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ABSTRACT

This paper reports the findings of an experiment designed to test extensions of the Technology Acceptance Model (TAM) within the context of using the World Wide Web to gather and analyze financial information. The proposed extensions are three-fold. Based on prior research, cognitive absorption variables are posited as predeterminants of ease of use. Similarly, cognitive instrumental variables are used as antecedents of usefulness. Finally a newly proposed construct, strategic importance, is used to capture perceptions of application relevance that are not personally motivated. While mixed support was found for the cognitive absorption variables, the cognitive instrumental variables were found to be strong predeterminants of usefulness. The relationship between usefulness and strategic importance was found to be highly significant; however, additional analysis indicated that strategic importance was a precursor rather than an effect of usefulness. The effects of adding strategic importance to the cognitive instrumental variables is also discussed. Includes seven tables: scale reliabilities; relationship of perceived ease of use, usefulness with intention to use; relationship of cognitive absorption variables with perceived ease of use; relationship of cognitive instrumental variables with usefulness; relationship of ease of use and usefulness with strategic importance; relationship of ease of use and usefulness with strategic importance; and relationship of cognitive instrumental variables and strategic importance with usefulness. Measurement scales are appended. (Contains eight references.) (Author)

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USING THE WEB AS A STRATEGIC RESOURCE: AN APPLIED CLASSROOM EXERCISE

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ABSTRACT

This paper reports the findings of an experiment designed to test extensions of the Technology Acceptance Model (TAM) within the context of using the World Wide Web to gather and analyze financial information. The proposed extensions are three-fold. Based on prior research, cognitive absorption variables are posited as predeterminants of ease of use. Similarly, cognitive instrumental variables are used as antecedents of usefulness. Finally a newly proposed construct, strategic importance, is used to capture perceptions of application relevance that are not personally motivated. While mixed support was found for the cognitive absorption variables, the cognitive instrumental variables were found to be strong predeterminants of usefulness. The relationship between usefulness and strategic importance was found to be highly significant; however, additional analysis indicated that strategic importance was a precursor rather than an effect of usefulness. The effects of adding strategic importance to the cognitive instrumental variables is also discussed.

INTRODUCTION

The information systems (IS) survey course, as a traditional staple of the undergraduate business school curriculum, is often the only exposure that non-IS majors have to concepts and issues relating to the use and management of information technology as a resource. Course objectives typically include:

- Gaining an appreciation for the strategic importance of information systems within the business environment;
- Developing an understanding of information technology that enables the student to leverage capabilities developed within their own discipline when working with information technology professionals; and
- To the extent that a hands-on lab component is offered, increasing competencies in office productivity tools.

In theory, these three objectives are interrelated. An appreciation for the strategic implications of information technology serves as an antecedent motivator for students to tackle the more technical aspects of the course. Likewise, the hands-on component is designed to reinforce technical understanding.

Two factors, however, may impact the first objective in ways that impair the ability to motivate students. First, technological advances in business communications, most notably those driving enterprise systems, inter-firm networks and e-businesses, increase the complexity of IS architectures in ways that are difficult to replicate in an education setting. Second, non-IS majors (and often, IS majors at the beginning of their discipline) are lacking not only technical skills, but also business knowledge that enables them to frame IS as an important resource.

Yet an appreciation for the strategic role of IS is more necessary than ever, as businesses are using communications technologies to open up the "black box"

of the firm both to customers and suppliers. Non-IS business majors are impacted in the sense that they are likely to be content providers for internal and external web information systems. The ever-widening audience for business information increases the responsibility of business students as future information providers to understand the sources of data, the application software used to manipulate and infuse data with meaning, and the communications technologies that create access to that data.

The purpose of this paper is to propose a hands-on assignment intended to enhance student awareness of the Internet as a strategic resource. At present, the assignment has been developed as a pilot initiative; however, a set of measures based on a modified version of the Technology Acceptance Model (TAM) has been used to gather preliminary data on its effectiveness in changing student intentionality regarding future Internet use. The following sections discuss the adoption and modification of the TAM model, the measures and the implementation methodology within a single classroom setting.

