Association for Information Systems
AIS Electronic Library (AISeL)

AMCIS 1997 Proceedings

Americas Conference on Information Systems (AMCIS)

8-15-1997

The Influence of Group Labs on Student Adoption of Software Methodologies: An Empirical Test

Jeffrey P. Landry
The Florida State University, jlandry@garnet.acns.fsu.edu

J. Harold Pardue
University of Minnesota -Duluth

Michael V. Doran
University of South Alabama

The Influence of Group Labs on Student Adoption of Software Methodologies: An Empirical Test

Jeffrey P. Landry
The Florida State University
Dept. of Information & Management Science
College of Business
Tallahassee, FL 32306-1042
e-mail: jlandry@garnet.acns.fsu.edu
J. Harold Pardue
University of Minnesota - Duluth
Dept. of Finance & Management Information Sciences
21 School of Business and Economics
Duluth, MN 55812-2496
Michael V. Doran
Roy J. Daigle
University of South Alabama
School of Computer and Information Sciences
Mobile, AL 36688

Abstract

The ACM's CIS curriculum model calls for structured laboratories using groups to instruct students in software engineering methodologies. A social-psychological model of individual acceptance of a technological innovation is employed to empirically test the effectiveness of structured labs in fostering individual adoption of a software engineering methodology. Our findings suggest that a structured lab experience does influence a student's belief system regarding the usefulness of a methodology, leading to a decision to adopt the methodology in completing individual programming assignments.

Introduction

The use of structured laboratories using groups has been identified as a critical element in computer information systems (CIS) curricula (ACM/IEEE-CS Joint Curriculum Task Force, 1991). This prescription is of particular relevance to fostering the adoption of software engineering methodologies. Research has found that despite the fact that undergraduate CIS students are taught systematic, engineering approaches to problem solving, novice programmers often fail to adopt such systematic approaches (Merrienboer 1988). This paper attempts to address the following questions: What impact do structured labs have on the individual adoption of software methodologies?

Conceptual Model

The question of how structured labs influence individual adoption of a software engineering methodology is viewed from a diffusion of innovations perspective. The question then becomes, what are the relevant antecedents that influence individual adoption?

The theory of reasoned action (TRA) is a social psychological model of individual behavior which posits that attitudes and subjective norms are predictors of behavioral intention (Ajzen and Fishbein 1980). This theory has been widely researched, especially with relation to information technology adoption. TRA is the basis for Davis' (1989) technology acceptance model (TAM). Both theories have been used to explain individual psychological processes as they relate to the adoption of information technology. Empirical research has demonstrated that the model holds up fairly well when the attitude and behavior are both specific. The adoption of a software methodology, as the dependent variable, fits nicely within the TRA/TAM framework.

In TRA, behavioral beliefs and outcome evaluations predict attitudes. The relevant behavioral beliefs and outcome evaluations for the current study are taken from TAM. These constructs are perceived usefulness of the technology and perceived ease of use of the technology. Davis derived these constructs from the diffusion of innovations perspective (Rogers 1995). Davis found these two constructs to be the most significant ones for influencing technology acceptance. In addition, one's attitude is influenced by prior experience with the attitude object, and these attitudes may tend to be quite strong. The most important experience in this study is the structured lab using groups. It is a trial experience with SDLC that is likely to influence their attitudes, and/or their intentions to use SDLC again in the future, according to theory (Rogers 1995). Finally, TRA posits that social pressure to adopt may come from peers and superiors.

Research Model

The dependent variable of interest is the individual adoption of software engineering methodologies. The software engineering methodology used in this study closely follows the traditional software development life cycle (SDLC). Greatly simplified, this approach is based on a four-step problem solving process (Polya 1957): (1) understanding the problem, (2) devising a plan, (3) implementing the plan, and (4) looking back. The dependent variable is operationalized as student adoption of the SDLC on individual programming assignments. The direct antecedent to adoption of SDLC is intent to use SDLC on the individual assignment.

