

Theory of Planned Behavior and Teachers' Decisions Regarding Use of Educational Technology

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ABSTRACT

According to Ajzen's Theory of Planned Behavior (TPB), behavioral intention (BI) is predicted by attitude toward the behavior (AB), subjective norm (SN), and perceived behavioral control (PBC). Previous studies using the TPB to explain teachers' intentions to use technology have resulted in inconsistent findings. This inconsistency might be due to overly broad definitions of the target behavior. To investigate this potential weakness, we defined a specific target behavior, using computers *only* to create and deliver lessons, and then used the TPB to investigate teachers' decisions. An elicitation study was used to identify teachers' salient beliefs and develop a closed-ended questionnaire. Results of the closed-ended questionnaire revealed that AB, SN, and PBC all were significant predictors of teachers' intentions. However, AB had twice the influence of SN and three times that of PBC. This finding suggests that teachers must have positive attitudes about using computers to create and deliver lessons. They are less concerned about what others think of this practice, and far less bothered by internal or external constraints. Results provide specific information that can be used to design effective teacher development programs and remind TPB researchers of the importance of using specific definitions of the target behavior.

Keywords

Theory of Planned Behavior, Behavioral intention, Technology usage, Teacher beliefs

Problem Statement and Theoretical Foundation

It is generally accepted that the use of technology in schools has altered, and continues to transform the educational landscape dramatically, fueling changes in content, pedagogy, and assessment (US DOE, 2004). In order to capitalize on the potential benefits of technology in the classroom, governments throughout the world have instituted initiatives intended to increase its use (e.g., Rha & Yoshida, 2005; US Web-based Education Commission, 2000).

These initiatives generally recognize the need for effective, continuous teacher development programs designed to help teachers integrate technology into their teaching. However, most recommendations focus mainly on teacher competence with technology. For example, according to the US Web-based Education Commission (2000), teachers must be, "able to apply it [technology] appropriately, and conversant with new technological tools, resources, and approaches (p. 39)."

We will argue that teachers' competence is only one of several factors determining their decisions regarding the use of educational technology. Other influences might include the value they attribute to the use of technology. Regardless of their perceived self competence, teachers may not use technology if they do not value it in their teaching. Another possible influential factor is the opinions of significant others. If, for example, a teachers' supervisor strongly promotes the use of technology in the classroom, this teacher might be inclined to please the supervisor by using technology, despite any perceived personal incompetence or uncertainty of the value.

As a result, designing professional development programs without taking into account other factors limits their potential impact. Moreover, monetary decisions regarding support for technology initiatives must be based on consideration of all factors that determine teachers' decisions to use educational technology. Finally, from a research perspective, it is important to establish the extent to which empirical findings support intuition or conventional wisdom. What then are the primary factors that underlie teachers' intentions to utilize technology in their classrooms, and what are their relative strengths?

Icek Ajzen's (1985) Theory of Planned Behavior (TPB), an explanatory model for a wide variety of behavioral intention, can be used to address this question. According to the TPB, volitional human behavior is immediately preceded by intention to engage in this behavior (see Figure 1). Behavioral intention is predicted, in turn, by three main determinants: attitude toward the behavior (AB), subjective norm (SN), and perceived behavioral control

(PBC). The extent to which individuals view a particular behavior positively (attitude), think that significant others want them to engage in the behavior (subjective norm), and believe that they are able to perform the behavior (perceived behavioral control), serve as direct determinants of the strength of their intention to carry out the behavior.

Each of these three direct determinants of behavioral intention is influenced, in turn, by an indirect determinant. Indirect determinants are based on a set of salient beliefs and evaluations of these beliefs. Measures of the indirect determinants embody expectancy-value theory (Fishbein & Ajzen, 1975). This theory posits that attitudes are developed and revised according to assessments about beliefs and values. This idea was applied to the calculation of the three indirect determinants of the TPB as follows (Ajzen, 1985):