THEORY AND MODEL DEVELOPMENT

Since its inception in 1989 (Davis), the Technology Acceptance Model has proved to be a robust descriptor of two factors—perceived usefulness and perceived ease of use—leading to user acceptance of new technologies. Two aspects of web information systems; content (*usefulness*) of the material, and hyper mediation (in which *ease of use* is an important factor) echo the pre-determinants of technology acceptance as posited by the Technology Acceptance Model (TAM). While this study uses an extension of the TAM model as a theoretical basis for assessing the value of these assignments, it should be emphasized that in this case, the focus is not on pure technology acceptance. Typically, students have already been using the Internet for some time, although largely for entertainment and peer-to-peer communications. Therefore, the shift in use represents an *adaptation* of an existing, well-known technology to change student perceptions regarding its strategic usefulness. Second, the dependent variable of user intention, has been separated into two variables to capture (1) intent to use web-based technologies for gathering and analyzing financial information, and (2) increased understanding of web information content as a strategic resource.

Subsequent research (Venkatesh, 1999; Venkatesh and Davis, 1996; 1998; Agarwal, Karahanna, 2000) extended TAM to incorporate additional pre-determinants of both usefulness and ease of use, and to examine the effects of intrinsic and extrinsic motivation. For example, Venkatesh and Davis (1996, 1999) explored the role of computer self-efficacy as an anchor for initial ease of use perceptions, finding that an individual's "comfort level" with computers in general affects their perceived ease of use before and after direct experience with new technology. This suggests that exercises designed to enhance general computer self-efficacy are an important complement that solely demonstrates systems usability.

The dramatic increase in web-based applications has led to corollary research on the intrinsic motivation properties of hyper mediated learning environments. Hyper mediated technology—such as that found in Internet applications and gaming software—provides a holistic experience in which informational aspects are augmented by visual cues that create enjoyment and "flow." Again, using TAM as the basis for examining possible antecedents of ease of use and usefulness, Venkatesh (1999) found that a game-based training intervention promoted a higher user acceptance of group collaboration software than traditional training. Not only was playfulness not a detractor, but also contrary to prior TAM research, the effect of perceived ease of use on the behavioral intent was greater than the inherent usefulness of the collaboration software.

Agarwal et al., (2000) extended this research by examining the effect of cognitive absorption, the state of focused and intense involvement with software, as a potential mediator of playfulness and personal innovativeness as predictors of user acceptance. Using survey results of perceptions of the World Wide Web as the target technology, cognitive absorption was measured as a set of variables, including *curiosity, control, temporal dissociation, focused immersion and heightened enjoyment*. The results indicate that playfulness and personal innovativeness were, in fact, fully mediated by the cognitive absorption response elicited from using the Web. In addition, the inclusion of cognitive absorption as direct predictor of behavioral intent in a separate test proved significant.

With regard to perceived usefulness, Venkatesh and Davis (1998) have posited two separate constructs as possible antecedent factors to further delineate the perception that a given technology is useful. The two constructs reflecting different aspects of a work experience that might lead an individual to regard a new technology as potentially useful are:

- Social influences (*subjective norms, voluntariness, and image*) relate to possible effects of adopting a new technology on personal interactions within a work environment.
- Cognitive instrumental processes (*job relevance, output quality, and result demonstrability*) potentially influence an individual's assessment of the effectiveness of a technology in meeting their specific job information requirements.

Using a longitudinal experimental technique, all six factors were found to be significant determinants of perceived usefulness, although the social interaction influences tended to be mediated by direct experience.

Given that these studies infuse TAM with a richer theoretical basis for understanding factors that might affect user adoption of a new technology, this study assesses a web-based training exercise, incorporating aspects of the previous research. Specifically, the components relating the cognitive instrumental process variables have been selected as having the greatest relevance to the objectives of creating a learning

experience that students will find personally relevant, in terms of giving them strategic personal financial information. Because the exercise uses a graphical and hypermediated environment, the variables measuring cognitive absorption are also included. The experiment tests the following:

- H₁ Heightened usefulness and ease of use perceptions leads to increases in the intent to use the Web as a tool for gathering and analyzing personal financial information.
- H₂ Tasks that incorporate hyper mediation heighten the properties of cognitive absorption and strengthen ease of use perceptions.
- H_{3a} The focus of using the Web as a tool for gathering and analyzing financial information increases user perceptions of the dimensions captured by the cognitive instrumental process variables, with a corresponding increase in perceived usefulness.
- H_{3b} Heightened usefulness perception of the Web as a tool for gathering and analyzing financial information also increases the perception of its value as a strategic business resource.

