

# FACULTY ATTITUDE TOWARD TECHNOLOGY-ASSISTED INSTRUCTION FOR INTRODUCTORY STATISTICS IN THE CONTEXT OF EDUCATIONAL REFORM

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*Technology-assisted instruction is a core focus of educational reform in most disciplines. This exploratory study (N=227) examined instructors' attitude toward technology integration (specifically computers for data analysis and the use of real-world data) for the teaching of introductory statistics at the college level. Salient attitudinal elements (including perceived usefulness, self-efficacy, and comfort) which can serve as barriers to, and facilitators of technology integration were identified. Additionally, a preliminary scale for measuring instructors' attitude toward technology integration was developed, and acceptable levels of internal reliability and validity were obtained. This scale will be referred to as ATTIS (Attitude Toward Technology Integration Scale). These results underscore the need for training programs and support services for instructors, by way of workshops, modeling of best practices (through team teaching and mentoring), and other targeted professional development programs.*

## INTRODUCTION

Technology-assisted instruction is a core focus of educational reform in most disciplines. This is particularly so for the teaching of introductory statistics at the college level (Garfield et al., 2002; Chance et al., 2007; Kaplan, 2011; Hassad, 2011), for which there is a consensus that the goal should be to foster statistical thinking and literacy by emphasizing concepts and applications rather than mathematical procedures, formulas and calculations (Franklin & Garfield, 2006). This instructional model embodies active-learning, and is grounded in constructivism (Cobb, 1994). A major focus of technology-assisted instruction, in this context, is the integration of statistical and research software packages, toward providing students with authentic experiences in collecting, entering, organizing, analyzing, and exploring real-world data, which activities can facilitate meaningful learning and the acquisition of transferable knowledge and skills. And according to Chance et al. (2007, p.7) such learning outcomes can be achieved by “*using pedagogically rich data sets and exploratory activities*”.

The literature is replete with justifications for the use of technology, and these vary from the purely behaviorist (and simplistic) notion that it reduces computational burden (Higazi, 2002; Chance et al., 2007) to the constructivist view that it serves as an analytical tool that allows students to explore data and distribution toward discovery of meaning, and conceptual understanding (Garfield & Ben-Zvi, 2007; Pratt, Davies, & Connor, 2011). The behaviorist tends to view the use of technology as a discrete and compartmentalized activity, and statistics as a branch of mathematics; whereas, the constructivist focuses on integration of technology and active learning toward a meaning-making experience for students, by facilitating them to “unlock stories in data” (Pfannkuch, 2008).

In support of integration of technology, Moore (1997, p.123) called for “*strong synergies among content, pedagogy, and technology*” if there is to be meaningful change in statistics education. While this notion is often referenced, there is a predominant focus on the technology component (separately) at the expense of pedagogy and integration, resulting in claims of high levels of use of technology, but learning outcomes that are lacking. Moore’s concept recognizes the need for the instructor to possess adequate knowledge of content, pedagogy, technology, and more importantly, technology literacy, which includes the type of knowledge required for effective integration of technology into teaching (Mishra & Koehler, 2006). For effective teaching, the integration of technology should be informed by pedagogy (the art and science of teaching). Failing this, the technology becomes a discrete tool used merely for delivery, distribution, automation and presentation of information, with a purely mechanistic and compartmentalized focus, rather than an analytical tool to facilitate active learning and conceptual understanding.

Evidence-based instructional models and strategies should guide teaching and learning. In other words, information from cognitive science (about how we learn), with attention to diversity of learning styles, and concepts such as the theory of multiple intelligences, should inform our teaching. Additionally, there is an emerging body of work on the role of assessment in learning (Rubin, 2007) which supports that in order to facilitate effective learning, competencies relating to application, critical thinking, and conceptual understanding must be assessed. This is in contrast to assessments geared toward rote memorization. What students learn, including the extent to which they engage in the material (and the use of technology) is largely determined by our assessment approach and philosophy. As psychologist Lauren Resnick puts it, “*What we assess is what we value. We get what we assess, and if we don't assess it, we don't get it*” (cited in Wiggins, 1990).

