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Factors influencing curriculum adoption in undergraduate cybersecurity programs

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Abstract

This study purposes to discover what factors influence the adoption of new curriculum at the undergraduate level through a quantitative adaptation and application of existing technology adoption models to the domain of curriculum adoption. It is hypothesized that many of the same factors that drive technology adoption also drive curriculum adoption with the addition of altruistic motivation of the faculty member on behalf of the student. The survey-based study employs a path model analyzed using partial least squares structural equation modeling. If it is desirable to drive toward standardized cybersecurity curriculum, this work will benefit standards bodies, accreditors, university leaders, and the federal government to determine the factors that drive adoption to direct resources appropriately.

Motivation

Increased demand in the cybersecurity workforce requires a significant response from colleges and universities to meet that demand. The federal government has emphasized cybersecurity education at all levels to meet that demand, yet there is wide variance in curriculum defined by academics, industry, and government organizations. While there are many curriculum standards (e.g. the NSA Centers for Academic Excellence, the ACM curriculum guidelines, ABET guidelines, and numerous industry certifications), little research has been conducted to investigate the drivers for curriculum adoption among faculty. Yet every one of the five regional accrediting bodies require faculty oversight of the curriculum via shared governance. Determining the factors that lead to curriculum adoption in faculty is important to advance cybersecurity education.

Literature Review

While motivations for curriculum adoption has not been widely studied, one effort by Ni (2009) did consider factors influencing adoption of "curriculum innovation." Using other fields as a basis, Ni states that "teachers' knowledge and beliefs could serve as critical factors that impact teachers' decisions about whether to adopt a new curriculum, especially at the post-secondary level…"

A behavioral model adapted from psychology, curriculum-as-technology forms a system in which the student-teacher feedback loop is employed to transmit knowledge and skills from teacher to student (Johnson, 2015; Jenkins, 2009). As an information system, curriculum consists of the people involved (students, teachers), the processes followed (instruction, assessment), the data that is processed (instructional content), and communications (student-teacher interactions). Thus the adoption of curriculum is consistent with the adoption of an information system or technology and the models can be legitimately applied.

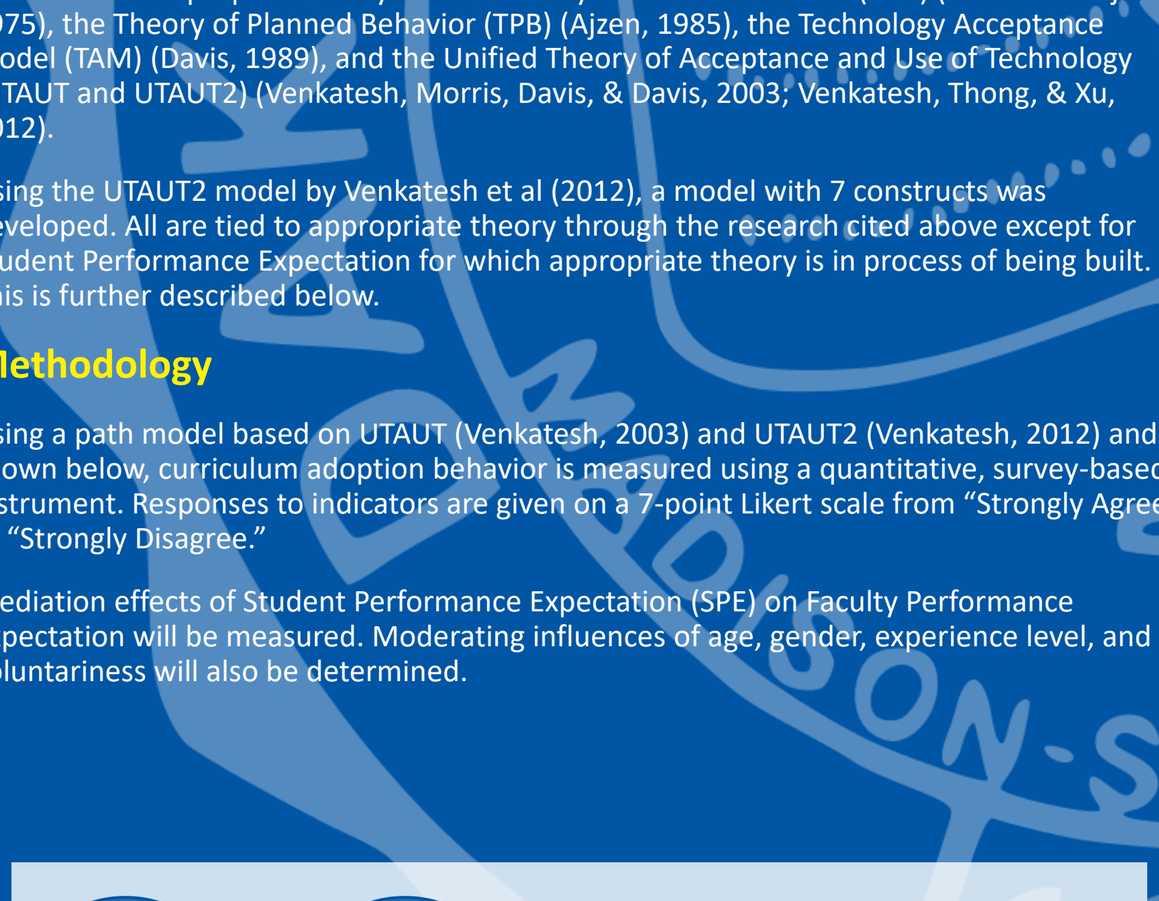
To identify factors influencing intention toward a particular behavior, it is appropriate to discuss a number of relevant information systems theories that have aimed at technology adoption. These can then be adapted toward curriculum adoption. The four most relevant theories for this proposed study are the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975), the Theory of Planned Behavior (TPB) (Ajzen, 1985), the Technology Acceptance Model (TAM) (Davis, 1989), and the Unified Theory of Acceptance and Use of Technology (UTAUT and UTAUT2) (Venkatesh, Morris, Davis, & Davis, 2003; Venkatesh, Thong, & Xu, 2012).

