Investigating Essential Factors on Students' Perceived Accomplishment and Enjoyment and Intention to Learn in Web Development

YULEI (GAVIN) ZHANG and YAN (MANDY) DANG, Northern Arizona University

Web development is an important component in the curriculum of computer science and information systems areas. However, it is generally considered difficult to learn among students. In this study, we examined factors that could influence students' perceptions of accomplishment and enjoyment and their intention to learn in the web development course. Specifically, we investigated both student-related and instructor-related factors. A research model was developed. To empirically test the model and the hypotheses, the survey method was used and the structural equation modeling (SEM) technique was adopted for data analysis. Overall, the results indicated that both student-related factors (perceived web development efficacy and motivation) and instructor-related factors (instructor characteristics and teaching method) could significantly influence students' perceptions toward accomplishment and enjoyment and their intention to learn web development. We also summarized comments collected from students to gain a deeper understanding of their ideas toward learning web development techniques. We believe the research results can help provide better knowledge and insights to educators on teaching web development.

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General Terms: Human Factors, Survey

Additional Key Words and Phrases: Web development, student-related factors, instructor-related factors, perceived accomplishment, perceived enjoyment, intention to learn

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1. INTRODUCTION

With the increasing popularity and advancement of the web over time, learning how to develop web applications has become more and more important for students majoring in computer science, computer information systems, and related areas [Ellis 2007; Sridharan 2004]. Web development ability is now treated as one of the most essential skills for those students, and it could have a significant impact on their job searching and future careers [Ellis 2007; Sridharan 2004].

However, programming classes are generally rated as very difficult by many students, especially new learners [Moons and Backer 2013]. This is even truer for web development, as it typically involves the use of multiple languages and requires

Authors' addresses: Y. (Gavin) Zhang and Y. (Mandy) Dang, The W. A. Franke College of Business, Northern Arizona University, 20 W. McConnell Drive, Flagstaff, AZ 86011; emails: {Yulei.zhang, Yan.dang}@nau.edu.

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a thorough understanding of the client/server structure, which is different from traditional programming classes [Moons and Backer 2013]. A great deal of research has been done to examine student learning in introductory programming classes [Asarta and Schmidt 2013; Liaw et al. 2007; Padilla-Meléndez et al. 2013; Sun et al. 2008]. Programming languages such as C++, Java, and C# are typically taught in those classes. Fundamental building blocks and logic are covered in those classes, including data types, methods, decision statements, loop structures, and file operations.

Web development is a type of programming, but it covers a whole group of different topics than those in introductory programming classes that teach languages such as C# and java. Topics in web development typically include various server controls, data validation, site navigation, HTML and CSS, one-page and multipage development, static and dynamic web page development, session management, database programming, and authentication and authorization of web users. However, compared with introductory programming classes, much less research has been done on student learning in web development.

Because of this, to better help students learn web development as well as provide educators some insights in teaching web development, this study aims to investigate the essential factors that can influence students' perceptions of accomplishment and enjoyment and their intention to learn web development. To the best of our knowledge, little effort has been put forth on this in previous literature. Thus, the overarching research question we aim to address in this study is:

—What are the essential factors that can influence students' perceived accomplishment and enjoyment and their intention to learn in the web development course?

To address this research question, we adopted the survey method. A research model was developed and tested. Specifically, different types of student-related and instructor-related factors were investigated. The structural equation modeling (SEM) [Chin 1998] technique was used to assess the research model and hypotheses. We also summarized comments collected from students to gain a deeper understanding on their ideas toward learning web development techniques.

This article is organized as follows. Section 2 describes factors that can affect student learning, presents some well-studied information systems adoption models, summarizes findings from previous literature on student learning in programming classes, and highlights the research gap. Section 3 presents our research model and hypotheses. Section 4 provides details about the research method, including the research process and measures. Section 5 talks about the data analysis, and Section 6 shows the results. To gain a deeper understanding, we also summarize and present student comments in Section 7. Then, Section 8 concludes the article with research contributions and limitations.

2. RELATED WORK AND THE RESEARCH GAP

2.1. Affecting Factors on Learning

2.1.1. Self-Efficacy. Previous research has examined various factors that could influence student learning in computer and information systems courses. One factor that has been studied is self-efficacy, which is one's own perception of his or her levels of ability to accomplish a given task [Akbulut and Looney 2007; Rosson et al. 2011]. Previous research found that self-efficacy was positively associated with students' orientation toward careers in computer- and information systems-related areas [Rosson et al. 2011]. Students with higher self-efficacy tended to be more willing to choose computer and information systems as the area of study [Rosson et al. 2011].

In the computing area, some studies adopted a more specific concept, computer self-efficacy (CSE), which aims to assess one's self-efficacy specifically for computer and information technology [Hassan 2003; Selim 2007]. Research found that individuals with high CSE were more likely to form a positive feeling toward computer and information technology [Durndell and Haag 2002; Thatcher and Perrewé 2002]. In education, it was found that learners' CSE could significantly influence their perception of the ease of use and satisfaction of the e-learning system [Roca et al. 2006]. In another study, Paraskeva et al. [2008] found that CSE among educators had significant impacts on their integration and development of modern technologies in teaching. However, in web development education, few studies have been seen to specifically examine the impact of self-efficacy (or CSE) on student learning.

2.1.2. Motivation. Motivation is considered as a complex human behavioral concept and has been found to play an important role in students' academic success [Law et al. 2010]. Previous research in education has found that motivation can significantly influence student learning in computer programming courses [Law et al. 2010]. By comparing various motivating factors, Law et al. [2010] found that individual attitude and expectation, clear direction, and reward and recognition could be more influential in learning programming courses. In another study, Nikula et al. [2011] found that many students had limited motivation in learning and completing introductory programming courses, which explained the high dropout rates in those courses. They suggested that in order to improve the teaching outcome, educators should keep this issue in mind and try to design assignments and projects that are interesting and useful to students.