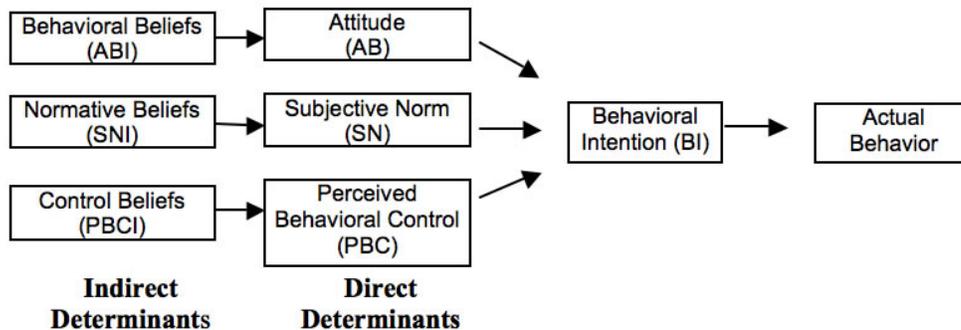


Figure 1. Theory of Planned Behavior (Adapted from Ajzen (1985))

Salient behavioral beliefs (BB) about the outcomes of a particular behavior, weighted by their outcome evaluations (oe), form an indirect measure of an individual’s attitude toward the behavior (ABI). Salient normative beliefs (NB) about whether important others approve of the behavior, weighted by the motivation to comply (mc) with these perceived norms, constitute an indirect measure of subjective norm (SNI). Salient control beliefs (CB) about facilitators of or obstacles to performing the behavior, weighted by their control power (cp), comprise an indirect measure of perceived behavioral control (PBCI). The three indirect measures are given by:

$$ABI = \sum_i (oe)_i (BB)_i \quad SNI = \sum_j (mc)_j (NB)_j \quad PBCI = \sum_k (cp)_k (CB)_k$$

The TPB has been used successfully to understand a wide variety of human behaviors, such as weight loss behavior (Schifter & Ajzen, 1985), and smoking cessation (Godin, Valois, Lepage, & Desharnais, 1992). Results of these studies have provided specific information used to design effective programs aimed at these behaviors (See Ajzen, n.d., for a comprehensive list of TPB studies). For example, because Godin et al. (1992) found perceived behavioral control to be a relatively strong predictor of both intention and behavior, they recommended programs that help smokers develop their will-power and inform them of the effort required in order to modify smoking behavior.

The TPB has also been used to explain teachers’ intentions and behavior in the classroom (e.g., Crawley, 1990; Zint, 2002). In particular, the TPB has been utilized in predicting K-12 teachers’ intentions toward educational technology usage (Czerniak, Lumpe, Haney, & Beck, 1999; Salleh & Albion 2004; Sugar, Crawley, & Fine, 2004). Results of such studies have the potential to help guide approaches to fostering teacher technology use.

Besides the TPB, several other models have been used to predict intentions to use technology, including the Theory of Reasoned Actions (Fishbein and Ajzen, 1975) and the Technology Acceptance Model (Davis, Bagozzi, and Warshaw, 1989). The Theory of Reasoned Actions, a precursor to the TPB, includes only two of the three direct determinants of behavioral intention, attitude toward the behavior and subjective norm. The Technology Acceptance Model uses perceived usefulness, instead of subjective norm, as the second determinant of behavioral intention. All three models postulate that behavior is predicted by behavioral intention.

Davis, Bagozzi, and Warshaw (1989) compared the relative effectiveness of the Theory of Reasoned Actions and the Technology Acceptance Model on MBA students' intention to use a word processing program and their subsequent usage and found that, while both models predicted behavioral intention well, perceived usefulness was a relative strong predictor, accounting for more than half of the variance in behavioral intention. Mathieson (1991) compared Technology Acceptance Model and TPB in predicting undergraduate students' intention to use an information system. Both models were found to be effective, and although the Technology Acceptance Model was easier to use, the TPB provided more specific guidance to developers. Because those who are interested in teachers' intentions to use technology are often searching for specific information to guide program development, the TPB is a wise choice.

Unfortunately, attempts to use the TPB to explain teachers' intentions to use technology have resulted in inconsistent findings. For example, Czerniak, Lumpe, Haney, and Beck (1999) concluded that subjective norm and perceived behavioral control were the only two statistically significant predictors of behavioral intention. Sugar, Crawley, and Fine (2004) found that the only significant predictor of behavioral intention was attitude toward the behavior. Salleh and Albion (2004) reported that only attitude and subjective norm were significant predictors of intention.

