Journal of
Information
Systems
Education

Volume 32
Issue 1
Winter 2021

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Recommended Citation: Hiranrat, C., Harncharnchai, A., & Duangjan, C. (2021). Theory of Planned Behavior and the Influence of Communication Self-Efficacy on Intention to Pursue a Software Development Career. *Journal of Information Systems Education,* 32(1), 40-52.

Article Link: http://jise.org/Volume32/n1/JISEv32n1p40.html

Initial Submission:	9 March 2020
Accepted:	4 August 2020
Abstract Posted Online:	10 December 2020
Published:	13 March 2021

ISSN: 2574-3872 (Online) 1055-3096 (Print)

Theory of Planned Behavior and the Influence of Communication Self-Efficacy on Intention to Pursue a Software Development Career

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ABSTRACT

In modern software development, communication is one of the key success factors in software project development and team performance. However, software engineering (SE) students and educators may not have fully considered its significance in comparison to technical skills. The objective of the study was to determine the influence of communication self-efficacy and factors related to the theory of planned behavior (TPB) on the intention to pursue a career in software development. A survey was used to collect data from senior SE students at six universities in Thailand. The partial least squares – structural equation model (PLS-SEM) was used to analyze the data. The findings indicate that attitudes toward software development careers and communication self-efficacy for software development had a positive influence on the students' intention to pursue a career in software development. This study is the first attempt to investigate how communication self-efficacy in software development affects intention to work in a software development career. Educators can use the findings to improve curricula to foster students' communication self-efficacy and encourage them to pursue a software development career.

Keywords: Software engineering, Intention, Technical communication, Self-efficacy, Soft skills, Careers

1. INTRODUCTION

Shifts in technology affect the skill requirements of the information and communications technology workforce and the dramatic growth of the software industry. However, as software development (SD) job demand has increased, the number of students interested in studying computing majors such as software engineering (SE), computer science (CS), and information technology (IT) has tended to decline. Previous studies have indicated that the intentions of students in computing majors to pursue a particular career depends upon their attitudes toward that career, their control beliefs, and their perception of significant others' evaluations of that career (Johnson, Stone, and Phillips, 2008; Heinze and Hu, 2009; Chen, Pratt, and Cole, 2016). However, previous research has rarely considered the factors corresponding to soft-skill capabilities, which are significant for software development team collaboration and performance, as an influence on career intention.

Recent studies have indicated that employers consider that personal skills, or soft skills, are more necessary for new graduates than technical skills. The individual skills of members of a software development team are key factors contributing to the team's collaborations or conflicts because of how the behaviors, actions, and feelings of individuals influence the entire team (Acuña et al., 2015; Akman and Turhan, 2018). A diversity of personalities within a team causes an increase in communication and the need for a high degree of interaction between team members (Acuña, Gómez, and Juristo, 2009). Modern software development practices, such as the agile approach, require teams to collaborate throughout the software process by sharing information, assigning tasks and responsibilities, and improving software quality (Giuffrida and Dittrich, 2015). Team collaboration requires extensive communication, which is considered to be an important factor in the success of using agile practices (Ambler, 2005). The agile approach promotes customer involvement throughout the software process since regular interaction with customers enables timely feedback and favors cooperation among team members, requiring more frequent face-to-face meetings and informal communication (Bjarnason, Wnuk, and Regnell, 2011). Moreover, effective communication and a positive social environment are helpful during software development and influence the sense of satisfaction of the team members (Pedrycz, Russo, and Succi, 2011).

The results of the previous studies have indicated that communication is an essential soft skill and represents a key difference between the skills possessed by graduates and those expected by employers in the software industry (Ahmed, et al., 2012; Chen, Pratt, and Cole, 2016; Jia, Chen, and Du, 2017; Hiranrat and Harncharnchai, 2018; Garousi et al., 2020). Throughout the software process, communication among team members occurs during software development tasks, for example interviewing clients to establish their requirements, translating client requirements into a software requirement specification, collaborating closely with stakeholders to create the system design, prototyping, and coordinating with the development team and stakeholders to evaluate and obtain feedback on the software products. Most students majoring in SE focus on developing technical knowledge, while they tend to view soft skills such as communication as being less important. Previous research has presented ideas of how to develop students' communication skills, for example by teaching communication skills in specific SE courses, applying communication activities and technology to facilitate team collaboration in the development of capstone projects, and promoting project-based and experience-based learning in the SE curriculum (Kamthan, 2016; Chassidim, Almog, and Mark, 2018; Raibulet and Francesca, 2018; Vanhanen, Lehtinen, and Lassenius, 2018; Abad, Bano, and Zowghi, 2019). These activities encourage students to understand the job roles in SD teams and what communication skills are needed for each role.

The perception of the communication skill requirements of an occupation and students' perception of their abilities in communication, such as self-efficacy and apprehension, influence students' choice of occupations (Daly and McCroskey, 1975; Hassall et al., 2013; Arquero, Fernández-Polvillo, and Valladares-García, 2017). Communication apprehension is one of the predictors of an individual's attitude toward the choice of occupation they make (Ahmed et al., 2012), while self-efficacy is a factor affecting a student's intention to pursue a particular major and career under social cognitive career theory (SCCT) (Heinze and Hu, 2009; Luse, Rursch, and Jacobson, 2014; Chen, Pratt, and Cole, 2016). However, there has been little research on the relationship between communication self-efficacy and SD career intention. In this study, the theory of planned behavior (Ajzen, 1991) was applied with the additional factor, communication self-efficacy for SD, to examine the effects on SE undergraduates' intention to pursue SD careers. Investigating the factors that influence career intention in SD careers will hopefully improve curricula within SE education and promote teaching and learning methods capable of developing skills in students appropriate for careers in SD and other IT-related careers.