2.1.3. Instructor Characteristics. Previous research found that instructor-related factors could significantly influence students' learning outcome [Sun et al. 2008]. Instructor characteristics have been measured in different ways based on different research contexts. For example, Sun et al. [2008] studied instructor characteristics as students' perception on how timely their instructor provides responses/feedback to them and their instructor's attitude toward the technology in the e-learning context. They found that students' perceived instructor attitude toward the technology could significantly influence students' satisfaction. Selim [2007] developed a more comprehensive measure of instructor characteristics with items about students' perceived instructor attitude toward technology, teaching style, and control of technology. In another study, Ahmed [2010] examined the blended learning environment and found that instructor characteristics could significantly influence learners' acceptance and usage of the blended teaching method.

2.1.4. Teaching Method. Teaching method and course-related factors could also have significant impacts on student learning. Previous research has examined course factors, including course flexibility and course quality and found that both of them could significantly influence learners' satisfaction [Sun et al. 2008]. For teaching programming courses, previous research found that pair programming could be very effective in that it helped improve students' programming skills, students' confidence in learning, and the course completion rate among students in general [Braught et al. 2011]. Isomöttönen and Tirronen [2013] suggested self-directed learning for teaching programming. What they did was replace lectures and exams with solely hands-on programming activities. Detailed findings about challenges and opportunities of adopting such a teaching method were presented in their study.

In web development, previous research has discussed different ways of teaching. For example, Sridharan [2004] presented his way of teaching web development courses and summarized it with several key activities such as teaching multiple languages and database access in developing web applications, having individual projects, and

providing seminars to students. In another study, Ellis [2007] proposed the teaching method of self-directed learning for graduate-level web development courses. Specifically, semester-long team projects were used as the teaching method with great room for student flexibility. Students were allowed to evaluate themselves based on their own defined grading metrics. The final grade was given based on the agreement between the team and the instructor.

2.2. Assessment Factors of Learning

In the information systems (IS) area, different factors have been developed to examine the success of the adoption of information systems and technology, such as behavioral intention to use and perceived accomplishment and enjoyment [Heijden 2004; Venkatesh et al. 2003]. These factors can also be applied in education to assess student learning.

Behavioral intention to use refers to an individual's intention to use an information system or technology [Dang et al. 2011; Venkatesh et al. 2003]. As a key dependent variable in the well-studied unified theory of acceptance and use of technology (UTAUT) [Venkatesh et al. 2003], behavioral intention to use has been widely accepted as an important dependent variable when studying how and why individuals adopt new information technologies. When applied to the education context, behavioral intention to use becomes the construct of intention to learn, which refers to a learner's intention to learn a given subject or class. In a recent study, Padilla-Meléndez et al. [2013] adopted the technology acceptance model (TAM) [Davis 1989; Davis et al. 1989] to the blended learning context and found that various factors could influence students' intention to learn with the support of a technology-enhanced software platform designed for blended learning. Those factors included perceived playfulness, perceived usefulness, perceived ease of use, and attitude.

Perceived accomplishment also has been used to assess the learning outcomes in education [Akbulut and Looney 2007]. For example, Pursell [2009] used student accomplishment as an assessment of a new teaching method that gave students the right to revise the syllabus to select topics of their interest. Firth and Wagner [2007] examined the importance and success of learning foreign languages from the perspective of social accomplishment that learners could gain out of it.

Perceived enjoyment (or playfulness) is another popular assessment of information systems and technology adoption [Heijden 2004]. It refers to the extent to which users perceive the information system or technology being used to be enjoyable [Heijden 2004]. As to education, Padilla-Meléndez [2013] adopted it in the blended learning environment. Ozkan and Koseler [2009] studied different types of learners' attitudes and found that their perceived enjoyment of the learning process was the most important one.

2.3. Review of Information System Adoption Models and Technology-Based Learning Models

In this section, we present some well-studied information systems adoption models and several learning models.

Information systems adoption models have been developed to assess the performance of new technology and information systems. The most famous and widely used ones include the TAM [Davis 1989] and the UTAUT [Venkatesh et al. 2003]. TAM holds that ease of use and usefulness influence behavioral intention, which ultimately determines system use [Davis 1989]. Later research has extended the model to TAM2 [Venkatesh and Davis 2000] and TAM3 [Venkatesh and Bala 2008]. Compared with TAM, TAM2 has added a new factor of cognitive instrumental processes, and TAM3 has further investigated the antecedents of ease of use and usefulness.

Developed by consolidating constructs from various related prior models, UTAUT includes four key constructs—performance expectancy, effort expectancy, facilitating conditions, and social influence—that are determinants of usage intention and behavior [Venkatesh et al. 2003]. Extension and enhancement on UTAUT has also been done in previous research. For example, Chau and Hu [2013] developed a model based on UTAUT to systematically investigate physicians' decisions to accept telemedicine technology. The model included additional factors such as compatibility, attitude, and perceived technology control.

Information systems adoption models also have been applied in the learning context, especially when examining the adoption of new technology to assist student learning. For example, Padilla-Meléndez et al. [2013] developed a research model based on TAM to assess the impacts of perceived playfulness, perceived usefulness, and perceived ease of use on learners' attitude and intention to use a technology-enhanced software platform designed for blended learning. In another study, Lin and Wang [2012] developed a model to investigate antecedents of continued intention to adopt online learning systems. They found that the fit between tasks and the technology as well as information quality of the online learning system could significantly influence learners' system acceptance. The focus of these studies is about examining the adoption of a particular learning system.