There are many possible explanations for this inconsistency. Our argument is that these conflicting findings may have resulted from insufficient granularity in the definitions used for the targeted behavior. These three studies applied the TPB to describe teachers' beliefs and intentions regarding the integration of electronic technology in general terms only. They did not take into account the fact that many different technologies exist, and there are many different ways for teachers to utilize a specific technology in the classroom. For example, Czerniak et al. (1999) defined the target behavior as using a wide variety of technologies to foster student learning. Similarly, in their study, Sugar et al. (2004) defined the behavior of interest as, "adopting at least one new technology into a lesson by the end of the next school year (p. 204)." Salleh and Albion (2004) used the general term, Information and Communication Technology, to describe the behavior. These definitions allow for many different technologies, ranging from electronic computers to physical manipulatives, not to mention a broad array of possible uses for each one.

According to Ajzen (2006), when using the TPB, the action comprising the behavior must be defined at an appropriate level of specificity to allow for useful generalization. Ajzen argued, for example, that using a definition such as walking on a treadmill as opposed to exercising would yield more useful results because the reasons individuals decide whether to exercise may depend on the specific form of exercise. Mathieson (1991) also pointed out that the TPB focuses on "specific beliefs that are specific to each situation (p. 178)," providing specific information and insight into an individual's or a group's predispositions.

In particular, teachers' attitude, subjective norm, and perceived behavioral control, and the relative importance of these three factors as predictors of behavioral intention might be very different for different technologies, such as the use of educational sources on the World Wide Web as opposed to the use of online conferencing systems. Relatively vague behavioral definitions may explain discrepancies in findings among previous studies of teacher's intention to utilize technology.

Moreover, from a practical perspective, many, if not most technology initiatives, focus on particular technological solutions to particular educational problems. In practice, teachers do not make global decisions about the place of technology in their classrooms, but rather, they make local decisions about whether or not they will adopt a particular, often emerging technology. Therefore, in order to be fruitful, any study of teachers' intentions, including those that use the TPB, must focus on particular uses of technology.

Purpose and Research Questions

In order to address the aforementioned discrepancy in findings of previous studies, we applied the TPB to investigate teachers' intentions to utilize a specific technology in a specific way. By defining the target behavior at an appropriate level of specificity, we expect to obtain more accurate insight into the factors that influence teachers' intentions to integrate a particular technological approach into their classrooms.

The primary purpose of this study is to use the TPB to examine the underlying beliefs and the relative strengths of the three direct determinants (AB, SN, and PBC) of teachers' intentions to utilize technology in a specific way. For

this study, the target behavior is defined as using computers to create and deliver teachers' lessons by using presentation software, such as PowerPoint, during the next month.

In particular, we address the following research questions:

1. Underlying Beliefs: What salient teacher beliefs (behavioral, normative, and control) underlie each of the three indirect determinants of teachers' intention to use computers to create and deliver lessons?
2. Direct and Indirect Determinants of Intention:
 - a. Which of the three indirect determinants of intention are statistically significant predictors of their corresponding direct determinants of teachers' intentions to use computers to create and deliver lessons?
 - b. To what extent does each statistically significant indirect determinant predict its associated direct determinant of teachers' intention to use computers to create and deliver lessons?
 - c. Which of the three direct determinants of intention are statistically significant predictors of teachers' intentions to use computers to create and deliver lessons?
 - d. For the statistically significant direct determinants of intention, what are their relative strengths vis-à-vis teachers' intentions to use computers to create and deliver lessons?

Research Method

The Republic of Korea is one of the most technologically advanced societies in the world. According to the 2008 Organization for Economic Cooperation and Development (OECD) report, Korea's broadband subscription rate is 32%, one of the highest rates among countries (OECD, 2008). Also according to the 2003 Program for International Student Assessment (PISA), Korea ranked fourth among 40 nations in student access to computers, averaging fewer than four students per computer (OECD, 2006). With such access, the potential impact of computer technology on education is vast. Consequently, Korea serves as an ideal setting for examining teachers' intentions to utilize technology.

In order to insure construct validity, guidelines for conducting TPB studies given by Ajzen (2006), Ajzen and Fishbein (1980), and Francis et al. (2004) were followed. First, a preliminary, elicitation study was conducted in order to identify participants' salient beliefs regarding the use of presentation software in classroom lessons. The results of the elicitation study were then used to develop measures of behavioral, normative, and control beliefs that were then included, along with direct measures of behavioral intention, attitude, subjective norm, and perceived behavioral control, in the construction of a closed-ended questionnaire.