2. LITERATURE REVIEW

2.1 Theory of Planned Behavior

According to the theory of planned behavior (TPB; Ajzen, 1991), various intrinsic and extrinsic factors determine behavior and behavioral performance, i.e., attitudes toward behavior, subjective norms, and perceived behavioral control (PBC). Ajzen (1991, p. 188) mentioned that attitudes toward behavior refers to "the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question," while a subjective norm refers to "the perceived social pressure to perform or not to perform the behavior," and PBC refers to "the perceived ease or difficulty of performing the behavior and it is assumed to reflect past experience as well as anticipated impediments and obstacles." Figure 1 presents a model of the TPB. Each motivational factor has possible feedback effects on the others, while interaction among these factors determines behavioral intention as shown by the solid bidirectional arrows in the model.

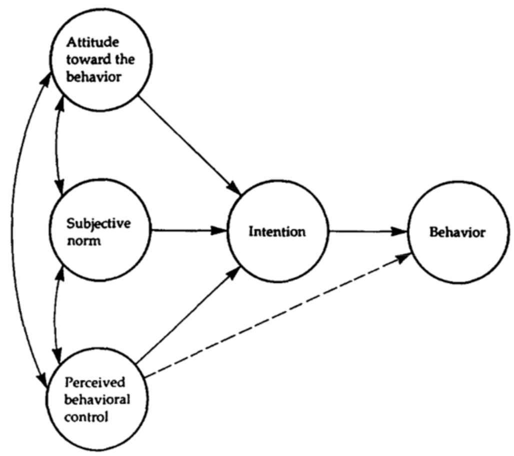


Figure 1. Theory of Planned Behavior (Ajzen, 1991)

Behavioral intention is the motivational factor that captures how much effort an individual is willing to devote to perform a behavior (Ajzen, 1991; Chen, Keys, and Gaber, 2015). With a favorable attitude, a positive subjective norm, and stronger PBC, an individual ought to have a stronger intention to perform a particular behavior (Ajzen, 1991; Chen, Pratt, and Cole, 2016). The combination of the three components leads to an intention to perform a behavior as depicted by the solid unidirectional arrows in the model in Figure 1. The components of TPB relate to beliefs that guide us to perform a behavior. Attitudes toward the behavior, subjective norms, and PBC associate with behavioral, normative, and control beliefs about the behavior (Bandura, 1991). Behavioral beliefs link the behaviors to positive or negative consequences and form favorable or unfavorable attitudes toward the behavior (Bandura, 1991). Normative beliefs are concerned with beliefs about the normative expectations of others and an individual's motivation to comply with those desires (Bandura, 1991). Control beliefs are beliefs about the presence of factors that will assist or prevent the behavior's execution (Ajzen, 2002). Individuals' beliefs in the efficacy of such factors impact their decisions and to what extent they are prepared to confront challenges (Bandura, 1991). Control beliefs provide the basis for PBC which is compatible with Bandura's concept of perceived self-efficacy (Ajzen, 1991). Perceived self-efficacy refers to "beliefs in one's capabilities to organize and execute the courses of action required to produce given levels of attainments" (Bandura, 1998, p. 624). Beliefs about self-efficacy can influence the choice of activities when individuals determine their confidence in their ability to deal with a situation. Therefore, self-efficacy beliefs or PBC can be used directly to predict behavioral achievement (Bandura, 1991) as illustrated by the dashed line in Figure 1.

Psychological variables and TPB elements have received previous attention from researchers in computing education. Variables such as enjoyment, goal clarity, and curiosity have been found to have a positive influence on learning intention (Chen, Keys, and Gaber, 2015; Pratt, Chen, and Cole, 2016). Further, various studies have indicated that TPB elements are associated with students' intentions to pursue a particular major or career (Johnson, Stone, and Phillips, 2008; Heinze and Hu, 2009; Chen, Pratt, and Cole, 2016).

Chen, Pratt, and Cole (2016) studied 162 information systems students to determine the effects of intrinsic motivation on their intention to pursue careers as systems developers. The findings indicated that attitudes toward SD (i.e., outcome expectation and job availability) and personal innovativeness in IT positively influenced students' intentions to pursue an SD career.

Heinze and Hu (2009) studied the factors that influence college undergraduates' decisions to pursue a major in IT based on a combination of TPB and Social Cognitive Career Theory (SCCT). Their research model showed that the SCCT constructs of self-efficacy and outcome expectations influenced PBC and attitudes toward studying an IT major, respectively. The findings indicated that positive attitudes toward IT careers and high PBC regarding IT majors had a positive effect on the intention to study an IT major. The study also found a positive relationship between self-evaluating outcome expectations and attitudes toward an IT career.

Another study by Johnson, Stone, and Phillips (2008) examined the relationships among the ethnicity, gender, IT self-efficacy, occupational stereotypes, attitudes toward jobs in IT, and intention to pursue an IT career of 159 African-Americans and 98 Anglo-Americans. The results showed that IT self-efficacy is positively associated with attitudes toward IT while attitudes are positively related to career intention.