2.4. Previous Studies on Student Learning in Programming Classes and the Research Gap

Previous studies have examined student learning in programming classes from different perspectives. For example, Hertz and Ford [2013] investigated the relationships between the topic importance and student mastery, as well as class time spent and student mastery, in learning introductory programming classes. They took the survey method by collecting data from instructors who taught different introductory programming classes. By performing the correlation analysis, they found that students' level of mastery of programing topics was generally correlated with the importance that instructors placed on them, while no significant correlation was found between students' level of mastery and the amount of class time instructors spent on different topics. In another recent study, Vivian et al. [2013] applied the Attribution Theory to explore the causal attributions for students' perceived success and failure in learning the introductory programming class. They used an instrumental case study design and conducted content analysis on students' reflective essays in which students were asked to provide one to two pages of writing to describe "their current software development processes, how they have changed and a description of how they intend to change them in the future" (p. 128). They found 16 different causal attributes from students' essays and mapped them into different dimensions of the Attribution Theory, including ability, task difficult, luck, and effort. Carbone et al. [2008] conducted an exploratory analysis on factors that could influence student learning of programming. By analyzing both semistructured interviews and students' self-reports, they identified three major types of factors—internal domain, external domain, and programming tasks. They further investigated the two subcategories of the internal domain—motivation and capability. Detailed discussions and examples were provided on different types of motivation and capability.

Several research models on student learning in programming have been developed in the literature. For example, Wiedenbeck et al. [2007] developed a research model to assess the impacts of students' software/programming experience and software/programming self-efficacy on their perceptions toward computer playfulness and computer interest, and their performance in learning the introductory programming class. The empirical results indicated that software/programming experience could significantly influence students' perceptions of software/programming self-efficacy, which in

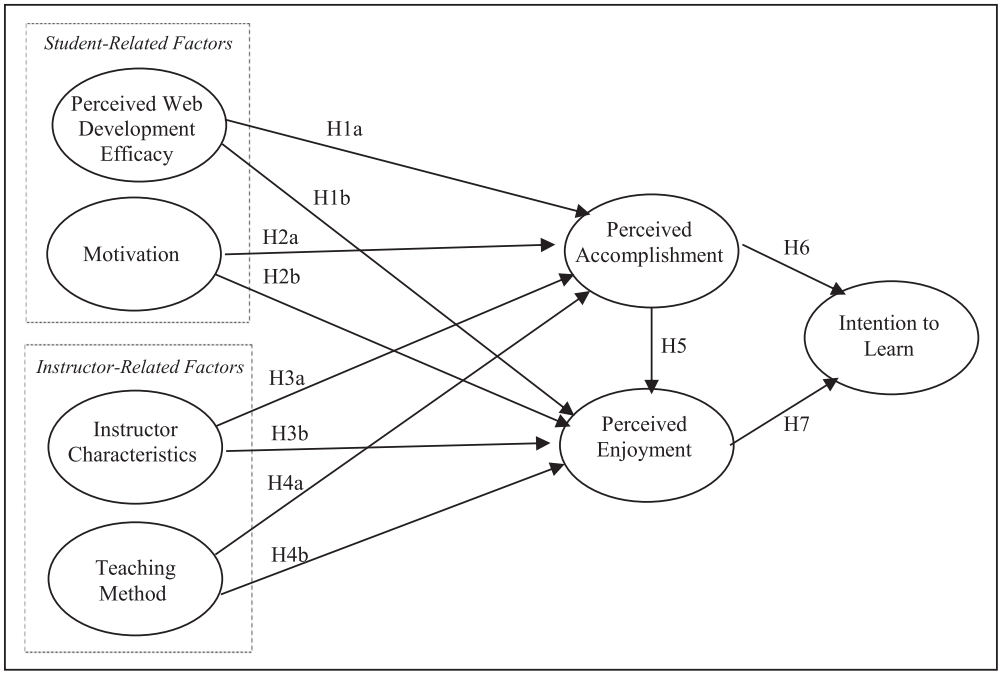

Fig. 1. Research model.

turn influenced their perceptions of computer interest. In addition, computer interest significantly affected students' performance. Law et al. [2010] presented a research model stating that intrinsic motivation and extrinsic motivation could influence students' efficacy in learning programming classes, and efficacy was positively associated with the perceived effect of the e-learning system adopted in their programming classes. Shaw [2010] developed a research model to assess the relationships among learning styles, participation types, and learning performance in programming language learning supported by online forums. They found that both learning styles and participation styles could significantly influence learning performance in terms of learning score.

Although previous research has investigated student learning of programming from different aspects, few studies have considered factors that are related to both students and instructors. In addition, relatively fewer studies have incorporated different influential factors into a nomological network to examine their impacts on student learning of programming by developing a research model. Further, compared with studies on learning introductory programming, fewer studies have focused specifically on web development. To the best of our knowledge, no research has systematically incorporated both student-related and instructor-related factors in a nomological network to investigate their impacts on student learning of web development.

3. RESEARCH MODEL AND HYPOTHESES

To address the aforementioned research gap as well as answer the overarching research question stated in Section 1, in this study we propose a research model (as shown in Figure 1) to specifically investigate the influence of both student-related and instructor-related factors on students' perceived accomplishment and enjoyment and intention to learn web development. For student-related factors, we adopt perceived web development efficacy and motivation since they both are about students' own

characteristics. Perceived web development efficacy is one's perception of his or her ability to learn web development, and motivation is one's own motivation to learn web development. For instructor-related factors, we include instructor characteristics and teaching method, both of which are things that instructors have more control over and can further improve. In this study, instructor characteristics and teaching methods are measured based on how students perceive the instructor and different ways of teaching that could assist their learning of web development. We also collect detailed comments from students about their feelings on learning web development in order to gain more insight.

Perceived web development efficacy is about self-efficacy in the context of learning web development courses. Previous research found that learners with higher self-efficacy tended to form a more positive feeling toward the subject of learning and were more willing to learn [Durndell and Haag 2002; Roca et al. 2006; Thatcher and Perrewé 2002]. Since web development is a technical course that is generally considered difficult, students who believe that they possess a higher level of web development ability are more likely to perceive a higher level of accomplishment and enjoyment in learning web development techniques. Thus, we hypothesize:

H1a: Students' perceived web development efficacy will positively influence their perceived accomplishment in learning web development.
H1b: Students' perceived web development efficacy will positively influence their perceived enjoyment in learning web development.