Variable	Definition
perceived usefulness in lab	beliefs that using SDLC actually increased performance in a lab assignment
perceive ease of use in lab	beliefs that using SDLC was relatively free of effort in a lab assignment
attitude towards SDLC use	the overall favorableness or unfavorableness of an individual's feelings toward using SDLC on a given task
peer influence	pressure from peers with respect to using SDLC on a given task
superior influence	pressure from superiors with respect to using SDLC on a given task

subjective norms	social pressure on the individual to use SDLC on a given task
intention to use SDLC	individual's intention to use SDLC on a given task
adoption of SDLC (*dependent variable)*	the systematic and consistent application of a software engineering design methodology in problem solving on a given task

Table 1 - Constructs used in this study

From TAM, usefulness and ease-of-use are retained as the salient beliefs proposed to influence an individual's attitude about adoption. These constructs are operationalized as perceptions of usefulness and ease-of-use as formed in the group lab environment. Three social constructs are taken from the TRA: subjective norms, peer influence and superior influence. Peer and superior influence are posited to determine subjective norm. The research model tested in this study is depicted in Figure 1. The basic hypothesis is that perceived usefulness and ease-of-use in the lab will affect a shift in a student's belief system, leading to the adoption of software engineering methodologies in individual programming assignments.

The Study

The subjects were undergraduate computer information science students taking an introductory programming course (CS-1 and CS-2) at a medium-sized, southern state university. The students received instruction on the SDLC approach during lecture and through required reading materials. Use of SDLC was encourages by the instructor. In addition to these traditional methods, the students also participated in structured labs. In teams of three and four, students worked step-by-step through programming assignments using an SDLC methodology (Pardue, Doran and Longenecker 1994). Later in the semester, the students were given an individual, take-home programming assignment.

Use of the SDLC was encouraged on the assignment, but it could not be mandated, due to the way the deliverables were designed. Students were required to turn in output from all steps of the SDLC. However, it was possible for students to "fake" the SDLC by first solving the assignment directly with a coded solution and then completing the other deliverables afterwards. In light of the students being able to do this without being detected, it can be said that adoption of the SDLC was voluntary on the part of the individual student.

In order to test the effects of the group lab experiences on individual adoption, a survey instrument was developed. Items were included to measure all of the constructs listed in Table 1. Except for the dependent variable, all constructs in the instrument were based on prior studies of TAM, TRA and the related theory of planned behavior (TPB) (Ajzen 1991, Davis 1989, Davis, et al, 1989, Taylor and Todd 1995). Seven-point semantic differential scales with bipolar adjectives were used. A pilot study was conducted to assess the validity and reliability of all measurement instruments. Twenty-five CIS students enrolled in a CS1 course were administered the instrument. Items with low reliability were either dropped or revised.

The final instrument was administered to 34 students. The data were collected in two waves in order to reduce the effects of common method variance. Shortly after participating in the structured lab and before working on an individual assignment, the students responded to survey questions on all variables except the dependent variable. After completing the individual assignment, students were administered the dependent variable items. The internal validity, or reliability, of the instrument was estimated with Cronbach's Alpha. The reliabilities ranged from .770 to .979. The theory-based nature of the constructs served as the strongest support of the instrument's external validity. Confirmatory factor analysis was performed to ensure construct validity. The factors loaded as predicted with minor exceptions.

Discussion of Results

The hypothesized paths in the research model were tested using Amos version 3.6, a structural equation modeling software tool (Arbuckle 1997). The overall fit, predictive power and the significance of paths were considered.

The fit statistics indicate that the model provides a good fit to the data (overall model fit: $^{2} = 62.19$, $p < 0.001$). The model accounts for 30% of the variance in behavior, 56% of the variance in intention, and 72% of the variation in attitude. Figure 1 provides a summary of the model results. The R^2 values are printed on each dependent variable in parenthesis.

The hypothesized relationship between perceived usefulness of SDLC and adoption of SDLC was significant along the beliefs-attitudes-intentions-behavior path. These results are consistent with prior TAM studies, as usefulness is typically the most important belief construct.