These studies indicate that psychological factors influence the intention to pursue a major or a career among computing students. However, no previous research traced has investigated this issue in a sample group consisting of SE students. The study described in this paper focused on determining the influence of the TPB factors and communication self-efficacy on SE students' SD career intentions.

2.2 Communication Self-Efficacy for Software Development

According to Bandura and Adams (1977) and Bandura (1986), self-efficacy refers to the beliefs about one's ability to successfully perform a given task or behavior. Perceived self-efficacy directly influences the choice of behaviors and activities. Efficacy expectations determine the extent to which people will persist when facing obstacles, for instance in taking actions to develop professional skills and capabilities. Performance accomplishment is the primary source of self-efficacy influencing behavior changes because it is based on personal mastery experiences (Bandura and Adams, 1977; Bandura, 1986). Senge (1990, p. 141) defined personal mastery as "the personal growth and learning discipline." People with high levels of personal mastery are constantly expanding their ability to produce the results they seek. The influence of self-efficacy on academic outcomes, career interests, career choice goals, and career performance demonstrates the role of cognitive and behavioral factors in the career development process (Lent, Brown, and Larkin, 1986; Lent, Brown, and Hackett, 1994). The findings from previous research have shown that self-efficacy beliefs strongly predicted career interests and choice of goals in the computing disciplines (Lent et al., 2008; Luse, Rursch, and Jacobson, 2014).

Self-efficacy in communication refers to a belief in one's ability to communicate effectively (Seth and Carryon, 2017) and links to communication competency and career development in various contexts, such as academic medicine (Song et al., 2015; Anderson et al., 2016), clinical communication (Axboe et al., 2016; Tatsumi et al., 2016), accounting (Hassall et al., 2013), and design (Gaffney, 2011; Seth and Carryon, 2017). However, the relationship between communication self-efficacy and career intention in the context of SD has not previously been investigated in published studies. This study defines communication self-efficacy in SD as the belief in one's capability to communicate effectively in SD tasks. Most studies in SD have focused on the general and technical communication skills required in the SD process, such as requirement gathering, software analysis, design, and testing (Rivera-Ibarra et al., 2010; Ahmed et al., 2012; Klendauer et al., 2012; Sedelmaier and Landes, 2014; Holtkamp, Jokinen, and Pawlowski, 2015; Moustroufas, Stamelos, and Angelis, 2015; Ruff and Carter, 2015). Different communication skills, such as listening, writing, discussion, and presentation are required in various tasks and roles. The skills of actively listening to and communicating with end-users and development teams are needed to translate natural language into notation/technical language (Al-Rawas and Easterbrook, 1996). Written communication is typically used in software project activities, such as writing software specifications, manuals, and test reports (Misnevs and Demiray, 2017). The ability to discuss and review the test process, methodologies, tools, and to verify issues with the team is also necessary. Meanwhile, the ability to elicit ideas and present technical information is also important in order to be able to obtain feedback from stakeholders (Ahmed et al., 2012).

Current SE curricula provide courses related to the knowledge areas specified in the Software Engineering Body of Knowledge (SWEBOK; Bourque & Fairley, 2014). Most knowledge areas in SWEBOK describe the technical knowledge required in the software development process. However, the essential soft skills such as communication are included in the broader knowledge area of SE professional practice. Learning and practical activities in the classroom and practical tasks in SE capstone projects are able to develop students' SD technical skills as well as soft skills, such as teamwork and communication. However, rarely has research focused on communication self-efficacy in SD and how it influences career intention. In the current study, the measures of communication self-efficacy were adapted from previous studies which have assessed SE students' communication self-efficacy in an SD context. Then, the notion of communication self-efficacy was applied through a TPB model to evaluate its effects on career intention.

3. RESEARCH MODEL AND HYPOTHESES

Previous research has indicated that the three core TPB variables (attitudes toward behavior, subjective norms, and PBC) are positively correlated with intention to pursue a major or career (Arnold et al., 2006; Heinze and Hu, 2009; Chen, Pratt, and Cole, 2016; James et al., 2018). In the present study, attitude toward SD career refers to the degree to which a student favors a job in SD. Subjective norm refers to the perceived social pressure that encourages a student's decision to major in SE or to pursue an SD career. PBC refers to one's perception of the ease or difficulty of studying in an SE major and judgments of how well they would be able to perform in an SD job.

In this study, based on prior findings obtained by employing TPB in information systems development research, it is hypothesized that the TPB model and its three components are an appropriate theoretical grounding to examine career intention for SE students. As a result, the following hypotheses were developed.

H1: Attitudes toward SD careers positively influence behavioral intentions to pursue SD careers.
H2: Subjective norms positively influence behavioral intentions to pursue SD careers.
H3: PBC positively influences behavioral intentions to pursue SD careers.

According to SCCT, outcome expectation refers to "beliefs about the consequences of given actions" (Lent et al., 2008, p. 53). Expectations in relation to career outcome are an extrinsic motivational belief according to which individuals select their careers, based on a sense of the satisfaction, appreciation, and career security which they will derive (Heinze and Hu, 2009; Chen, Pratt, and Cole, 2016). Previous research indicates that outcome expectations affect attitudes toward IT majors and information systems careers. Accordingly, the following hypothesis was tested.

H4: Career outcome expectations positively influence attitudes toward SD careers.