Students' motivation has been seen as an important factor to influence students' learning outcome [Law et al. 2010]. The more they are motivated to learn, the better the learning outcome can be. This could be even truer for difficult-to-learn subjects, such as web development. If an individual is highly motivated to learn web development techniques, he or she tends to be willing to put effort into it in order to pass the learning curve and fully grasp the key ideas/techniques. Then, it can be expected that the learner will treat the learning process more positively, thus experiencing a higher level of perceived accomplishment and enjoyment in learning. There, we posit the following hypotheses:

H2a: Students' motivation will positively influence their perceived accomplishment in learning web development.
H2b: Students' motivation will positively influence their perceived enjoyment in learning web development.

Instructors' characteristics also can influence students' learning outcome [Sun et al. 2008]. For example, if students believe that their instructor provides feedback to them in a timely manner, they will be positively involved in the learning process [Sun et al. 2008]. If students feel that their instructor is interested in the subject of teaching, they tend to gain a positive feeling in learning the subject as well [Sun et al. 2008]. In web development education, instructor characteristics also are expected to influence students' perception on their accomplishment and enjoyment in learning. So, we hypothesize:

H3a: Instructor characteristics will positively influence students' perceived accomplishment in learning web development.
H3b: Instructor characteristics will positively influence students' perceived enjoy ment in learning web development.

Effective teaching methods are crucial in education. A great effort has been put forth in previous research to develop innovative and effective teaching methods in

computing-related education [Braught et al. 2011; Ellis 2007; Sridharan 2004]. In web development, teaching method is expected to significantly influence students' perceived accomplishment and enjoyment in learning as well. Thus, we posit the following hypotheses:

H4a: Teaching method will positively influence students' perceived accomplishment in learning web development.
H4b: Teaching method will positively influence students' perceived enjoyment in learning web development.

Previous research in computing education has found that students' sense of personal accomplishment can significantly influence their interest (or enjoyment) in learning [Akbulut and Looney 2007]. When learning web development techniques, if the student has a strong sense of accomplishment, he or she tends to have a positive feeling in learning and perceives the learning experience as enjoyable. This can also lead to a strong intention to learn the subject. Therefore, we hypothesize:

H5: Students' perceived accomplishment will positively influence their perceived enjoyment in learning web development.
H6: Students' perceived accomplishment will positively influence their intention to learn web development.

Perceived enjoyment has been found as a strong predictor of intention to use in information systems and technology adoption [Heijden 2004]. In education, students' enjoyment in learning can also influence their intention to learn [Padilla-Meléndez et al. 2013]. When students have fun in class, they are likely to develop a passion for learning, thus becoming willing to keep learning [Nemanich 2009]. We expect the same thing in web development education. Therefore, we hypothesize:

H7: Students' perceived enjoyment will positively influence their intention to learn web development.

4. RESEARCH METHOD

The survey method was used in this study. In the following, we provide detailed information about the research process and measures of constructs in the proposed research model.

4.1. Research Process

Our subjects were students enrolled in a junior/senior-level web development class at a major public university located in the southwest United States. The class was to teach students web development techniques using ASP.NET, C#, HTML, and CSS. The class was designed as half lectures and half labs. Each week, the instructor met the students twice, one time in a regular classroom to teach concepts and techniques in the format of lectures and the other time in a computer lab where students worked on hands-on exercises to practice the techniques they learned in that week. In addition to exams and weekly quizzes, students were also required to work on weekly individual lab assignments and form teams to complete a comprehensive, semester-long project.

Thirty-seven students enrolled in the class. All of them were encouraged to participate in the survey. Extra credit was provided as an incentive for students' voluntary participation. In total, 36 students participated in and completed the survey. Each of them completed the survey with a set of questions (for details see Section 4.2) in the 7-point Likert scale, with 1 being strongly disagree and 7 being strongly agree. We also asked participants to provide additional comments about their ideas toward learning in the web development course. In Table I, we summarize participant demographics.

Table I. Summary of Participant Characteristics

Characteristic	Participants
Gender	Male: 28; female: 8
Age	Mean: 23.75; standard deviation: 3.86
Major	Computer Information Systems
Voluntariness	Required class
Year of Study	Junior: 14; senior: 22
Experience	This is their first and only required web development class in college.
Prior Programming Experience	They are all required to take the C# programming class, which is a prerequisite of this web development class. A database class is also required as a prerequisite.

Table II. Measurement Items of Perceived Web Development Efficacy and Motivation

Construct	Item No.	Measurement Item
Perceived Web Development Efficacy	PWDE1	Overall, I feel my web development ability is: weak/strong
	PWDE2	I am confident about my web development skills.
	PWDE3	I am confident that I can apply my web development skills in solving problems.
Motivation	M1	I am motivated to learn web development as I feel the topic is interesting.
	M2	I am motivated to learn web development as it is an important skill set in my area of study.
	M3	I am motivated to learn web development as it could help prepare me better in my job searching.

Among them, 28 were males and eight were females. The average age among the participants was 23.75. They were all in their 20s or 30s. All students were Computer Information Systems majors, including 14 juniors and 22 seniors. The web development class was a required class for all participants. A C# programming class and a database class were prerequisites of this class.

4.2. Measures

In this section, we present the measures of each construct in the proposed research model.

4.2.1. Measures of Constructs About Student-Related Factors. As shown in the proposed research model, Perceived Web Development Efficacy and Motivation are two student-related factors. To measure Perceived Web Development Efficacy, we adopted the measures of Efficacy from Law et al. [2010] with changes to fit the context of this study. Motivation is a complex human behavioral factor and is multifold [Law et al. 2010]. In this study, we developed our own measurement items of motivation to better fit the context of our study. These items focus on motivation related to one's personal interest, importance of the subject, and the expected job-related benefit it could bring. We list the detailed measurement items of both constructs in Table II.