Because the participants are Korean, all research instruments were administered in Korean. However, following the procedures described in a manual for developing TPB questionnaires (Francis et al., 2004), the documents were first written in English and then translated by two of the authors, who are native Korean speakers. A third native Korean speaker reviewed final drafts. Back-translation validation procedures, as described in Francis et al. (2004), were also used.

Elicitation Study

Participants

The academic preparation of secondary teachers is the same for middle school and high school teachers, but differs significantly from that of elementary school teachers. Because this difference may be related to differences regarding the research questions, and because the TPB is intended for use with homogeneous groups, both the elicitation study and the questionnaire study focused on secondary teachers alone.

The elicitation study was conducted with 34 middle and high school teachers in the Republic of Korea, in March, 2007, in order to identify teachers' relevant salient beliefs. These teachers were purposely selected to represent various subjects, grade levels, teaching experience, and expertise with technology. Table 1 contains participants' demographic information.

Table 1. Elicitation Study Participant Information

Category	Number	
Location	Seoul	26
	Busan	3
	Deajeon	5
Gender	Male	16
	Female	18
Age	25-29	6
	30-34	9
	35-39	7
	40-44	6
	45-49	6
School Type	High School (HS)	24
	Middle School (MS)	3
	Vocational HS	3
	Science HS	4
Subject	Math	7
	Language	5
	Science	6
	Social Science	7
	Korean	4
	Other	5
	Teaching Experience	0-4
5-9		10
10-14		6
15-19		5
20-14		9
Technology Level	Low	4
	Middle	22
	High	8

Procedure

Participants were asked to write answers to open-ended questions regarding their beliefs about the use of presentation software to create and present classroom lessons. In order to elude behavioral beliefs, participants were asked to specify advantages and disadvantages of using presentation software. They were asked to list individuals or groups who would approve or disapprove their use of presentation software in order to provide data on their normative beliefs. Finally, in order to elicit control beliefs, participants were asked to enumerate factors or circumstances that would facilitate or hinder their use of presentation software.

Analysis

In order to answer Research Question 1, two of the authors analyzed the responses independently, grouping similar responses into categories, labeling the categories, and noting their frequencies. All three authors met to finalize labels and reach consensus on discrepant cases. Labels that occurred most often were selected for inclusion in the subsequent closed-ended questionnaire.

Closed-ended Questionnaire Study

Instrument

The closed-ended questionnaire was developed following procedures described in Ajzen (2006) and Francis et al. (2004). In addition to background questions, the questionnaire contained both direct measures of behavioral intention, attitude, subjective norm, and perceived behavioral control, as well as indirect measures (behavioral beliefs, normative beliefs, and control beliefs). Standard scaling procedures were used to construct measures. Except for background questions, all items used a seven-point Likert scale, and items measuring various constructs were interspersed.

As recommended in Ajzen (2006), in order to improve internal consistency of the direct measures, items were constructed with the particular behavior and population in mind. Items on the attitude scale included two types: those that are instrumental (e.g., valuable, beneficial), and those that are experiential (e.g., pleasant, enjoyable). Items on the perceived behavioral control scale embody capability or controllability of performing the behavior.

As mentioned earlier, results of the elicitation study were used to develop each of the three indirect measures. As recommended by Ajzen and Fishbein (1980), those beliefs constituting a majority of the beliefs obtained in the elicitation study were selected for inclusion in the closed-ended questionnaire. Items were constructed for each identified behavioral belief and its outcome evaluation, each normative believe and the motivation to comply with it, and each control belief and its power.

Before administering the closed-ended questionnaire, it was piloted with 20 graduate students in the education department at a large university in Korea, including 10 middle school or high school teachers, and reviewed by two university faculty members. Based on the pilot study and review, minor changes were made to questionnaire instructions and a few items, and subsets of scales that exhibited high internal consistency were selected for the final version.

Reliability of each construct in the final questionnaire was calculated using Cronbach alpha procedures, and all scales were found to have acceptable internal consistency ($\alpha \geq 0.6$) based on guidelines provided by Francis et al. (2004). Table 2 contains reliability data for each of the 10 constructs.