Regarding the use of technology in statistics education, Moore (1997, p.135) aptly noted that we are “*teaching our subject and not the tool*”. Technology is simply a tool, and like any tool, if it is not appropriately and effectively used, there could be far-reaching negative consequences for students, including increased levels of fear, anxiety, failure, attrition, lack of conceptual understanding, and students who are disillusioned about pursuing the field of statistics. Such negative outcomes can result from a lack knowledge and skills regarding creating and managing an active learning environment (Chance et al., 2007; Okojie et al., 2006).

While the synergy of content, pedagogy and technology is important, another domain has emerged as fundamental to the adoption and effective use of technology in teaching, and that is, instructors’ psychological predisposition (particularly, attitudes and beliefs) toward technology (Hassad, 2011; Wingenbach et al., 2003; Koc, 2005). Much of the research in this area has been guided by the Technology Acceptance Model, TAM (Davis, 1989, 1993) which is based largely on the theories of reasoned action (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980), and planned behavior (Ajzen, 1991). The relevant research evidence has consistently identified perceived usefulness, self-efficacy, and level of comfort, as substantive and significant predictors of the use of technology (Ahmad, 2010; Chuttur, 2009; Zayim, Yildirim, & Saka, 2006). It must be noted, however, that the focus of models such as the TAM, is on the mere use of a particular technology tool rather than the use and integration of technology (for effective teaching and learning).

## THE PROBLEM

There is a rapidly growing body of research evidence that supports technology-assisted instruction as an effective model for introductory statistics at the college-level (West, 2009; Konold & Kazak, 2008; Garfield & Ben-Zvi, 2007; Pratt, Davies, & Connor, 2011). However, the use of technology to promote active learning, in this context, is still relatively innovative, and hence it is quite plausible to expect resistance and concerns from potential adopters and users (at various stages). Moreover, there is an abundance of research evidence indicating that psychological predisposition (beliefs, attitudes, values, and concerns) is a strong and significant determinant of the adoption, use, and maintenance of best practices (including integration of technology) by instructors (Ahmad, 2010; Chuttur, 2009; Keengwe, 2007; Wingenbach et al., 2003; Koc, 2005). This underscores the importance of examining the role of such non-cognitive factors as barriers to, and facilitators of the effective use of technology (Zayim, Yildirim, & Saka, 2006). As Valdez, et al. (2000, p.4) noted, the impact of technology use depends more on “*human and contextual factors than on hardware or software*”.

Much of the research on instructors’ use of technology and attitudinal predisposition comes from the traditional STEM (Science, Technology, Engineering, and Mathematics) disciplines, however, there is a dearth of such data for statistics education. The only accessible published work (Garfield et al., 2002, p.5), a report on the status of educational reform efforts, noted that “*about one-half of the faculty surveyed involve students in using a statistical software program*”, and that the most common change reported by faculty in the past few years was “*increased use of technology (70-80%)*”. Apparently, there has been no published follow-up study, to date, albeit the use of technology (particularly computers) has been a major focus of the statistics education reform movement (in the past decade), involving a tremendous amount of financial and other resources.

Certainly, since the Garfield et al. (2002) report, there have been many published studies focused on the use of technology in introductory statistics education, but these are largely surveys

of students, and qualitative reports (primarily case studies and literature reviews) of curricular materials, pedagogical strategies, and assessment exercises focused on web resources, such as applets (Dinov, Christou, & Gould, 2009; Al-Aziz, Christou, & Dinov, 2010), the use of clickers (Kaplan, 2011), computer simulations (Mills 2004; Doane, 2004; Watson & Donne, 2009), as well as calculators, statistical software packages, and multimedia materials (Chance et al., 2007). What is not known, is the recent or current level of engagement of introductory statistics instructors with technology, and their associated attitudinal predispositions. Such data are necessary for meaningful and objective assessment of reform efforts regarding the use of technology, as well as the development of appropriate and effective training (and support) programs to facilitate technology integration.