4.2.2. Measures of Constructs About Instructor-Related Factors. The two instructor-related factors in the research model are Instructor Characteristics and Teaching Method. They are measured based on students' perception toward the characteristics of the instructor and different ways of teaching. Specifically, to measure Instructor Characteristics, we condensed and adopted the items from Selim [2007] with changes to fit the context of this study. To measure Teaching Method, we developed our own measures based on the specific methods used in the web development course that the participants took. By doing this, instead of asking about the general quality of instruction, we can get a more specific understanding of the impact of those teaching methods on student

Table III. Measurement Items of Instructor Characteristics and Teaching Method

Construct	Item No.	Measurement Item
Instructor Characteristics	IC1	The instructor is enthusiastic about teaching the class.
	IC2	The instructor is friendly toward individual students.
	IC3	The instructor is active in teaching the course subjects.
Teaching Method	TM1	Having this class as half lectures and half labs is helpful for me to learn the course subjects.
	TM2	Showing sample code and project examples in lecture slides can better help me learn web development techniques.
	TM3	Showing clear, step-by-step instructions in lab assignments can better help me learn how to apply web development techniques.
	TM4	The comprehensive team project can better help me learn web development techniques.
	TM5	The weekly individual assignments can better help me learn web development techniques.

Table IV. Measurement Items of Perceived Accomplishment, Perceived Enjoyment, and Intention to Learn

Construct	Item No.	Measurement Item
Perceived Accomplishment	PA1	My knowledge on web development gained in the class gives me a feeling of accomplishment.
	PA2	My knowledge on web development gained in the class gives me a feeling of achievement.
	PA3	My knowledge on web development gained in the class can contribute to my professional development.
Perceived Enjoyment	PE1	The web development class is: disgusting/enjoyable.
	PE2	The web development class is: unpleasant/pleasant.
	PE3	The web development class is: boring/interesting.
Intention to Learn	ITL1	I intend to learn more techniques about web development in this class as well as in the future.
	ITL2	I am willing to learn more techniques about web development in this class as well as in the future.
	ITL3	I would like to learn more techniques about web development in this class as well as in the future.

learning. For both constructs, students were asked to provide their ratings on the measurement items based on their own perceptions. We list the detailed measurement items in Table III.

4.2.3. Measures of Dependent Variables. The three dependent variables studied in this research are Perceived Accomplishment, Perceived Enjoyment, and Intention to Learn. To measure Perceived Accomplishment, we adopted items about Personal Accomplishment from Staples et al. [2002] with changes to fit the context of this study. Measures of Perceived Enjoyment were adopted from Heijden [2004], and measures of Intention to Learn were adapted from the measures of Behavioral Intention to Use from Venkatesh et al. [2003]. Table IV shows the measurement items of the three dependent variables.

5. DATA ANALYSIS

In the proposed research model, Perceived Web Development Efficacy, Instructor Characteristics, Perceived Accomplishment, Perceived Enjoyment, and Intention to Learn are reflective constructs, meaning that each of them is the common cause of its indicators (i.e., measures). Motivation and Teaching Method are formative constructs. Different from reflective constructs, formative constructs summarize the common

variation in a collection of indicators (i.e., measures). In our study, the three measurement items of Motivation are about different types of motivation. The five measurement items of Teaching Method aim to measure it from different perspectives, and these perspectives are independent—about different aspects of methods used in the class. Therefore, Motivation and Teaching Method are formative constructs.

Two streams of SEM techniques can be used to measure causal models, including covariance based (e.g., SAS and LISREL) and component based (e.g., SmartPLS and PLS-Graph) [Chin 1998]. The covariance-based methods are not appropriate for this study, since they are not able to deal with formative constructs [Lee and Xia 2010]. The partial least squares (PLS) method is a component-based method and therefore can handle both formative and reflective constructs [Chin 1998]. Another advantage of PLS is that it can deal with small sample size. Considering the statistical power of PLS and the relatively small number of participants in this study, we choose to use PLS for our model analysis. Specifically, Smart PLS 2.0 (M3) beta [Ringle et al. 2005] is used to conduct the analysis.

To assess the measurement model related to different constructs, both reliability and validity tests were conducted. To test reliability, the loadings (for reflective items), weights (for formative items), and their t-values were calculated. Unlike reflective items (i.e., items caused by a construct), for formative items (i.e., items themselves causing a construct), only weights rather than loadings need to be considered in assessing the measurement model [Au et al. 2008; Chin 1998]. For reflective constructs, we also calculated the Cronbach's alpha values, a measure of internal consistency among indicators of reflective constructs. A validity test was conducted by calculating the composite reliability, average variance extracted (AVE), square root of AVE, and correlations of the constructs [Au et al. 2008].

6. RESULTS

6.1. Measurement Model Assessment Results

Table V lists the reliability test result for all constructs. For reflective items, the standardized item loadings need to be above the commonly specified minimum value of 0.4 [Hair et al. 1998] or a more stringent threshold of 0.7 [Au et al. 2008; Hair et al. 1998]. As shown in Table V, all loadings are greater than 0.7 and statistically significant at the 0.05 level. For weights, TM2 is not significant and thus is being dropped from later analysis. The Cronbach's alpha values of all reflective constructs are greater than the 0.7 guideline [Hair et al. 1998; Nunnally 1978], indicating the internal consistency of measurement items.

Table VI shows the descriptive statistics, composite reliability, AVE, square root of AVE, and correlations of the constructs. The composite reliability values are all above the recommended level of 0.70, indicating adequate internal consistency between items [Au et al. 2008]. Convergent validity is demonstrated as the AVE values for all constructs are higher than the suggested threshold value of 0.50, which is the same as the requirement of the square root of AVE to be at least 0.707 [Gefen et al. 2000]. Comparing the square root of AVE of a given construct with its correlations among other constructs indicates that each construct is more closely related to its own measures than to those of other constructs, and discriminant validity is therefore supported [Chin 1998]. In other words, in each column (from IC to TM) of the table, the bolded square root of AVE value is the largest among all values in that column.