Table 2. Reliability Values from Closed-Ended Questionnaire

Variable	Cronbach's alpha
Behavioral Intention (BI)	0.94
Attitude Toward the Behavior (AB)	0.71
Subjective Norm (SN)	0.73
Perceived Behavioral Control (PBC)	0.73
Behavioral Beliefs (BB)	0.77
Outcome Evaluations (oe)	0.94
Normative Beliefs (NB)	0.79
Motivation to Comply (mc)	0.70
Control Beliefs (CB)	0.60
Control Power (cp)	0.75

Procedure

Stratified sampling was used to select 11 schools for the questionnaire, based on the relative student population size in each of several major geographic regions of Korea, and intended to represent urban, suburban, and rural areas. Based on the number of teachers in each school, a predetermined number of questionnaires was sent via post. At each school, a senior administrator was asked to distribute questionnaires to teachers and then collect and return all completed and blank questionnaires via post. A detailed script and instructions for administering the surveys were provided to the administrators. The script included a description of the purpose of the research study as well as assurances of confidentiality and safety for participants.

Questionnaires were administered to 149 middle school and high school teachers in Korea, in May, 2007. A total of 137 questionnaires were returned, representing a return rate of 91.9 percent. Assuming a moderate effect size for TPB studies (Francis et al., 2004), a sample size of 137 resulted in acceptable statistical power.

Data Analysis

In order to address Research Question 2, a two-stage regression procedure was used (Francis et al., 2004). After item analysis was performed in order to establish internal consistency and appropriate diagnostics for linearity, normality and homoscedasticity were performed, multiple regression was conducted using the direct determinants of attitude, subjective norm, and perceived behavioral control as predictors of intention. Finally, regression was performed with each of the indirect determinants and its associated direct determinant. As described earlier, the sum of the products of each behavioral belief and its outcome evaluation was used as the predictor of attitude toward the behavior, and similarly for subjective norm and perceived behavioral control. SPSS Version 12.0 for Windows was used to compute all statistics for this report.

Results

Underlying Beliefs: Research Question #1

Middle and high school teachers who participated in the elicitation study expressed a variety of behavioral, normative, and control beliefs regarding the use of computers to create and deliver lessons. Table 3 contains a summary of the most commonly held beliefs.

Teachers' behavioral beliefs regarding the use of computers to create and deliver lessons gravitate toward two areas: better teaching, and improved student behaviors. Reactions were generally positive, with perceived advantages of using computers outweighing disadvantages. Following are a few samples of specific teacher comments about attitudes and, in parentheses, the categories to which they were assigned in Table 3:

“Because of reducing writing time on the blackboard, I can give more detailed explanations.” (quality of teaching)

“When presenting computer graphics, it could deliver wrong information. For example, in the case of $y=x$, if the graphic angle is not exactly 45 degree on PPT, students may get the wrong information.” (student achievement)

“Visualized computer-based presentations make students pay attention to teacher's instruction.” (student attention)

The most important others whose opinions teachers consider include school administrators, students and their parents. Teachers who cited school administrators generally reported that these administrators support the use of computers to create and deliver lessons. However, those who cited students or their parents had conflicted views reporting that, for example, students who are interested in computers encourage their use to create and deliver lessons, but those who are not discourage it.

In order to use computers effectively to create and deliver lessons, teachers cite the importance of both external (reliable hardware and software) and internal (skills) factors. For both types of factors, some teachers reported inhibitory effects, whereas in others reported enabling effects.

Table 3. Summary of Salient Beliefs from Elicitation Study

Behavioral Beliefs	Normative Beliefs	Control Beliefs
• quality of teaching	• school administrators	• reliable hardware and software
• student achievement	• students	• skills
• student attention	• students' parents	• training and support
		• time to create

Direct and Indirect Determinants of Intention: Research Question #2

Summary statistics for the seven main constructs measured in the closed-ended questionnaire are provided in Table 4. For each of the four direct measures (BI, AB, SN, PBC), the theoretical minimum and maximum scores are -21 and 21, respectively. For the each of the three indirect measures (ABI, SNI, PBCI), the theoretical minimum and maximum scores are -63 to 63, respectively. All intercorrelations are considerably less than 1, indicating that discriminant validity was achieved. We also considered the assumption for TPB models that predictive factors in the model are correlated. As shown in Table 4, pairwise correlations among all predictors in the model were statistically significant at the 0.05 level.