One of the purposes of the current study was to examine how communication self-efficacy influences career intention. Communication self-efficacy in SD relates to an individual's perception of one's ability to communicate in SD tasks. Prior studies in different contexts have indicated the positive effect of communication self-efficacy and communication skills on career intention (Jackling and Calero, 2006; Cameron et al., 2015; Anderson et al., 2016). Therefore, the following hypothesis was tested.

H5: Communication self-efficacy positively influences the intention to pursue an SD career.

Based on the above hypotheses, the research model illustrated in Figure 2 was created.

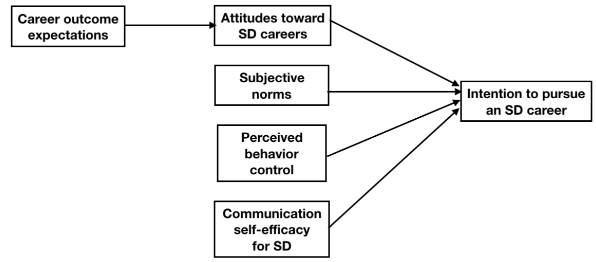


Figure 2. Research Model

4. RESEARCH METHODOLOGY

4.1 Instrument Development
The measurement of the variables in this study was conducted using a questionnaire consisting of items related to the three constructs of TPB and software development communication self-efficacy. The questionnaire was custom-developed based on previous studies. The items in the questionnaire relating to the TPB constructs required the respondents to respond based on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree).

4.1.1 Attitudes toward SD careers. The four items measuring this construct were adapted from the previous studies of Johnson, Stone, and Phillips (2008), Heinze and Hu (2009), and James et al. (2018). The attitudes of the respondents, all of whom were students studying in an SE major or intending to work in an SD-related career, were measured by items such as "I enjoy study majoring in software engineering" and "To work in software development would be a positive experience for me."

4.1.2 Career outcome expectations. The four items measuring this construct were adapted from the study by Luse, Rursch, and Jacobson (2014) and measured the students' expectations of their opportunity of working in an SD career, e.g., "There will be many employment opportunities in a software development career" and "A job in software development will keep me intellectually motivated."

4.1.3 Subjective norms. The four items in this section were adapted from previous studies (Heinze and Hu, 2009; James et al., 2018) and measured the extrinsic motivations influencing students' decisions to major in software engineering or to follow a career in SD with items such as "My family members support my decision to study in an SE major" and "I was influenced by an important person I know, as a role model, in my decision to work in an SD career."

4.1.4 Perceived behavior control. The four items measuring PBC were adapted from previous studies (Yi et al., 2006; Johnson, Stone, and Phillips, 2008) and measured students' perception of their ability to study and perform tasks in SD, e.g., "I believe I have the knowledge and skills to complete tasks and assignments in SE courses" and "I believe I have the necessary knowledge, skills, and abilities to work in a software development career."

4.1.5 Intention to pursue an SD career. The item measuring career intention was adapted from prior research (Johnson, Stone, and Phillips, 2008). The students were asked to indicate their level of intention to work in an SD career by a single item, "I intend to pursue a job in a software development career."

4.1.6 Communication self-efficacy for software development. The measurement of communication self-efficacy relates to the communication ability requirements of new SE graduates. Relevant literature regarding the communication competencies required for entry-level positions in SD careers was reviewed and an initial pool of 32 items which investigated the level of confidence in oral and written communication ability in both a general and technical SD context was generated. Then, in-depth interviews were conducted with ten professionals in the software industry to determine the communication skill requirements of new graduates. The findings enabled the pool of items to be reduced to 14 critical items relating to the communication abilities required in real-world SD tasks. The items relating to communication self-efficacy for SD were measured on a 7-point Likert scale ranging from 1 (very insecure) to 7 (very confident) with the instruction to the respondent "Please rate your level of confidence (even if you have never done it yet) in your ability to …." The items covered SD-related tasks, such as "Interview customers to gather software requirements" and "Write detailed programming specifications after analyzing business requirements for system subcomponents."

All the measurement items were prepared in two versions, one in Thai and one in English, and they were reviewed and revised by five experts consisting of a professional working in the software industry, three university professors teaching in the SE undergraduate programs, and a professor in behavioral science. The indicators of the study are presented in the Appendix.

4.2 Data Collection

The final version of the questionnaire was prepared for online access and was posted at the web addresses of lecturers in six universities in Thailand based on personal contacts. The selected universities are all public universities that have provided SE programs for at least five years. The survey was then sent to 122 senior students who were majoring in SE in August 2019, of whom 62 responded by completing the survey (a response rate of 50.82%). Table 1 shows the demographic data and descriptive statistics of the full sample of respondents. Also, the questionnaire included one question that asked the respondents to indicate the first job for which they were intending to apply as a means of confirming their intention to pursue an SD career. The choices of SD jobs were categorized into four groups: (1) business analyst (BA) / requirements engineer (RE) / systems analyst (SA), (2) designer/user interface (UI) / user experience (UX) designer, (3) developer/software engineer (SE) / programmer, and (4) software tester/quality assurance (QA) engineer. An *Other* option was also provided with the respondents able to write in the name of any other job which was not included in the list.