6.2. Structural Model Assessment and Hypothesis Testing Results

Table VII shows the PLS testing results of the research model. As hypothesized, Perceived Web Development Efficacy could significantly influence both Perceived

Table V. Reliability Test Results

Construct	Cronbach's Alpha	Item	Loading	Weight	T-Statistics
Instructor Characteristics	0.75	IC1	0.88		35.20*
		IC2	0.75		18.42*
		IC3	0.82		23.77*
Intention to Learn	0.93	ITL1	0.95		102.26*
		ITL2	0.92		44.85*
		ITL3	0.94		60.95*
Motivation	n/a	M1		0.50	3.21*
		M2		0.41	5.04*
		M3		0.26	2.17*
Perceived Accomplishment	0.95	PA1	0.96		125.72*
		PA2	0.98		213.29*
		PA3	0.93		109.09*
Perceived Enjoyment	0.88	PE1	0.93		76.61*
		PE2	0.94		58.80*
		PE3	0.83		23.45*
Perceived Web Development Efficacy	0.94	PWDE1	0.94		127.93*
		PWDE2	0.94		86.11*
		PWDE3	0.94		77.16*
Teaching Method	n/a	TM1		0.34	4.14*
		TM2 *(dropped)*		−0.04	0.50
		TM3		0.13	2.80*
		TM4		0.29	4.77*
		TM5		0.66	10.09*

Note: *Significant at 0.05 level.

Table VI. Validity Test Results

Construct	Mean	Std. Dev.	Composite Reliability	AVE	IC	ITL	M	PA	PE	PWDE	TM
IC	6.63	0.74	0.86	0.67	**0.82**						
ITL	6.14	1.00	0.96	0.88	0.55	**0.94**					
M	5.88	1.13	n/a	n/a	0.44	0.88	n/a				
PA	5.74	1.16	0.97	0.91	0.55	0.61	0.59	**0.96**			
PE	6.01	0.96	0.93	0.81	0.60	0.71	0.72	0.75	**0.90**		
PWDE	4.72	1.24	0.96	0.89	0.42	0.68	0.63	0.63	0.65	**0.94**	
TM	5.83	1.44	n/a	n/a	0.49	0.58	0.65	0.63	0.77	0.51	n/a

Note: Diagonal elements in bold are the square root of AVE by constructs from their indicators; off-diagonal elements are correlations among constructs. Composite reliability and AVE can be calculated only for reflective constructs.

Accomplishment (path coefficient = 0.331, t = 5.44) and Perceived Enjoyment (path coefficient = 0.118, t = 2.38). Therefore, H1a and H1b were supported. For Motivation, the results showed that it could significantly influence Perceived Enjoyment (path coefficient = 0.210, t = 4.00), but not Perceived Accomplishment. This indicates that if students are motivated to learn web development, they tend to enjoy the learning process, but it doesn't necessarily mean that they will have a strong feeling of accomplishment. So, H2b was supported, but not H2a. Instructor Characteristics significantly influenced both Perceived Accomplishment (path coefficient = 0.231, t = 4.64) and Perceived Enjoyment (path coefficient = 0.144, t = 3.05), in the support of H3a and H3b. Teaching Method significantly influenced both Perceived Accomplishment (path coefficient = 0.283, t = 4.69) and Perceived Enjoyment (path coefficient = 0.347, t = 5.27). Thus, H4a and H4b were supported. In addition,

Table VII. Model and Hypothesis Test Results

Hypothesis	Path	Path Coefficient	T-Statistics	Result
H1a	Perceived Web Development Efficacy → Perceived Accomplishment	0.331	5.44**	Supported
H1b	Perceived Web Development Efficacy → Perceived Enjoyment	0.118	2.38*	Supported
H2a	Motivation → Perceived Accomplishment	0.095	1.28	Not Supported
H2b	Motivation → Perceived Enjoyment	0.210	4.00**	Supported
H3a	Instructor Characteristics → Perceived Accomplishment	0.231	4.64**	Supported
H3b	Instructor Characteristics → Perceived Enjoyment	0.144	3.05*	Supported
H4a	Teaching Method → Perceived Accomplishment	0.283	4.69**	Supported
H4b	Teaching Method → Perceived Enjoyment	0.347	5.27**	Supported
H5	Perceived Accomplishment → Perceived Enjoyment	0.255	4.41**	Supported
H6	Perceived Accomplishment → Intention to Learn	0.170	2.16*	Supported
H7	Perceived Enjoyment → Intention to Learn	0.582	6.41**	Supported

Note: *Significant at the 0.05 level. **Significant at the 0.01 level.

Perceived Accomplishment could significantly influence Perceived Enjoyment (path coefficient = 0.255, t = 4.41), supporting H5. Both Perceived Accomplishment (path coefficient = 0.170, t = 2.16) and Perceived Enjoyment (path coefficient = 0.582, t = 6.41) significantly influenced Intention to Learn, in the support of H6 and H7.

The four independent variables (i.e., PWDE, M, IC, and TM) together explained 57.0% ($R^2 = 0.570$) of the variance of Perceived Accomplishment (PA). Those five then together explained 77.4% ($R^2 = 0.774$) of the variance of Perceived Enjoyment (PE). Perceived Accomplishment (PA) and Perceived Enjoyment (PE) together explained 51.7% ($R^2 = 0.517$) of the variance of Intention to Learn (ITL).

We also tested the gender (male vs. female) and age (early 20s vs. older) differences in students' responses for each construct, and no significant results were found. In addition, no statistically significant moderating efforts were found on gender or age.

7. SUMMARY OF STUDENT COMMENTS

To gain a deeper understanding about students' perceptions toward learning web development, we also collected comments from participants of the study. All 36 participants provided their comments. Overall, those comments can be grouped into two general categories—specific comments and general feelings. In the following subsections, we first summarize students' specific comments followed by their general feelings.

7.1. Specific Comments

Most of the specific comments from students were about their motivation and teaching methods. Motivation is a student-related factor in the research model, and teaching method is an instructor-related one.

7.1.1. Specific Comments on Motivation. Many participants mentioned that they were motivated to learn web development because it was a key technique that could significantly help them in their future jobs and careers. Examples of comments are:

"I am motivated to learn Web programming because I plan on using it in my future career. I want to learn as many skills as I can because I believe they will be very useful in any business I might be in."

"I am dedicated to become a well rounded IT employee for a company and web development is an important skill."

"...Learning more about this will help me be successful in the professional world."

"My motivation is a better future."