Table 4. Descriptive Statistics and Correlations (N= 137)

	ABI	AB	SNI	SN	PBCI	PBC	BI	Mean	SD
Indirect Attitude toward the Behavior (ABI)	--							27.33	15.735
Direct Attitude toward the Behavior (AB)	-.534**	--						14.56	3.410
Indirect Subjective Norm (SNI)	-.360*	.443**	--					-1.12	17.852
Direct Subjective Norm (SN)	-.240**	.657**	.662**	--				12.68	3.306
Indirect Perceived Behavioral Control (PBCI)	.474**	-.708**	-.330**	-.612**	--			19.33	18.454
Direct Perceived Behavioral Control (PBC)	-.402**	.583**	.302**	.558**	-.687**	--		15.17	3.392
Behavioral Intention (BI)	-.434**	.799**	.479**	.661**	-.713**	.604**	--	13.21	4.752

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

All direct measures in the model are positive. Teachers in the study intended to use computers to create and deliver lessons, they had positive attitudes about its use, significant others endorse this use, and teachers expressed confidence they had the necessary capability.

The situation with regard to indirect measures is less consistent. Teachers in the study exhibited positive beliefs about the outcomes associated with using computers to create and deliver lessons. In addition, they expressed the belief that they possessed the internal and external resources needed to do so. However, teachers reported that opinions of others regarding their use of computers were neutral, overall.

Data diagnostics were conducted in order to ascertain whether assumptions underlying the validity of conclusions based on the regression analysis were met. A preliminary examination of histograms and normality plots suggested that all seven variables were normally distributed. Subsequent analyses were conducted using the Kolmogorov-Smirnov test, with the Lilliefors correction (Lilliefors, 1967) and the Jarque-Bera test (Jarque and Bera, 1987). The results of these tests confirmed that none of the variables differs from normality at the 0.05 significance level (Table 5).

Table 5. Normality Tests

Variables	Kolmogorov-Smirnov Statistic	Jarque-Bera Statistic
ATTI	0.074	1.283
SNI	0.074	1.171
PBCI	0.053	1.720
ATTD	0.076	0.835
SND	0.075	1.031
PBCD	0.072	1.676
BI	0.076	4.262

An examination of scatter plots provided strong evidence of linearity and multivariate normality. Ramsey's RESET test (Ramsey, 1969) provided formal support for the assumption of linearity and the specification of the models with all results failing to reject the null hypothesis at the 0.05 significance level (Tables 6-9). A scatterplot of the standardized residuals versus the predicted values from the regression analysis confirmed the assumption of homogeneity of variance-covariance. Formal tests of heteroscedasticity, using White's test (White, 1980) with the number of predictors as the degrees of freedom, were conducted. All results failed to reject the null hypothesis at the 0.05 significance level, and, therefore, supported the assumption of homoscedasticity for all regressions (Tables 6-9).

Tables 6-8 contain the results when each direct determinant was regressed on its indirect counterpart. The indirect determinant of attitude toward the behavior (ABI) was a significant predictor of the direct determinant (AB), $F(1,135) = 48.610$, $p < 0.001$, and accounted for 26.5 percent of its variance. The indirect determinant of subjective norm (SNI) had a significant influence on the direct determinant (SN), $F(1, 135) = 113.017$, $p < 0.001$, and accounted for 45.6 percent of its variance. The indirect determinant of perceived behavioral control (PBCI) was a significant predictor of the direct determinant (PBC), $F(1,135) = 114.281$, $p < 0.001$, and accounted for 45.8 percent of its variance.

Regarding Research Question 2a and b, each of the three indirect determinants of the theory constructs was significantly and strongly related to its corresponding direct determinant, further supporting the model, and providing additional support for the measures' validity.

Table 6. Regression Analysis: Predicting Attitude Toward the Behavior, AB (N = 137)

	R ²	S.E.	F	B	S. E. B	β	White's Statistic	Ramsey's RESET Statistic
Indirect Attitude toward the Behavior (ABI)	0.265	2.935	48.610***	0.112	0.16	0.515	1.781	1.586

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 7. Regression Analysis: Predicting Subjective Norm, SN (N = 137)

	R ²	S.E.	F	B	S. E. B	β	White's Statistic	Ramsey's RESET Statistic
Indirect Subjective Norm (SNI)	0.456	2.448	113.017***	0.125	0.012	0.675	3.699	1.724

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 8. Regression Analysis: Predicting Perceived Behavioral Control, PBC (N = 137)

	R ²	S.E.	F	B	S. E. B	β	White's Statistic	Ramsey's RESET Statistic
Indirect Perceived Behavioral Control (PBCI)	0.458	2.505	114.281***	0.124	0.012	0.677	5.617	0.123