## OBJECTIVE AND THEORETICAL FRAMEWORK

The primary objective of this study was to help to fill the gap in evaluation data pertaining to faculty attitude toward technology integration (specifically computers), as well as the level of use of computers (with statistical software packages) and real-world data, with regard to the teaching of introductory statistics, at the college level. Also, personal and sociodemographic characteristics were examined as possible correlates of attitude. The secondary objective was to explore the data toward developing a preliminary scale for measuring faculty attitude toward technology integration (specifically computers), in this context. Attitude was conceptualized and defined as an evaluative disposition toward some object based upon cognitions, affective reactions, and behavioral intentions. In other words, attitude is an informed predisposition to respond. According to the tripartite attitude theory, attitude is composed of three dimensions: the cognitive (beliefs), the affective (feelings), and readiness or intent to act. Additionally, this study was guided by the Theory of Reasoned Action, the Theory of Planned Behavior, and the “Stages of Concern” component of the Concerns Based Adoption Model (Hall & Hord, 1987), with attention to change, innovation, and the attitude-behavior relationship.

## METHODOLOGY

### *Study Design and Sampling*

The data used in this study were collected as part of a cross-sectional study (Hassad, 2011) from which the TISS (Teaching of Introductory Statistics Scale) and the FATS (Faculty Attitudes Toward Statistics) scale were developed. Note that details of the full study methodology have been published elsewhere (Hassad, 2011), however, the attitudinal variables which constitute the focus of this paper, were not previously reported. Established standards for psychometric research were followed. All data were obtained using 5-point Likert-type scales. The study participants were a purposive (maximum variation) sample of 227 volunteer instructors of introductory statistics from the health and behavioral sciences at four-year regionally accredited, degree-granting institutions in the USA (and the equivalent in foreign countries). Both full-time and adjunct (part-time) instructors who had full responsibility for an introductory statistics course were eligible to participate.

Purposive sampling has been widely used in major studies to explore teachers’ beliefs, attitudes and practices in school reform situations. Specifically, this sampling approach helps to guard against a restricted range in measurement, which can result in attenuated correlations among items (Gorsuch, 1983; Fabrigar et al., 1999). Furthermore, it must be recognized that this is an initial exploratory study, and therefore, purposive sampling was desirable in order to “*maximize discovery of the heterogeneous patterns and problems that occur in the particular context under study*” (Erlandson et al., 1993, p. 82). The general goal of recruitment was to enlist a sample of instructors that represents the broad range of attitudes and teaching practices, in this context. The questionnaire was programmed in Hypertext Markup Language (HTML), and three emails (an invitation to participate, a reminder, and a last call to participate) were sent one week apart with an online link to the questionnaire. Informed consent was obtained online.

### *Data Analysis*

Given the exploratory nature of this study, emphasis was given to reporting descriptive statistics, specifically, the percent response to each item, for each category of the 5-point Likert-type scale. The internal reliability of these items was assessed using Cronbach's alpha (Cronbach, 1951) which quantifies the degree of internal consistency of a set of items. In general, a Cronbach's alpha of at least .7 is viewed as the minimum acceptable level of reliability (Nunnally, 1978); however, a prior recommendation that "*in the early stages of research ... reliabilities of .60 or .50 will suffice*" was also considered (Nunnally, 1967, p. 226), as this is an initial exploratory study. Furthermore, Loewenthal (1996) suggests that a reliability level of .6 may be considered acceptable for scales with less than ten items. The corrected item-total correlations were also calculated in order to help to determine the relevance and usefulness of each item to the cluster.

Six (6) items formed a meaningful cluster, and were used as a preliminary attitude toward technology integration scale (with a composite score). Possible variation in the attitude score was examined based on gender, age, ethnicity, duration of teaching, teaching area, location/country, highest academic degree concentration, employment status, and membership status in professional organizations, using the independent samples t-test, one-way ANOVA, chi-squared, and Pearson's (as well as Spearman's) correlation. Additionally, the relationship between attitude (toward technology integration) score and the subscale scores (behaviorists and constructivist) of the TISS (Teaching of Introductory Statistics Scale) was examined as a measure of criterion validity of the preliminary attitude scale (in accordance with the theoretical framework of this study). Regarding the TISS; behaviorist refers to the traditional, mathematical or teacher-centered approach, whereas constructivist refers to the reform-based, concept-based or student-centered approach. An alpha level of .05 was used for all tests of significance. Also, where applicable, assumptions underlying the statistical methods were checked, and post-hoc analyses (with Bonferroni correction) were performed. SPSS versions 18.0 and 19.0 were used for data entry and analysis.