Some of them were motivated with specific plans for their future careers, such as:

"...My motivation stems from my drive at a future career goal of becoming head Analyst or CIO of a fortune 500."

"My motivation is to have my own small business."

In addition to the career-related motivation, another type of motivation as mentioned by several participants was about the usefulness of web development techniques and their own personal interest. Here are some examples:

"I am motivated to learn about web programming because it is an interest of mine and I know that there is so much out there to learn. My motivation is to continue to get better and learn as much as I can."

"I would like to be able to create amazing websites for myself and other people."

"Many of the jobs in the career field I would like to enter require web programming skills. I also enjoy programming which is another source of motivation."

"My primary motivation is to help in my career, but I also like it."

There are also participants who attributed their motivation to certain teaching methods used in the class, such as "I felt pretty motivated because the instructors teaching methods were awesome" and "...because I enjoy lab days."

In sum, students' motivation in learning web development falls into several folds. One type of motivation came from students' belief of the importance of the technique in their future career development. Another type was from students' personal interest of the subject. Interestingly, we also found that the teaching methods used in the class could also motivate students in their learning of web development. This also highlights the importance of the instruction methodology that educators should pay attention to.

7.1.2. Specific Comments on Teaching Method. Participants also expressed their opinions on the teaching methods used in the class. Many of them mentioned that the individual, weekly lab assignments were very helpful in their learning of web development. Because of the nature of the subject, students found that they learned it better through hands-on exercises given to them each week. Examples of comments are:

"I believe that the individual lab assignments are the most helpful. They are very hands-on and help me to learn the skills that we have gone over in the lab class. They are also very rewarding because I feel a sense of accomplishment when I do them."

"Individual lab assignments are the most helpful."

"The individual labs are a good way to actually practice the concepts consistently each week."

"Individual assignments are what teach me most everything within the class."

In addition to the individual lab assignments, some participants mentioned that the semester-long, comprehensive team project was also very helpful. Examples of comments are:

"I think the individual lab assignments as well as the team project are helpful in web development. The team project allows other students to teach you things you may not have picked up on yourself."

"The team project is the most helpful, but the lab assignments are very helpful too."

"I think the individual and team projects are the best way to learn Web development."

Other participants expressed the helpfulness of lectures; for example:

"...Individual lab assignments, [and] lectures i [I] think that is [they are] helpful for my learning web development."

"I felt the lab assignments and lectures were the most useful because I tend to learn more when doing hands on training or work."

"Individual lab assignments and lectures are the most helpful to me."

As to lectures, we do see mixed options from the participants. The previous shows some positive ideas toward it. A couple of other participants also expressed their negative feelings about the traditional way of teaching by using lectures and their preference for hands-on based teaching methods, such as "Lab assignments and lab classes are the most helpful when learning web development. Lectures are not useful to me for learning computer programming; I am a visual learner who prefers hand on practice" and "I do not seem to retain much from lectures and retain better from the actual application of the concepts."

Overall, participants preferred hands-on teaching methods in learning web development. Some of them favored the individual work, while others liked the team project better. Not surprisingly, mixed opinions were found toward lectures. As web development itself is a technical subject, it is understandable that some students may not find lectures promising. Therefore, educators could consider condensing lectures and incorporating more hands-on work in teaching web development. However, we do see students who found lectures helpful. This indicates that it is still necessary to keep lectures in web development education. A better way to attract students' interest could be closely linking the concepts conveyed in lectures to the hands-on work.

7.2. General Feelings

Overall, three types of general feelings were expressed in student comments: the difficulty in learning web development and their interest in learning web development and programming in general.

7.2.1. Feelings About the Difficulty in Learning Web Development. Many participants expressed that web development was either difficult or challenging to learn. The coding, either the overall code structure or more specifically the code-behind files, was treated as the most difficult by many participants. Examples of comments expressing the difficulty of the overall code structure are:

"It's just the code. Understanding why things go where they do is always challenging for me."

"The hardest part for me is remebering [remembering] what coding means what. I usually have to go back and look at that a couple of times a project."

Examples of comments particularly about the difficulty of the code-behind files (i.e., source code files containing the event procedures written in C# that take charge of the action part of dynamic web forms) are:

"Knowing what file structure does what, how to program the code behind file [is difficult]."

"The c# coding is the hardest part."

Some participants also listed the database programming (i.e., linking the backend database to the front-part web forms to display data in a dynamic manner) as difficult to learn. Examples of comments are:

"The hardest parts [part] of the class for me was linking the database to drop down lists etc."

"Using and maintaining the database on a website [is difficult]."

"Getting a database to work on our team site [is difficult]."

Other participants mentioned that server controls and cascading style sheets (CSSs) were difficult to learn, such as "I found the server controls was [were] the most difficult for me in this course but I was able to understand it [them] after [later]" and "Formatting things exactly how I want them to look on the web page with css [is difficult]."

7.2.2. Interest in Learning Web Development. Many participants expressed their strong willingness and interest to learn web development. They believed that web development skills were valuable and could help prepare them better for getting jobs and future career development. Examples of comments are:

"I like learning web programming because I know it will be very helpful for my future."

"...it's interesting and valuable to my field of study. I've always wanted to learn how to build a website."

"Most businesses have a website, so having the knowledge and skill set to work on those websites is a great advantage going into the workforce."

"I really enjoy it because i [I] see a lot of future in this business. It could help get a job a lot faster."

Other participants attributed their interest in learning web development to the fact that web development is very functional and gives room for creativity. Some comments are:

"...web programming is more functional. Also allows for more creativity."

"It is a concept that know no [has no] bounds and has endless possibilities for creativity."

Some participants also mentioned that their interest stemmed from the practical application of web development in the real world, such as:

"I love web programming. I like web programming because it is very enjoyable to create a shopping website where you can see directly the uses of the work that you are doing."

"...it helps to understand more of what we see everyday on the Web and how it is made."

"...it is a useful skill I will be able to use in the real world."

Several participants said that they liked web development because of its visualization advantage compared with other types of programming. Examples of comments are:

"It is interesting and I really like the fact that I can visually see my results on the web."