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 9. Regression Analysis: Predicting Behavioral Intention (N=137)

	R ²	S.E.	F	B	S. E. B	β	White's Statistic	Ramsey's RESET Statistic
Model	0.700	2.630	103.644***				16.577	0.211
Attitude toward the Behavior (AB)				0.793	0.094	0.569		
Subjective Norm (SN)				.0329	0.096	0.229		
Perceived Behavioral Control (PBC)				0.201	0.084	0.144		

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 9 contains the results of behavioral intention regressed on the three direct predictors in the model, which show that at least one of the direct determinants influenced behavioral intention, $F(3,133) = 103.644$, $p < 0.001$. In response to Research Question 2c, the analysis revealed that all three direct determinants – attitude toward the behavior, $t(133) = 8.481$, $p < 0.001$, subjective norm, $t(133) = 3.446$, $p = 0.001$, and perceived behavioral control, $t(133) = 2.386$, $p < 0.05$ – were statistically significant predictors of teachers’ intentions to use computers to create and deliver lessons. Together, the three determinants accounted for 70 percent of the variance in teachers’ intentions. This finding is in contrast to those of Czerniak et al. (1999), Sugar et al. (2004), and Salleh and Albion (2004). In none of those studies were all three direct determinants found to be significant predictors of behavioral intention.

Figure 2 represents the pathways, including beta values, found in the regression analysis. The betas from regression model were used to determine the relative weights of each factor.

Regarding Research Question 2d, of the three direct determinants, attitude toward the behavior had the most substantial impact ($\beta = 0.569$) on teachers’ intentions to use computers to create and deliver lessons, producing a change of 0.569 units in behavioral intention for each unit change in attitude. This influence on intention is more than twice that of subjective norm ($\beta = 0.229$) and more than three times that of perceived behavioral control ($\beta = 0.144$). This finding suggests that teachers’ decisions about using computers to create and deliver lessons are influenced strongly by their view of its value, moderately by the opinions of significant others, and weakly by teachers’ perceived ability to do so.

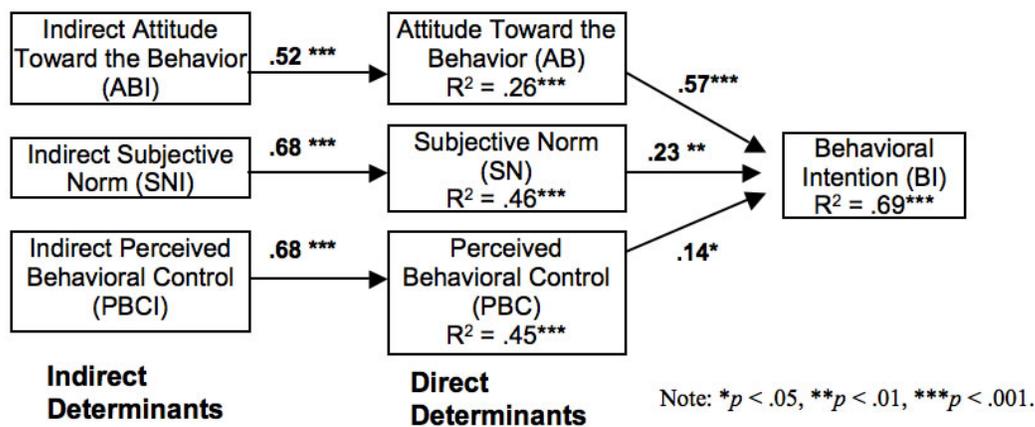


Figure 2. Path diagram of TPB model of teachers’ use of computers to create and deliver lessons

Discussion

Regarding Research Question 1, underlying salient beliefs, it is interesting to compare and contrast the results of this study and those of Czerniak et al. (1999), Sugar et al. (2004), and Salleh and Albion (2004). All of the modal salient beliefs in attitude, subjective norm, and perceived behavioral control identified in this study were also present in Czerniak et al. (1999) and all but one in Sugar et al. (2004) (Salleh and Albion (2004) did not report salient beliefs.). However, the first two studies identified several additional common beliefs. For example, under attitudes, both Czerniak et al. (1999) and Sugar et al. (2004) reported preparing students for the future and helping them to acquire new skills as common responses. These additional salient beliefs are undoubtedly an artifact of the relatively general definition of the target behavior used in the other studies. Given that the current study focused specifically on teachers’ use of computers to create and deliver lessons, it is not surprising that these other beliefs were not observed.