## RESULTS

### *Respondents' Background Characteristics*

Of the 227 participants, 222 provided country information: 165 (74%) were from the U.S., and 57 (26%) were from international locations (primarily the UK, Netherlands, Canada, and Australia). In all, the participants represented 24 countries and 133 academic institutions. The median age category was 41–50 years, and median duration of teaching was 10 years. The majority (139 or 61%) of participants were male, and from the U.S. sub-sample, 135 (82%) identified as Caucasian. There were 94 (41%) instructors from the health sciences, 102 (45%) from the behavioral sciences, and 31(14%) who taught both in the health and behavioral sciences. The modal category for highest academic degree concentration was statistics, 92 (41%), followed by psychology, social, and behavioral sciences, 71(31%), health sciences, public health, epidemiology, and biostatistics, 28 (12%), education, business, and operations research, 19(8%), and mathematics and engineering, 17 (8%).

### *Response to Attitude and Level of Use/Integration Items*

Almost all (or all) of the instructors (Table 1) reported some level of use (and integration) of computers and real-world data, with higher frequencies (always or usually) noted for 171 (76%) and 178 (79%) respectively. Moreover, intention to avoid using computers was low, 14 (6%). The majority, 161 (72%) believed that using computers to teach introductory statistics makes learning fun, and 204 (90%) felt comfortable using computer applications. However, considerable proportions either perceived difficulty (or were undecided) regarding the use of active learning strategies, 111 (49%), and integrating hands-on computer analysis into the introductory statistics course, 85 (37%). Additionally, 63(28%) reported being hesitant (or undecided) about using computers without the help of a teaching assistant, and a similar proportion, 58 (26%) perceived a need for training (or were undecided) on how to integrate hands-on computer exercises.

The attitudinal items were subjected to reliability analysis, and items 1 through 6 (Table 1) formed a plausible (and internally consistent) cluster with a Cronbach's alpha of .68 (and no meaningful change if any item was deleted). Additionally, the corrected item-total correlations

ranged between .3 and .5. Items were reverse-coded where necessary so that higher values represent more favorable levels of attitudinal predisposition toward computer use and integration. These six items encompass cognition (belief), affect (feeling) and intentionality, which are the established components of attitude, in accordance with the tripartite attitude theory. Also, the six attitudinal items reflect core underpinnings of reform-based teaching of introductory statistics, namely: active learning, integration of technology, teaching self-efficacy, perceived usefulness, and perceived comfort. Accordingly, this cluster of items (Table 2) was considered to possess adequate content validity for measuring attitude toward computers, in this context.

Table 1. Percent Response to Technology-related Items

Attitude Items	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1. Using active learning strategies (such as projects, group discussions, oral and written presentations) in the introductory statistics course can make classroom management difficult.	16(7%)	67(30%)	28(12%)	95(42%)	21(9%)
2. Integrating hands-on computer analysis into the introductory statistics course is not a difficult task.	42(19%)	100(44%)	18(8%)	55(24%)	12(5%)
3. I will need training on how to integrate hands-on computer exercises into the introductory statistics course.	4(2%)	37(16%)	17(8%)	93(41%)	75(33%)
4. I am hesitant to use computers in my introductory statistics class without the help of a teaching assistant.	9(4%)	32(14%)	22(10%)	88(39%)	76(34%)
5. Using computers to teach introductory statistics makes learning fun.	62(27%)	101(45%)	46(20%)	14(6%)	3(1%)
6. I am not comfortable using computer applications to teach introductory statistics.	6(3%)	8(4%)	9(4%)	82(36%)	122(54%)
7. I will avoid using computers in my introductory statistics course.	6(3%)	8(4%)	16(7%)	71(31%)	125(55%)
Technology Use and Integration Items	Always	Usually	Sometimes	Rarely	Never
8. Students use a computer program to explore and analyze data.	93(41%)	78(35%)	30(13%)	17(8%)	8(4%)
9. I use real-life data for class demonstrations and assignments.	66(29%)	112(50%)	43(19%)	5(2%)	0

A composite attitude (toward technology integration) score was obtained by summing the scores (equally weighted) of the six attitude items (Table 2). There was no significant variability in attitude score based on gender, age, ethnicity, teaching area, location/country, highest academic degree concentration, employment status, and membership status in professional organizations. Duration of teaching was weakly but significantly correlated with attitude, that is, as instructors years of experience increased, their attitude toward technology integration was more positive ( $r = .18$ ,  $df = 218$ ,  $p = .007$ ).