However, ease-of-use was not significant, nor were subjective norms. Ease-of-use may not be relevant. The purpose of the SDLC is not necessarily to make problem-solving easier, but to make the solution better. It could be that the use of such a methodology results in an efficiency-effectiveness tradeoff. Peer influence would be expected to influence norms and intentions. Perhaps peer influence was captured by the fact that the labs influence individual beliefs about the usefulness of the labs, rather than showing up in the subjective norms. Social norms continue to be poorly understood in this context anyway, as prior TAM studies have uncovered (Davis 1989, Davis, et al, 1989, Taylor and Todd 1995). They are likely to be more influential in a realistic setting, rather than in a university setting.

Conclusion

The findings support the prescription that structured labs are an important component in computer and information science education. The findings also support theory which suggests that beliefs about the usefulness of an information technology will lead to a favorable attitude toward an information technology and eventually to its adoption.

References

References are available from the first author by request.

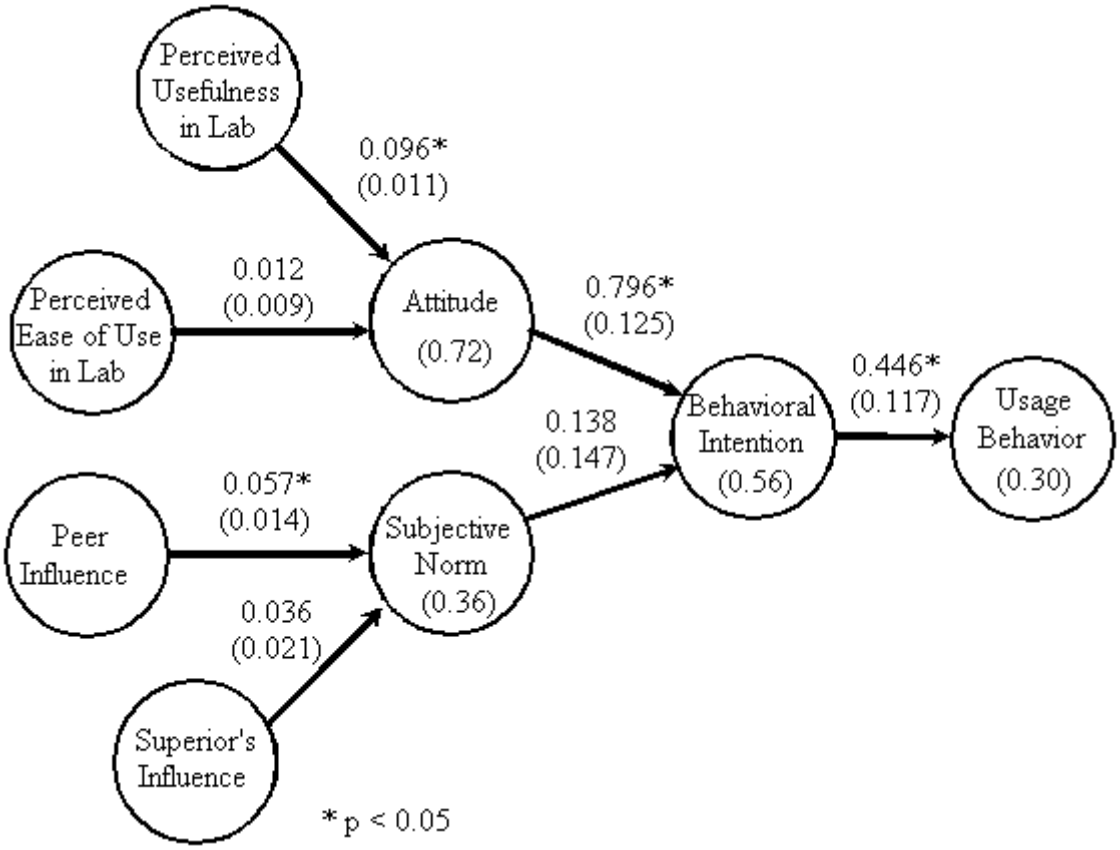

Figure 1 - Path coefficients with standard errors