The following model depicts the original Technology Acceptance Model relationships and the proposed extensions for the cognitive absorption, and instrumental variables.

METHODOLOGY

The goal of the exercise was to both introduce students to various types of web-based tools that can be used to gather and analyze financial information and to convey the idea that such tools can provide individuals and businesses with a strategic advantage. The three tasks were:

- (1) Use of an intelligent search agent to find and evaluate various online booksellers. Because the search agent canvasses booksellers in Europe and Canada as well as the U.S, an ancillary step of the task was to verify the exchange rate.
- (2) Use of two decision support tools in making a use car purchase decision. The two tools were quite different; one is an intuitive graphical interface, the second a more familiar text entry style tool. Students were instructed on the use of the two tools, comparing ease of use and results.
- (3) Acquisition of the student's own credit report. For privacy reasons, this task was entirely voluntary, and the assessment of the students is limited solely to their perception of amount and extent of information available.

The empirical test of the exercise involved a single computer lab session conducted across multiple undergraduate student groups. Half of the students received the treatment exercise, and the other half a trivial web information gathering exercise. All students were given a survey questionnaire immediately upon completing the instructional session to determine initial levels of computer self-efficacy, and to establish baseline results on the parameters of cognitive absorption and cognitive instrumental variables.

The survey questions to determine levels of student cognitive absorption were adapted from a similar instrument used by Agarwal and Karahanna (2000) and include their five variables. The remaining questions elicited student perceptions of the cognitive instrumental variables; perceived usefulness, ease of use, and intentionality as derived from Venkatesh and Davis (1998). Finally, three items measuring perception of the strategic importance of the web as a financial analysis tool were developed specifically for this exercise. All items were measured on a seven point scale with strongly agree and strongly disagree as the endpoints.

An initial analysis of the instrument psychometric properties indicated acceptable levels of internal validity for the scales measuring the cognitive instrumental variables, perceived ease of use, usefulness, intention and strategic importance. The scales developed for the three of the cognitive absorption variables (temporal disassociation, heightened enjoyment and control) demonstrated at least one item with low internal correlation. In examining these items further, it was found that the two items for temporal disassociation ("*Most times when I get on the Web, I end up spending more time than I had planned*", "*I spent more time on the Web assignment than I had intended*") measured a slightly different dimension—that of devoting more time to the activity than originally intended. While this dimension was appropriate in the Agarwal study which examined general web use, the items did not fit the experimental setting with its specified assignment. Each of the problematic items for heightened enjoyment and control were the result of reverse coding. Dropping these items substantially improved Chronbach alpha coefficients (Table 1). The resulting scales are included in Appendix A.

**TABLE 1
SCALE RELIABILITIES**

Scale	Number of Items	Reliability
Behavioral Intention	3	.758
Perceived Usefulness	4	.869
Perceived Ease of Use	4	.799
Strategic Importance	3	.876
Information Quality	2	.769
Result Demonstrability	4	.806
Personal Relevance	3	.782
Temporal Dissociation	3	.819
Focused Immersion	5	.772
Heightened Enjoyment	3	.924
Control	2	.764
Curiosity	3	.837

DATA ANALYSIS AND RESULTS

To gauge the effect of each variable individually, single variable regressions were conducted for each of the cognitive absorption and instrumental variables on the corresponding TAM variable and on the independent variable of strategic importance. Multiple regressions were also conducted to ascertain the composite effect of the independent variables.

Hypothesis H₁, which posits ease of use and usefulness as antecedents of intention to use a given technology, is a straight forward application of the TAM in the context of using the web to gather and analyze financial information. The results indicated mixed support. Individually, both usefulness and ease of use were shown to be significant predictors of the intention to use the web (Table 2). The composite model was also highly significant ($p < 0.0001$), with an R-squared of 0.584; however, ease of use switched a positive to a negative affect on behavioral intention.

With regard to the cognitive absorption variables (H₂), the results of the single regressions (Table 3) indicate that three of the variables: temporal dissociation,

heightened enjoyment, and control were positive determinants of strengthened perceptions of ease of use within the context of gathering and analyzing financial information. In a multiple regression assessing the composite model, however, only temporal disassociation and control remained significant. Curiosity became highly significant, but in the opposite direction of the hypothesized relationship. While the composite model was significant, it explained only 30% of the variation in perceived ease of use. These findings only partially support hypothesis H₂ that tasks incorporating hypermediation heighten the properties of cognitive absorption with a commensurate effect on ease of use perceptions.