#### *Correlation between Attitude and Teaching Practice (Constructivist and Behaviorist)*

Attitude toward technology integration (the composite score) was moderately, positively and significantly correlated with constructivist teaching ( $r = .4$ ,  $df = 217$ ,  $p = .001$ ). That is, a higher attitude score (or more favorable predisposition toward technology use and integration) was associated with a higher level of constructivist (reform-based, concept-based or student-centered) teaching. This is theoretically and empirically plausible (Nanjappa & Grant, 2003; Walker, 2000), and consistent with major attitude-behavior research (Ajzen & Fishbein, 2004; Schwartz, 2007), thereby establishing acceptable evidence of criterion validity of the preliminary attitude toward technology integration scale. On the other hand, attitude toward technology (the composite score) was orthogonal to (not correlated with) behaviorist teaching practice ( $r = -.02$ ,  $df = 220$ ,  $p = .80$ ).

This indicates that these two constructs are independent of each other, and that the level of attitude toward technology use and integration is not directly helpful in determining the degree of behaviorist teaching practice (unlike constructivist teaching).

## DISCUSSION

This study identified attitudinal characteristics pertaining to integration of technology (in particular, computers) for the teaching of introductory statistics at the college level. Technology integration was conceptualized in the context of constructivist or reform-based teaching, with emphasis on the use of active and authentic learning strategies (including the use of computers and real-world data). Attitude is recognized as a potential barrier to, and facilitator of such teaching practice. Compared to the last published study on technology use, in this context (Garfield et al., 2002, p.5), which reported about 50% of instructors “*involving students in using a statistical software program*”, the current study (almost one decade later), notes widespread use of computers with almost all faculty (96%) acknowledging this to some degree (and 76% reporting always or usually doing so). Similar findings were noted for the use of real-world data.

These findings are not surprising, as computer use (with statistical software packages) along with the use of real-world data has been the major thrust of the statistics education reform movement, especially over the past decade, as evidenced by the widely used and publicized blueprint of the statistics education reform movement (the GAISE report). Indeed, the finding of such a high level of computer use may be directly related to the nature of statistics, which is about analysis, and hence a natural fit with computers (and software packages). Unlike these very high proportions for instructors of introductory statistics, Georgina and Olson (2008), in a survey of general faculty, reported that a lower proportion (71%) claimed that they use some type of technology tool in their teaching.

Consistent with the overall high level of reported use of computers and real-world data, is the level of favorable predisposition (or attitude) toward use and integration of technology (particularly computers). Most importantly, in this regard, is the low level of avoidance toward computers, 14 (6%), the high level of comfort with computers, 204 (90%), and the report by the majority, 163 (72%) that the use of computers to teach statistics makes learning fun. Together, these findings suggest a meaningful embrace or acceptance of computer use, in this context. The perceived benefit or usefulness by instructors that computer use makes learning fun, is particularly reassuring, as this can facilitate the use of pedagogical strategies that can foster deep and meaningful learning (including conceptual understanding, and transferrable knowledge and skills). Moreover, this attitude is helpful for a subject that generally is known to evoke high levels of anxiety and fear among students, which can be a barrier to effective learning.

Notwithstanding these favorable attitudinal elements, there are other dispositional components that warrant attention. Specifically, active learning strategies are what the use of computers and real-world data are intended to facilitate, however, sizable proportions of instructors in this study, perceived difficulty (or were undecided) regarding the use of active learning strategies, 111 (49%), and integrating hands-on computer analysis, 85 (37%). In view of the general high level of reported computer use, these findings could imply that a considerable proportion of instructors may not be using computers effectively or as frequently as they would like (or would be beneficial to their students). This clearly suggests the need for training programs and support services for instructors, by way of workshops, modeling of best practices (through team teaching and mentoring), and other targeted professional development programs.

