *Proceedings of the 37th Hawaii international conference on system sciences*. Honolulu, HI.

Marshall, G., & Cox, M. (2008). Research methods: their design, applicability and reliability. In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education* (pp. 983–987). New York: Springer.

McIlroy, D., Bunting, B., Tierney, K., & Gordon, M. (2001). The relation of gender and background experience to self-reporting computer anxieties and cognitions. *Computers in Human Behavior, 17*(1), 21–33.

Meelissen, M. (2008). Computer attitudes and competencies among primary and secondary school students. In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary secondary education* (pp. 381–391). New York: Springer.

Ministry of Education. (2000). *Teaching syllabus for mathematics*. Accra, Ghana: Ministry of Education.

Ministry of Education, Science and Sports. (2007). *Teaching syllabus for mathematics*. Accra, Ghana: Ministry of Education.

Morales, C. (2006). *Cross-cultural validation of the will, skill, tool model of technology integration*. Unpublished doctoral dissertation, University of North Texas, Denton, TX.

Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: a review of the literature. *Journal of Information Technology for Teacher Education, 9*(3), 319–342.

Murphy, P., Anzalone, S., Bosch, A., & Moulto, J. (2002). Enhancing learning opportunities in Africa: Distance education and information and communication technologies for learning. *Africa region human development working paper series*.

Myers, J. M., & Halpin, R. (2002). Teachers' attitudes and use of multimedia technology in the classroom: constructivist-based professional development training for school districts. *Journal of Computing in Teacher Education, 18*(4), 133–140.

Pamuk, S., & Peker, D. (2009). Turkish pre-service science and mathematics teachers' computer related self-efficacies, attitudes, and the relationship between these variables. *Computers & Education, 53*, 454–461.

Paraskeva, F., Bouta, H., & Papagianna, A. (2008). Individual characteristics and computer self-efficacy in secondary education teachers to integrate technology in educational practice. *Computer and Education, 50*(3), 1084–1091.

Pelgrum, W. J., & Anderson, R. A. (Eds.). (1999). *ICT and the emerging paradigm for life long learning: A worldwide educational assessment of infrastructure, goals and practices*. Amsterdam: IEA.

Resta, P., & Laferrière, T. (2008). Issues and challenges related to digital equity. In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education* (pp. 765–778). New York: Springer.

Sandholtz, J., Ringstaff, C., & Dwyer, D. C. (1997). *Teaching with technology: Creating student-centered classrooms*. New York: Teachers College Press.

Sang, G. Y., Valcke, M., van Braak, J., & Tondeur, J. (2010). Student teachers' thinking processes and ICT integration: predictors of prospective teaching behavior educational technology. *Computers and Education, 54*(1), 103–112.

Smarkola, C. (2008). Efficacy of a planned model: belief that contribute to computer usage intentions of student teachers. *Computers in Human Behavior, 24*, 1196–1215.

Tekinarslan, E. (2008). Computer anxiety: a cross-cultural comparative study of Dutch and Turkish university students. *Computers in Human Behavior, 24*, 1572–1584.

Teo, T. (2008). Assessing the computer attitudes of students: an Asian perspective. *Computers in Human Behavior, 24*, 1634–1642.

Tilya, F. (2008). IT and educational policy in the Sub-Saharan African region. In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education* (pp. 1145–1159). New York: Springer.

Vankatesh, V. (1999). Creation of favorable user perceptions: exploring the role of intrinsic motivation. *MIS Quarterly, 23*(2), 239–260.

Voogt, J. (2003). Consequences of ICT for aims, contents, processes and environments of Learning. In J. van den Akker, W. Kuiper, & U. Hameyer (Eds.), *Curriculum landscapes and trends* (pp. 217–236). Dordrecht: Kluwer.

Woodrow, J. E. (1992). The influence of programming training on the computer literacy and attitudes of preservice teachers. *Journal of Research on Computing in Education, 25*(2), 200–218.

Please cite this article in press as: Agyei, D. D., Voogt, J. M., Exploring the potential of the will, skill, tool model in Ghana: Predicting prospective..., Computers & Education (2010), doi:10.1016/j.compedu.2010.08.017