Variable	Category	Frequency	Percentage
Gender	Female	25	59.7%
	Male	37	40.3%
Nationality	Thai	55	88.7%
	Other	7	11.3%
Program type	Thai	44	71.0%
	International	18	29.0%
First job interest	BA/RE/SA	11	17.7%
	Designer/UI/UX	11	17.7%
	Developer/SE/ programmer	35	56.5%
	Tester/QA	4	6.5%
	Other (Project manager)	1	1.6%

Table 1. Demographic Data and Descriptive Statistics

4.3 Data Analysis Technique

The partial least squares (PLS; Wold, 1980) method, a variance-based structural equation modeling (SEM) technique, was applied to analyze the survey dataset. PLS-SEM estimates are partial model structures using principal component analysis and ordinary least squares regression (Fornell and Bookstein, 1982; Mateos-Aparicio, 2011). PLS-SEM is a path analysis technique that is appropriate for predictive applications as well as theory development. PLS-SEM was selected in preference to covariance-based SEM (CB-SEM) with the objective of predicting the latent dependent variables. Compared to PLS-SEM, CB-SEM aims to confirm theories and requires more restrictive distributional assumptions (Hair et al., 2016). PLS-SEM provides significant advantages in model estimation. When a structural model is complex, PLS-SEM can handle multicollinearity among the independent variables in a mediation model or causal relationship (Ramli, Latan, and Nartea, 2018; Hair et al., 2019). In addition, PLS-SEM can handle small-sized, non-normal samples (Chin, 1998; Okazaki and Taylor, 2008; Hair et al., 2014) and both reflective and formative indicators.

This study aimed to predict the intention to pursue a job in SD by determining the influences of communication self-efficacy and the three TPB factors. The research hypotheses tested the causal relationships among the factors as a mediation model. The sample size in this study was relatively small, and the minimum sample size was estimated with the minimum R-squared method (Hair et al., 2014) which seems to be an improvement over the 10-times rule method, the most widely used method in information systems research (Kock and Hadaya, 2018). The maximum number of arrows pointing at a construct is four, and the minimum R^2 in the research model is 0.488. According to the recommendation for the minimum sample size estimation in Cohen's power table (Cohen, 1992; Hair et al., 2014), the closest R^2 of 0.50 showed the minimum sample size to be 42. The sample size of 62 in this study was therefore adequate for PLS-SEM analysis. Therefore, PLS-SEM was a suitable statistical method for testing the research model in this study.

PLS-SEM can test both the measurement model (the relationships between a construct and its variables) and structural model (the hypothesized relationship among the constructs studied) (Fornell and Larker, 1981; Lohmoller, 1988). The standard parametric significant tests cannot be applied because PLS-SEM does not rely on any distributional assumptions. Therefore, PLS-SEM relies on a non-parametric bootstrapping procedure (Cohen, 1992; Hair et al., 2014) to test the statistical significance of the estimated path coefficients. Bootstrapping is a resampling approach that randomly draws sub-samples (with replacement) from the original set of data and uses these sub-samples to estimate the path model with the PLS-SEM algorithm. This process repeatedly occurs until a large number of random sub-samples have been created (Hair et al., 2016). In this study, the SmartPLS software version 3 (https://www.smartpls.com) was used for both measurement and structural model assessment. The 500 re-samples bootstrap approach was used for significance testing of the path estimates. Chin (1998) recommended 500 bootstrap samples as being sufficient for the general standard bootstrap method.

5. RESULTS AND DISCUSSION

5.1 The Measurement Model

The goal of measurement model assessment is to ensure the reliability and validity of the construct measures. Since all the variables were reflective constructs, the assessment of the measurement model consisted of testing for internal consistency reliability, convergent validity, and discriminant validity. First, the indicators' reliability represented by the correlations between each item and their construct was examined. Hulland (1999) suggests that the outer loading values of 0.70 or higher are preferable, but for exploratory research, loadings of 0.40 or higher are acceptable. In this study, items were only accepted as being reliable if their loadings were 0.707 or above (Henseler, 2012; Hair et al., 2014). The outer loadings of all the items are shown in Table 2. In the first round, it was found that the outer loading values of eight indicators were lower than 0.707 and these items were therefore removed in the second round. Then, the internal consistency reliability based on Cronbach's alpha (CA) and the composite reliability (CR) were evaluated. Cronbach's alpha produces lower values than CR but assumes similar thresholds (Hair et al., 2019) with the accepted standard being a value of 0.70 or above (Nunnally, 1978). Table 2 shows that all the Cronbach's alpha and CR values were acceptable, indicating that the instrument was reliable after the removal of the eight items for which the outer loadings were unacceptable.