Providing training (and support) for faculty, should be a priority, in order to build on the gains achieved thus far, in particular, the general favorable level of readiness of instructors to use computers to facilitate active learning. Regarding training and support programs, the responses to two attitudinal items are particularly instructive. These are, 63(28%) being hesitant to use computers without a teaching assistant, and 58 (26%) perceiving a need (or being undecided) regarding training on how to integrate hands-on computers into the introductory statistics course. These reports seem to underscore concerns about perceived self-efficacy (that is, belief in one's capability to successfully accomplish a task), and integration of technology; and it would be wise to address these domains (self-efficacy and integration) in training, with attention to contextual

factors such as class size, and diversity (including learning styles, students' academic preparation, and majors).

#### *Correlation between Attitude and Teaching Practice (Constructivist and Behaviorist Subscales)*

The moderate positive relationship between attitude toward technology and constructivist teaching can suggest a level of specificity between these two constructs, and indicate that technology integration is a necessary and salient component of constructivist teaching (of introductory statistics). In other words, the relationship between attitude toward technology and constructivist teaching can be viewed as complementary, synergistic and bi-directional. The effective use of technology (as cognitive tools), can serve as a vehicle for creating a constructivist learning environment by facilitating the use of active learning strategies. And, a constructivist-minded instructor is inclined to view technology integration as salient to teaching.

However, as Nanjappa and Grant (2003, p.6) observed, the mere use of technology is no assurance of constructivist teaching, as some instructors tend to focus primarily on “*drill and practice type of software*”, or technology simply for presentational purposes – an approach that is consistent with behaviorist (or instructor-centered) pedagogy, which is counter-productive to educational reform. The orthogonal relationship between attitude toward technology integration and behaviorist teaching can support this view. That is, a high level of favorable attitude toward technology integration can be associated with either a high or low level of behaviorist teaching. This finding (while apparently counter-intuitive on the surface) is meaningful, given the complex nature of decision-making regarding pedagogical strategies, especially with attention to contextual factors. In this regard, this finding (although not a priori conceptualized) can serve as an indicator of divergent validity of the preliminary attitude scale, by showing that measures that are theoretically dissimilar (or should not be related), are in fact, not related.

It must be noted that the relationship between the constructivist and behaviorist subscales (of the TISS) has been reported to be orthogonal (Hassad, 2011). This implies that these practice orientations are not related on a continuum, are independent of each other, are not mutually exclusive, and can therefore coexist for a particular instructor and teaching session; as instructors may adapt to the diversity of learning styles and/or the nature of the material being addressed (as well as other contextual factors). This can result in a mixed pedagogical approach, where teaching practice can be described in terms of a two-dimensional space (that is, varying levels of behaviorist and constructivist teaching).

#### *The Preliminary Attitude Toward Technology Integration Scale (ATTIS)*

An exploratory analysis revealed a homogeneous cluster of six (6) attitude items, which can be used as a preliminary scale for measuring attitude toward technology integration for the teaching of introductory statistics (Table 2). An adequate level of internal consistency ( $\alpha = .68$ ), as well as meaningful evidence of construct validity (including content, criterion and divergent dimensions) were established. While some common attitude toward technology scales contain multiple subscales, and a higher number of items; the focus of those measures is on the general use of technology rather than a specific target group, task/behavior, and context. It is therefore, reasonable to expect, that a scale with such specificity (as the preliminary scale reported herein) would have fewer items.

This 6-item preliminary attitude toward technology integration scale (ATTIS) (Table 2) emerged from secondary data, which could limit its content validity. However, while those data were not collected with the goal of developing this particular attitude scale, they were obtained as part of a psychometric study aimed at developing a scale to measure the broader construct of attitude toward reform-oriented (or constructivist) teaching of introductory statistics, of which technology integration is a core component. It was therefore expected, that items salient to technology use and integration (in this context) would exist in the data set. However, it is recognized, that a dedicated study may identify a larger pool of related items, possibly along multiple content dimensions, which would then be subjected to factor analysis (and other scaling procedures); an approach that should be used in further studies. Nonetheless, major psychometric measures have been developed from secondary data (Bromley, Johnson, & Cohen, 2006; Windle, Markland, & Woods, 2008).