Regarding Research Question 2, indirect and direct predictors of intention, recall the disagreement as to which factors serve as significant predictors of teachers’ intention to use technology. Czerniak et al. (1999) found that SN and PBC were the only two significant predictors of teachers’ intentions to use technology. Sugar et al. (2004) identified AB as the only significant predictor of this behavior. Salleh and Albion (2004) found that only AB and SN

were significant predictors of the behavior. The main finding of this study, embodied in Research Question 2c, provides a possible resolution to this paradox, by demonstrating that AB, SN, and PBC all served as significant antecedents to teachers' intentions to use computers to create and deliver lessons. This finding demonstrated our claim that providing a clear and specific definition of the target behavior, as opposed to general definitions, could lead to more meaningful conclusions that are consistent with the TPB.

Once the significance of all three direct determinants was established, we were able to examine their relative strengths. In response to Research Question 2d, AB had more than twice the influence of SN and more than three times the influence of PBC on teachers' intentions to use computers to create and deliver lessons. This finding suggests that teachers must believe positive educational outcomes will follow in order for them to intend to use computers to create and deliver lessons. They are less concerned about what others think of this practice, and far less bothered by any internal or external constraints that may exist.

Conclusion

This study has both theoretical and practical importance. With regard to the TPB, we refined the application of a widely used social psychological theory by reemphasizing the importance of providing specific definitions of the target behavior.

Findings provide practical information to two groups of individuals interested in the effective integration of computer technology in the classrooms. First, these findings give specific guidance to individuals who design and implement technology initiatives. In particular, findings from the elicitation study lead to specific recommendations for developers of teacher development programs. For example, because several teachers expressed concern that using computers to create and deliver lessons requires too much time, designers of teacher development programs should emphasize methods to improve efficiency.

Second, the findings will aid decision makers in determining where resources should be targeted in order to optimize their allocation. Attitude toward the behavior was found to have much greater influence on teachers' intentions to use computers to create and deliver lessons than either subjective norm or perceived behavioral control. According to these findings, teachers base their decisions primarily on their evaluation of the potential benefits, with less regard for the opinions of others and little concern over internal and external resources. Therefore, resources directed toward teacher development programs should be allocated accordingly.

The concern for internal consistency for direct measures discussed earlier does not apply to indirect measures in the TPB because individuals can (and often do) hold both positive and negative beliefs about any particular behavior. Therefore, alternate measures of reliability, such as test-retest studies, are recommended for indirect measures (Ajzen, 2006; Francis et al., 2004). Unfortunately, participant access constraints did not allow for completion of a test-retest study of indirect (belief-based) measures in this study. As an alternative, reliability analysis was conducted, with satisfactory Cronbach alpha values obtained for all three indirect measures, as was the case with the direct measures. Although this approach provides strong evidence of reliability for the direct measures, it gives weaker reliability support for indirect measures and thus may limit this study's conclusions.

Our primary interest in this study is in the direct and indirect factors determining teachers' intentions to utilize technology. The ultimate goal of many, of course, is that teachers will actually use technology effectively in their classrooms. However, for reasons outlined earlier, unless teachers "buy into" the idea, efforts to bring technology into the schools will have limited effectiveness. Our decision to focus on behavioral intention and not the behavior itself rests on solid theoretical and empirical ground. Like many other models of behavior, The TPB postulates that behavioral intention is the immediate antecedent of volitional behavior. Empirical studies have validated the strength of this intention-behavior link in the TPB model (e.g., Ajzen & Madden, 1986) as well as in other models of behavior (Davis et al., 1989; Sheppard, Hartwick, & Warshaw, 1988).

This study demonstrated that precise definitions must be used in order to determine the predictors of teachers' intentions to use technology in specific ways. A logical next step would be to replicate study with other specific uses of technology in order to ascertain what differences exist among them when the TPB is used as an explanatory model. The authors have completed a study comparing and contrasting the results among three different uses of

technology that reveals significant differences with respect to significance and influence of the three direct determinants of teachers' intentions to use different forms of educational technology (Lee, Cerreto, & Lee, in press).

Finally, in order to establish the generalizability of the results, the study should be replicated in other geographic locations and with elementary school teachers. Findings of these follow-up studies would help us to identify which findings can be applied to which populations.

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