Latent Variable	**Indicator**	**Mean**	**SD**	**Loading 1st Rnd.**	**Loading 2nd Rnd.**	**Cronbach's Alpha**	**Composite Reliability**	**AVE**
Attitudes toward SD career	ATT1	4.984	1.235	0.818	0.818	0.904	0.934	0.779
	ATT2	5.145	1.278	0.930	0.930			
	ATT3	5.565	1.223	0.884	0.884			
	ATT4	5.290	1.508	0.893	0.893			
Career outcome expectations	COE1	5.903	1.211	0.780	0.780	0.867	0.909	0.715
	COE2	5.516	1.251	0.870	0.870			
	COE3	5.306	1.262	0.819	0.819			
	COE4	5.274	1.217	0.907	0.907			
Perceive behavior control	PBC1	5.145	1.143	0.890	0.890	0.906	0.935	0.781
	PBC2	5.323	1.098	0.902	0.902			
	PBC3	5.452	1.141	0.898	0.898			
	PBC4	5.226	1.193	0.845	0.845			
Subjective norms	SJN1	5.839	1.074	0.898	1.000	1.000	1.000	1.000
	SJN2*	4.919	1.474	0.576	-			
	SJN3*	4.371	1.581	0.529	-			
	SJN4*	4.742	1.342	0.383	-			
Communication self-efficacy for SD	CSE1*	5.726	1.074	0.401	-	0.931	0.940	0.636
	CSE2	4.532	1.097	0.733	0.733			
	CSE3	5.065	1.199	0.715	0.715			
	CSE4	5.129	1.221	0.723	0.723			
	CSE5	4.984	1.152	0.766	0.766			
	CSE6	5.065	1.199	0.715	0.715			
	CSE7*	5.081	1.191	0.695	-			
	CSE8*	4.145	1.502	0.684	-			
	CSE9	4.903	1.238	0.751	0.751			
	CSE10*	4.855	1.171	0.656	-			
	CSE11	4.919	1.284	0.834	0.834			
	CSE12	4.677	1.238	0.878	0.878			
	CSE13	4.613	1.192	0.711	0.711			
	CSE14*	4.581	1.222	0.670	-			
Intention	INT	5.371	1.507	1.000	1.000	1.000	1.000	1.000
*Note: * The item was removed in the 2nd round because its loading value in the 1st round was below 0.707*								

Table 2. Measurement Model

The validity was evaluated based on convergent validity and discriminant validity. Convergent validity is the degree to which the construct converges to explain the variance of its items (Hair et al., 2019) and is determined by the average variance extracted (AVE). An acceptable AVE is 0.50 or higher meaning that the construct explains 50% or more of the variance of its items (Hair, Ringle, and Sarstedt, 2011; Hair et al., 2019). Table 2 shows that the AVE values of all the constructs are acceptable.

Discriminant validity refers to the extent to which a construct is empirically distinct from other constructs (Hair et al., 2014). The purpose of discriminant validity assessment is to confirm that a reflective construct has stronger relationships with the items used to measure it when compared with those measuring other constructs in the PLS path model (Hair et al., 2014). The heterotrait-monotrait ratio of correlations (HTMT; Henseler, Ringle, and Sarstedt, 2015) was the method used in this study to evaluate discriminant validity. HTMT is the mean value of the indicator correlations across constructs measured relative to the mean of the average correlations for the indicators measuring the same construct (Hair et al., 2019). The HTMT values close to 1 indicate a lack of discriminant validity. Kline (2010) and Henseler, Ringle, and Sarstedt (2015) suggested a threshold of 0.85. Table 3 shows that none of the HTMT values of the constructs exceeded 0.85, indicating that their discriminant validity was acceptable.

The result of the measurement model assessment, therefore, shows adequate reliability, convergent validity, and discriminant validity. Consequently, the measurement model in this study demonstrates the appropriate reliability and validity of the constructs.

	ATT	COE	CSESD	PBC	INT
COE	0.780				
CSESD	0.184	0.348			
PBC	0.718	0.793	0.372		
INT	0.832	0.584	0.327	0.647	
SJN	0.485	0.593	0.282	0.388	0.321

Table 3. Discriminant Validity - Heterotrait-Monotrait Ratio (HTMT)

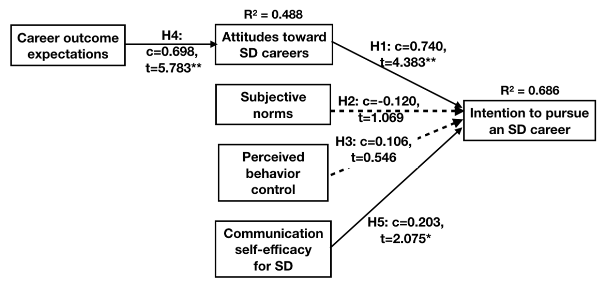
5.2 The Structural Model

The objective of the structural model assessment is to examine the model's predictive capabilities and the relationships between the constructs (Hair et al., 2016). The structural model assessment consists of path modeling and hypotheses testing. In this study, the bootstrap procedure with 500 re-samples was applied to test the significance of the estimated path coefficients in the PLS-SEM. The parameter estimates calculated from the sub-samples were used to derive standard errors for the estimates, and t-values were calculated to assess each estimate's significance. Figure 3 presents the path model with t-values. The 95% significance level (i.e., $p < 0.05$) requires a t-value > 1.96; the 99.9% significance level (i.e., $p < 0.001$) requires a t-value > 3.10. The PLS path model indicates that, with the exception of the path/hypothesis of subjective norms and perceived behavior control to SD career intention, all the paths/hypotheses are substantially supported at the significance level of 95% or 99.9% ($p < 0.05$ or $p < 0.001$, respectively). The result of the hypothesis testing is shown in Table 4.

Effect	Coef.	t-test	p-value	Result
H1: ATT → INT	0.740	4.383	0.000	Accept
H2: SJN → INT	-0.120	1.069	0.285	Reject
H3: PBC → INT	0.106	0.546	0.585	Reject
H4: COE → ATT	0.698	5.783	0.000	Accept
H5: CSESD → INT	0.203	2.075	0.038	Accept

Table 4. Hypothesis Testing

Figure 3 presents the R^2 values for SE job intention and attitudes toward SD careers. The R^2 value of 0.488 indicates that career outcome expectations explain 48.8% of the variance in attitudes toward SD careers. Attitudes, subjective norms, PBC, and communication self-efficacy for SD together describe 68.6% of the variance in intention to pursue an SD career. However, the effects of subjective norms and PBC on intention were not statistically significant.