Using the UTAUT2 model by Venkatesh et al (2012), a model with 7 constructs was developed. All are tied to appropriate theory through the research cited above except for Student Performance Expectation for which appropriate theory is in process of being built. This is further described below.

Methodology

Using a path model based on UTAUT (Venkatesh, 2003) and UTAUT2 (Venkatesh, 2012) and shown below, curriculum adoption behavior is measured using a quantitative, survey-based instrument. Responses to indicators are given on a 7-point Likert scale from "Strongly Agree," to "Strongly Disagree."

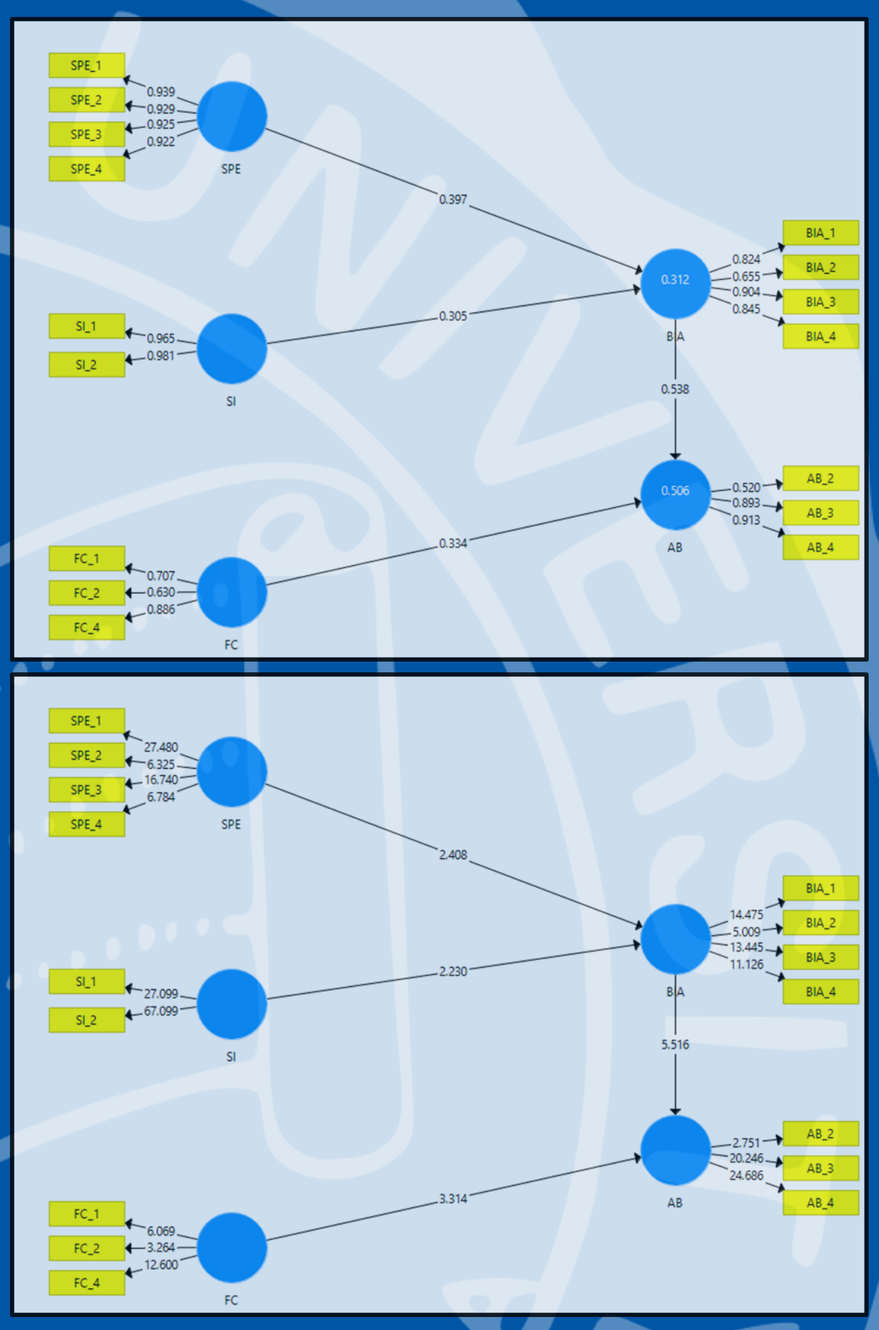
Mediation effects of Student Performance Expectation (SPE) on Faculty Performance Expectation will be measured. Moderating influences of age, gender, experience level, and voluntariness will also be determined.



Results and Discussion

Survey data collected from 55 faculty and administrators with responsibility for cybersecurity programs were collected and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) software (SmartPLS). Following the processes in Hair et. Al (2017), the measurement model was evaluated based on loadings on latent variables and crossloadings on others. As a result, 6 indicators were cut from the model, yielding high composite reliability and AVE and HTMT ratios were under 0.8 thereby establishing both discriminant and convergent validity.

The structural model was likewise evaluated. All inner VIF values were below the threshold of 5 and therefore there are no collinearity issues among constructs. Running the bootstrapping procedure showed that only BIA->AB, FC ->AB, SI -> BIA, and SPE->FPE were significant. By evolving the model to eliminate FPE, then the direct effect of SPE on BIA became significant. Further, removing EE and HM from the model yielded a more parsimonious model with the same AVE as the more complex one. Both the weighted path model and the t-statistic path model are given below for this final state.



Conclusions and Future Work

This parsimonious model is a first step toward understanding the factors that influence curriculum adoption. The model shows that faculty expectation of future student performance, social influence, and facilitating conditions significantly contribute to overall adoption behavior. The AVE for adoption behavior was high at 0.633 and the R2 was likewise high at 0.506. Future analysis will determine moderation effects of demographics.

This research is significant because it can help drive better curricular adoption by universities, industry, and government. Further, it applies a technology acceptance model in a different context to good effect. Finally, it introduces the concept of third party performance expectation to acceptance models.

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Video walkthrough

I'd love to talk you through this poster and provide greater detail. Scan this QR code to access a video where I explain the research presented here.
This URL redirects to http://cs.franklin.edu/~whittakt/DSUGRI and then to a YouTube video.