TABLE 2
RELATIONSHIP OF PERCEIVED EASE OF USE, USEFULNESS WITH INTENTION TO USE

	Individual Variable Effects		Composite Model Effects	
	β	t	β	t
Perceived Ease of Use	.527	5.57***	-.228	-1.94*
Perceived Usefulness	.758	10.65***	.935	-8.15***
Effect of Ease of Use on Usefulness	.807	12.07***		
				$R^2 = 0.584***$
* $p < 0.10$	** $p < 0.05$	*** $p < 0.01$		

TABLE 3
RELATIONSHIP OF COGNITIVE ABSORPTION VARIABLES WITH PERCEIVED EASE OF USE

	Individual Variable Effects		Composite Model Effects	
	β	t	β	t
Temporal Dissociation	.237	3.43***	.175	1.66*
Focused Immersion	.088	1.00	-.077	-0.86
Heightened Enjoyment	.204	3.16***	.073	0.57
Control	.377	4.98***	.428	3.56***
Curiosity	.102	1.35	-.319	-2.77***
				$R^2 = 0.302***$
* $p < 0.10$	** $p < 0.05$	*** $p < 0.01$		

Hypothesis H_{3a}, that the cognitive instrumental variables of result demonstrability, information quality and personal relevance are positive determinants of usefulness was fully supported (Table 4). It should be noted that in further analysis of the composite model, personal relevance was both the most highly significant and largest predictor of change in the perception of usefulness.

However, the fourth hypothesis (H_{3b}), that of usefulness as a pre-determinant of perceptions of strategic importance presented the most interesting findings. In multiple regression modeling usefulness, ease of use and strategic importance, the relationship between usefulness and strategic importance was found to be highly significant (Table 5). However, further analysis of the relationship between usefulness, strategic importance and behavioral intention indicated a fully mediating effect of usefulness on strategic importance (Table 6).

Of equal interest (Table 7) was a corollary analysis of strategic importance added to the cognitive instrumental variables as determinants of usefulness. This model, with an R-squared of 0.767 was highly significant ($p < 0.0001$). Although all four determinants remained significant, result demonstrability ($p < 0.087$) and information quality ($p < 0.067$) were no longer significant at the $\alpha = 0.05$ level. Strategic importance and personal relevance both continued as highly significant ($p < 0.0001$), indicating partial mediation of the effects of result demonstrability and information quality. Similarly, the beta coefficients for strategic importance and personal relevance demonstrated that they were stronger predictors of variation in usefulness.

Finally, although not formally tested as a hypothesis, two experimental treatments were given: one with web exercises directed towards gathering and analyzing

TABLE 4
RELATIONSHIP OF COGNITIVE INSTRUMENTAL VARIABLES WITH USEFULNESS

	Individual Variable Effects		Composite Model Effects	
	β	t	β	t
Result Demonstrability	.747	9.99***	.214	2.29**
Information Quality	.641	8.41***	.214	2.91***
Personal Relevance	.810	12.78***	.513	5.56***
$R^2 = 0.716^{***}$				
* $p < 0.10$	** $p < 0.05$	*** $p < 0.01$		

TABLE 5
RELATIONSHIP OF EASE OF USE AND USEFULNESS WITH STRATEGIC IMPORTANCE

	Composite Model Effects	
	β	t
Usefulness	.634	5.76***
Ease of Use	-.003	-0.03
$R^2 = 0.506^{***}$		
* $p < 0.10$	** $p < 0.05$	*** $p < 0.01$

TABLE 6
RELATIONSHIP OF EASE OF USE AND USEFULNESS WITH STRATEGIC IMPORTANCE

	Composite Model Effects	
	β	t
Usefulness	.643	6.41***
Strategic Importance	.182	1.61
		$R^2 = 0.579^{***}$