(p-value < 0.05, ** p-value < 0.001)*

Figure 3. PLS Path Model

5.3 Discussion

This empirical study investigated how TPB-based factors (attitudes toward SD career, subjective norms, and PBC) and communication self-efficacy influence the intention to pursue an SD career among undergraduate students in Thailand. The findings significantly support Hypothesis 1, that the attitudes toward SD careers have a positive influence on the students' intentions to pursue an SD career. Thus, the finding of the present study is consistent with those of the previous studies (Heinze and Hu, 2009; Chen, Pratt, and Cole, 2016) that the attitudes factor of TPB is closely linked to behavioral intention, a hypothesis which this study supports in relation to the SD context.

The study also found a significant and positive relationship between career outcome expectations and attitudes which supports Hypothesis 4. In SCCT, outcome expectations influence career interest and choice (Lent, Brown, and Hackett, 1994). Outcome expectations are students' beliefs relating to a career choice (such as job availability, satisfaction, payment, and security) associated with their attitudes to a career (Heinze and Hu, 2009; Luse, Rursch, and Jacobson, 2014).

However, the results reject Hypotheses 2 and 3, which indicate that the other two TPB factors, subjective norms and PBC, fail to predict the intention to pursue an SD career. Subjective norms represent students' beliefs relating to social influence in pursuing an SD career. The findings in this study are similar to those from previous research (Heinze and Hu, 2009; Chen, Pratt, and Cole, 2016), and thus, students majoring in IT or SE do not appear to be influenced by friends, role models, or social media in relation to their decisions about pursuing an SD career. Although students' decisions to choose to study an SE major may, therefore, be encouraged by family members, their influence does not contribute to career choice. One possible reason for this is that students may lack understanding about jobs and responsibilities in SD careers before entering universities. During high school, students may achieve good grades in basic programming classes or enjoy playing games and may be supported by their family in deciding to study a computing major. However, after entering university, the students will learn about the job responsibilities in an SD career and may be better able to determine whether their personal competencies are appropriate for SD jobs, and that may change their intentions with regard to pursuing an SD career.

In addition, the current study found that although PBC had a positive relationship on career intention, the relationship was not statistically significant which contradicts the findings of previous studies (Johnson, Stone, and Phillips, 2008; Heinze and Hu, 2009). According to Ajzen (1991), PBC is compatible with perceived self-efficacy (Bandura and Adams, 1977; Bandura, 1986) which is concerned with an individual's confidence in their ability to perform a behavior. The current study's PBC items measured the students' perceptions of their ability to study and perform tasks in SD, with the mean score for PBC being 5.29 measured on a scale of 1 to 7. This indicates that the students generally believed that they had high confidence in their ability, but that confidence may not have been strong enough to directly influence their career intention. Similarly, in previous SCCT research, IT self-efficacy was not found to have a significant direct relationship with the students' intentions to pursue an IT major, but it strongly affected their interest in IT and acted as a mediator to intention (Lent et al., 2008; Luse, Rursch, and Jacobson, 2014).

This study included the new variable, communication self-efficacy for software development, into the TPB model. The findings support Hypothesis 5 that this variable significantly influenced career intention. Although there has been a lack of research on the link between communication self-efficacy and career intention in the SE context, previous studies have indicated that communication skills influence career intention in other disciplines, notably, the findings of Cameron et al. (2015) that scientific communication skills affect career intention among biomedical trainees. Further, Jackling and Calero (2006) showed that generic skills are essential for accounting careers and that students who perceived the importance of generic skills, such as verbal and written communication skills and teamwork, were more likely to intend to pursue an accounting career than those who did not consider such skills important.

6. CONCLUSION

The tasks entailed in SD require intensive cognitive-behavioral processes and collaboration among developers and stakeholders. Communication is one of the essential soft skills that affects team performance and project success. In the modern software process, approaches such as agile SD encourage both informal and formal communication among development team members and stakeholders. The current study is the first to extend prior studies on TPB to include the communication self-efficacy variable in the SD context. An initial intention to pursue a career in SD is probably reflected by the selection of an SE major at university, and the current study provides preliminary information about the factors influencing the career intentions of SE students. The findings indicate that career outcome expectations contribute to attitudes toward an SD career, which, together with communication self-efficacy for SD, predicted behavioral intention to pursue an SD career.

6.1 Significance and Implications for Practice

This study has important implications for TPB research, SE education, and the software industry. First, future TPB research should take note of the importance of communication self-efficacy as a variable influencing career choice. While communication self-efficacy plays an essential role in psychology and therapeutic domains, to our knowledge, no previous TPB studies have examined the effect of communication self-efficacy in the context of SD.