This preliminary attitude scale should prove useful, especially given the importance of attitude as a barrier to, and facilitator of best instructional practices, as well as the recognition that no other attitude scale (specific to the teaching of introductory statistics at the college level) is known to be published. At the very minimum, these attitudinal items (if not considered adequate to derive a meaningful composite score), can be used separately as an indicator of the respective facet of attitude that each represents.

The finding of no significant variability in attitude (toward technology integration) score for selected personal and sociodemographic characteristics is not unusual, especially for age and gender, and to a lesser extent, ethnicity. As noted in a recent faculty technology survey report (University of Minnesota, 2009, p.12), technology users are not “*stereotypical*”, a characterization that is supported by these findings. However, there is evidence in the research literature of a positive relationship between duration of teaching (or teaching experience), and measures of attitude toward technology use among faculty (Petherbridge, 2007), as was the case in this study (albeit weak).

Table 2. Attitude Toward Technology Integration Scale (ATTIS)

Attitude Items	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1. Using active learning strategies (such as projects, group discussions, oral and written presentations) in the introductory statistics course can make classroom management difficult.	1	2	3	4	5
2. Integrating hands-on computer analysis into the introductory statistics course is not a difficult task.	5	4	3	2	1
3. I will need training on how to integrate hands-on computer exercises into the introductory statistics course.	1	2	3	4	5
4. I am hesitant to use computers in my introductory statistics class without the help of a teaching assistant.	1	2	3	4	5
5. Using computers to teach introductory statistics makes learning fun.	5	4	3	2	1
6. I am not comfortable using computer applications to teach introductory statistics.	1	2	3	4	5

Note that some items are reverse-coded so that higher scores represent more favorable levels of attitude toward technology integration (for the teaching of introductory statistics at the college level). The composite score ranges from 6 to 30.

#### Data Considerations

The use of these results should take into consideration that the data were self-reported by a maximum variation (purposive) sample of instructors of introductory statistics from the health and behavioral sciences. While this was not a probability sample, and therefore, the external validity (or generalizability) of the findings could be limited, the recruitment strategies used to achieve “maximum variation”, and the resulting distribution of the background characteristics of the participants, could render this technique, an optimal sampling strategy (in this context). Indeed, with regard to the development of the preliminary scale for measuring instructors’ attitude toward technology integration, this is a desired sampling approach, as representativeness in the context of scale development research does not follow conventional wisdom; that is, the goal is not to closely represent any defined population but to ensure that those who are likely to score high and those who are likely to score low, are well represented. This was facilitated by the use of a purposive sample (Gorsuch, 1997).

#### CONCLUSION

This initial exploratory study examined instructors’ attitude toward technology integration (particularly computers for data analysis, and the use of real-world data) for the teaching of

introductory statistics at the college level. Salient attitudinal elements (including perceived usefulness, self-efficacy, and comfort), which can serve as barriers to, and facilitators of technology integration, were identified. Additionally, a preliminary scale for measuring instructors' attitude toward technology integration was developed, and acceptable levels of internal reliability (consistency) and validity were obtained. This scale will be referred to as ATTIS (Attitude Toward Technology Integration Scale).

The finding of an orthogonal relationship between attitude toward technology integration and behaviorist teaching (unlike the positive relationship with constructivist teaching) warrants further research and analysis, and underscores the need to give greater importance to the pedagogy of technology integration. Integration in the constructivist context, should be viewed as the meaningful and systematic incorporation of technology tools, intended to create stimuli to engage students in active learning, including critical thinking, collaboration, negotiation, construction of meaning, and ultimately, conceptual understanding, leading to transferrable knowledge and skills. The mere use of technology does not imply integration of technology, and integration of technology does not necessarily imply constructivist teaching, unless effectively operationalized in that context. Indeed, an instructor can integrate technology toward behaviorist teaching goals.

These results also have implications for assessing the effectiveness of technology integration (and specific tools) in relation to learning outcomes. The development of this scale is a major step toward empirically describing and assessing faculty attitude toward technology integration, which can facilitate the adoption, use and maintenance of best practices for the teaching of introductory statistics. Further research is required in order to be conclusive about the structural and psychometric properties of this new scale. Additionally, this study examined internal consistency (reliability), and not test-retest reliability, which should be assessed in order to determine the stability of the scale over time.

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