"...web programming doesn't deal with compiling and the GUI markup is easy. Web programming has the advantage of instant gratification, something other programming styles don't really have. Also it is easily cross-platform."

Overall, most of the participants expressed their strong willingness and interest to learn web development. Several reasons were identified from their comments, such as the usefulness of the technique in their field of study, the creativity it could give, its practical application in the real world, and the attractive visual representation.

7.2.3. Interest in Learning Programming in General. Many participants mentioned that, as Computer Information Systems majors, they were interested in learning programming in general. They believed that learning programming could help them further develop their problem-solving and logical thinking abilities. Examples of comments are:

"I enjoy learning programming because it is creative but involves logical steps."

"...it helps me actively engage a problem and it[s] solution with technology."

"I like it [programming] for the problem solving aspect."

"...it allows me to gain knowledge on how things work and fix problems that I see."

Several participants mentioned that their interest came from the fact that learning programming skills could help them to solve real-world problems. Examples of comments are:

"Programming has helped me analysis [analyze] problems in real life. It also is motivating because I feel I can create products to help people via programming."

"...it helps me in life with more than just programming. It helps me problem solve [solve problems] easier [more easily]."

"I do enjoy learning programming. I like the aspect of being able to create something, and see it put into action."

Other students mentioned that they liked to learn programming because it was a key technique in their field of study, and they might pursue it in their future careers. Examples of comments are:

"I like to learn programming because it will greatly help me in my future career. As i [, as I] would like to pursue a career in web development."

"I believe that the skills that I am learning as a programmer will help me greatly in the future. Knowing that it will help me I enjoy learning about [it] as I see the practicality of the knowledge."

"i [I] like to learn it because it will help me develop skills that i [I] see are necessary."

"It's a tool that many others do not have."

Overall, the majority of students were interested in learning programming in general, with various reasons such as gaining problem-solving ability, being able to apply it to solve real-world tasks, and the benefit brought by it to their future careers.

8. CONTRIBUTIONS, LIMITATIONS, AND FUTURE RESEARCH SUGGESTIONS

Learning web development has become more and more important for students in computer science, computer information systems, and related areas. Having the ability and skill sets to develop web applications is beneficial to their personal development and potentially future careers. However, it is generally believed among students that web development techniques are difficult to learn. In order to develop a fully functional website with dynamic server controls, students need to learn and be able to apply a variety of techniques using different languages (such as HTML, ASP.NET, and C#) and supporting techniques (such as CSS). Therefore, a considerable learning curve could be expected to be experienced by students. Because of the importance of and difficulty in learning web development, it is essential for educators to pay special attention to how to teach the subject more effectively.

However, previous research on student learning in programming has mainly focused on introductory programming classes (such as Java, C++, and C#). Many fewer studies have been done particularly on web development classes in which students need to learn a whole different set of new techniques. In addition, existing research on student learning in web development is mainly about introducing and comparing specific ways of instruction, such as self-directed learning and pure hands-on activities-driven learning. To the best of our knowledge, little research has considered both student-related and instructor-related factors and systematically incorporated them into a nomological network to examine student learning of programming, and no such study has been done on student learning in web development. To address such a research gap, this study proposes a research model to investigate the influencing factors on student learning in web development.

Specifically, this study makes the following research contributions and practical implications. First, we investigated the impacts of two groups of factors, student related and instructor related, on student learning in web development. We included two student-related factors, perceived web development efficacy and motivation, both of which are about students' perceptions toward their own characteristics. Instructor characteristics and teaching method are the two instructor-related factors. They are the things that are controlled and can be further improved by instructors. Second, we developed a research model to incorporate those factors into a nomological network to systematically study their impacts on student learning of web development. Specifically, their impacts on three dependent variables—students' perceived accomplishment, enjoyment, and intention to learn web development—were examined. Third, we also collected and summarized detailed comments from students to get a deeper understanding about their subjective perceptions toward the learning of web development.

In addition, the results of the study indicate that students' perceived accomplishment and enjoyment in learning web development could significantly influence their intention to learn the subject. Because of the difficult-to-learn nature of web development and a wide range of techniques to be covered in the class, it is common to observe frustration among students in web development classes. Therefore, to help them keep a high level of learning intention, educators of web development should put more effort into checking and making sure that students enjoy the learning process and have a sense of accomplishment in learning. Based on the research findings of this study, to do this, educators need to encourage students to keep a high level of motivation and try to find ways to help students build a sense of self-efficacy gradually in web development. To motivate students, educators can keep emphasizing the importance of mastering web development skills and the long-term benefits it can bring to their careers. To help build their self-efficacy, educators can provide step-by-step practices to students and give them constructive feedback and comments on their gradual improvement over

the semester. In addition, instructors also need to maintain certain characteristics, such as being enthusiastic, friendly, and active, and utilize effective teaching methods. Students won't like the subject to learn (especially for difficult-to-learn subjects) unless they find that their instructors like it and are approachable when they need help. Effective teaching methods (such as providing hands-on exercises) also play an important role in influencing student learning of web development since they can better help students grasp and digest difficult concepts and techniques.

This study also has several limitations that future research can further address. First, the sample size of the study is relatively small. Future research can further validate the research model by using a large number of subjects and potentially include data about more classes and instructors. Second, future research can further examine the impact of facilitating conditions (such as learning environment and any other related facilities) on student learning in web development and incorporate it as another dimension in the research model. In this research, we included independent variables based on two groups (i.e., student related and instructor related) of specific factors that could influence students' learning outcome. Future research can extend the research model by including independent variables from other adoption models such as UTAUT. Third, as web development courses typically have a deep learning curve for students, it is interesting to see how students' performance improves over time and which factors are more influential in different learning stages. A longitudinal study can be conducted to examine it in detail. In addition, future research can extend the research model to examine moderating effects based on different demographic variables. Also, the research model proposed in this study can be applied to examine student learning in other computing courses.

Overall, we believe the research model developed in this study is contributory to web development education as well as computing education in general. The results of the study provide insights into student learning of web development that can be of interest and practical importance to educators.

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