Second, the findings reveal that attitudes, career outcome expectations, and communication self-efficacy for SD are the behavioral factors influencing SE students' career intentions. SE educators can use these findings to motivate students to study in SE majors and to select jobs appropriate for that intention. In addition, the understanding of intrinsic and extrinsic factors that influence students' intentions to choose to study an SE major and their future career choice is advantageous for curriculum development. While studying in an SE program, students should be encouraged to develop SD knowledge and skills through coursework, training, capstone projects, and cooperative training with professionals in software industry environments. These experiences develop students' mastery in both technical SD skills (i.e., using tools, methods, and practices to produce software products) and SD soft skills (i.e., teamwork and communication) which can contribute to their perceived beliefs in their capabilities and readiness to work in the software industry.

Third, the results of the study are advantageous for employers in the software industry. In industrial SE, a software engineer can take on different roles, such as requirements engineer, user interface designer, programmer, and software tester. Different roles require different communication skills and other psychological factors. The findings of this study can be used as a guideline when recruiting, motivating, and training employees in order to develop self-efficacy in communication for SD.

6.2 Limitations and Future Research Directions

There are limitations to this study that can provide opportunities for future research. First, the surveys were conducted among students in Thailand and the results may differ from those which would be achieved in other countries. Therefore, conducting similar research using a more broadly representative sample of SE undergraduates would be useful for future research. Second, this study focused on applying the communication self-efficacy factor to the TPB model and analyzed its effect on career intention. The measurement of communication self-efficacy was conducted by items designed based on interviews with ten professionals in the software industry. While skill requirements may be general for SE programs, SE students may have different career intentions such as those of requirements engineers, user interface designers, programmers, or software testers. Our recommendation for future research would be to design items that measure the unique communication self-efficacy requirements of different SD careers which might be found to produce different effects on career intentions.

Lastly, other human factors might have direct and indirect effects on career intentions. Students acquire SD experience during their studies in an SE program and gain not only technical knowledge and skills but also reveal their perception of themselves or self-concept. Self-concept is the perception of one's personal image while the ideal self represents the self that the individual would like to be and on which he places the highest value for himself (Rogers, 1959). An awareness of oneself can be the starting point to develop abilities and skills that correspond to the concept of personal mastery, the discipline of personal growth, and learning (Senge, 1990; Senge et al., 1994). Personal vision comes from within what the individual desires, and creative tension, which is the gap between personal vision and current reality, are the cornerstone of personal mastery. Creative tension is a source of creative energy that drives people to act and develop professional skills and capabilities. In educational research, personal vision has been linked to goal-setting theory. Students who naturally have a challenging and vivid personal vision also set more specific and challenging college goals and dedicate themselves more to their goals (Masuda et al., 2010). Under TBP, students' intentions to pursue a career could originate from their personal vision of the career goal that they want to achieve. Students are more likely to engage in a particular achievement task during study when they expect to do well and when the task has some value to them. Our future research direction is to investigate the relationships among these factors and the TPB variables which would help educators develop educational programs that would encourage students to learn and develop professional skills in their SD careers.

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Appendix. Description of Indicators

Latent Variable	Indicator	Item
Attitudes toward SD careers (adapted from Johnson, Stone, and Phillips, 2008; Heinze and Hu, 2009; James et al., 2018)	ATT1	I enjoy study majoring in software engineering.
	ATT2	To work in software development is an important part of what I want.
	ATT3	To work in software development would be a positive experience for me.
	ATT4	Software development is the ideal profession for future.
Career outcome expectations (adapted from Luse, Rursch, and Jacobson, 2014)	COE1	There will be many employment opportunities in a software development career.
	COE2	A job in software development will keep me intellectually motivated.
	COE3	There will be good chances for promotion in software development career path.
	COE4	Working in software development will make me satisfied.
Subjective norms (adapted from Heinze and Hu, 2009; James et al., 2018)	SJN1	My family members support my decision to study in SE major.
	SJN2	I get encouragement from my friends for studying in SE major.
	SJN3	I was influenced by an important person I know, as a role model, for my decision to work in an SD career.
	SJN4	I was influenced by news/ TV programs/ social media on software development career opportunities and profession.
Perceive behavior control (adapted from Yi et al., 2006; Johnson, Stone, and Phillips, 2008).	PBC1	I believe I have the knowledge and skills to complete tasks and assignments in SE courses.
	PBC2	I believe I have ability to complete my SE capstone project.
	PBC3	I believe I have ability to learn and use new technology, tools, and methods for software development.
	PBC4	I believe I have the necessary knowledge, skills and abilities to work in a software development career.
Communication self-efficacy for SD	CSE1	Listen to others and consider their thoughts.
	CSE2	Explain precisely and accurately.
	CSE3	Interview customers to gather software requirements.
	CSE4	Interact with customers in prototyping user experience and design ideas.
	CSE5	Discuss and review of plan, process, tools, and issues with development team.
	CSE6	Present technical information to groups and solicit ideas is required to get feedback.
	CSE7	Communicate via formal and informal presentations to a group.
	CSE8	Communicate with English fluently.
	CSE9	Capture user requirements and notate with user stories.
	CSE10	Write formal requirements/specifications.
	CSE11	Craft scenarios, storyboards, information architectures, features and interfaces.
	CSE12	Write detailed programming specifications after analyzing business requirements for system subcomponents.
	CSE13	Translates detailed flow charts into coded machine instructions and organize source code for reading and comprehending easily to modify, extend, or rewrite software.
	CSE14	Produce test specifications, test plan, test manuals, and test results required writing skills.
Intention to pursue an SD career (adapted from Johnson, Stone, and Phillips, 2008)	INT	I intend to pursue a job in a software development career.

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ISSN 2574-3872