*p < 0.10

**p < 0.05

***p < 0.01

TABLE 7
RELATIONSHIP OF COGNITIVE INSTRUMENTAL VARIABLES AND STRATEGIC IMPORTANCE WITH USEFULNESS

	Individual Variable Effects		Composite Model Effects	
	β	t	β	t
Strategic Importance	.801	9.43***	.333	4.27***
Result Demonstrability	.747	9.99***	.150	1.73*
Information Quality	.641	8.41***	.130	1.85*
Personal Relevance	.810	12.78***	.445	2.77***
				$R^2 = 0.767^{***}$

*p < 0.10

**p < 0.05

***p < 0.01

personal financial information; the other derived from the Laudon and Laudon text. The latter included exercises to check United Postal Service shipping rates and to determine hotel conference rates. An ANOVA of the two groups did not uncover any significant differences for the TAM, cognitive instrumental or strategic importance variables, but both heightened enjoyment and curiosity did indicate variation between the groups. In both cases, the group receiving the personal exercises experienced greater enjoyment and a higher level of curiosity than the group performing the business oriented tasks.

DISCUSSION

In retrospect, this study cast a wide net by examining predeterminants of both perceived ease of use as variables measuring cognitive absorption, and usefulness in the form of the cognitive instrumental variables in the

same experiment. These predeterminants captured very different aspects of the application exercise. Again, it is important to note that the focus of the exercise was quite narrow—that of using web-based tools for gathering and analyzing financial information. Within this context, the cognitive absorption variables measured whether the web based hypermediation created an engaging mental environment for accomplishing the task. The usefulness component turned on the quality and relevance of the tools.

With regard to the relationship between cognitive absorption and ease of use, there was some support of Agarwal's original findings. Temporal disassociation and control were found to be significant determinants, as was curiosity, although in the opposing direction. Given that Agarwal's study examined general web use, and the experiment conducted in this assessment consisted of a controlled assignment, it is not surprising that

heightened enjoyment and focused immersion would not play a significant role, as they might if the subjects were left to "surf the net" at will.

Of the three factors that were found to be significant, control emerged as having the greatest effect. Again, this is consistent with the nature of the exercise, as the ability to control (through the graphical interface and user-directed hyperlinks) the various web-based tools to complete the assignment should convey both a sense of mastery and corresponding ease of use. Temporal disassociation, while significant only at the $p < 0.10$ level, was also consistent with Agarwal's findings.

The negative results for curiosity were surprising; however, the findings may be explained by the nature of the questions posed by the measurement instrument. As with heightened enjoyment and focused immersion, the constructs captured by: "*I was stimulated....excited...my imagination was stimulated*" are more applicable to a situation in which the individual is roaming the web at will, rather than completing a business task. It should also be noted that because group differences were found for this variable, the composite model was assessed using multiple regression for each group. While both generated a negative coefficient, the group receiving the personal exercises was not significantly different from zero. Therefore, the significance of the negative findings was driven solely by the second group that received a standard set of business web-exercises based on the Laudon and Laudon text.

The importance of this study is found in the relationship between the cognitive instrumental variables, strategic importance, and usefulness. As hypothesized, the cognitive instrumental variables were found to be significant predeterminants of usefulness, replicating the findings of Venkatesh. The anticipation was that usefulness would be a predeterminant of the perception of strategic importance; and the initial findings did indicate a significant relationship between the two. Similar assessments of strategic importance and the intention to use also detected a significant relationship. But additional analysis of the model with intention to use included as a third variable, provided unexpected results. While usefulness remained a significant antecedent of intention to use, strategic importance was no longer significantly different from zero. Clearly, usefulness mediated the relationship between perception of strategic importance and intention to use.

With an improved understanding of the role of strategic importance as a predeterminant of usefulness; analysis of the composite model including the strategic importance presented interesting results. While each of the cognitive instrumental variables remained significant, the two strongest factors driving beliefs of system usefulness were (1) perceptions of personal relevance, and (2) strategic importance. The addition of strategic importance also increased the explanatory value of the composite model from an R-squared of 0.715 for the three instrumental variables in isolation, to an R-squared of 0.767 for the model encompassing both the instrumental variables and strategic importance. This appeared to indicate that there may be a dimension of usefulness that is impacted by considerations of relevance extending beyond a preoccupation with personal productivity.

CONCLUSION

Given that the study was largely a replication of prior research involving a different application of technology, the findings do provide mixed support for cognitive absorption as a predeterminant of ease of use, and strongly support Venkatesh's results of cognitive instrumental variables as antecedents of usefulness. There are, of course, limitations. Students are somewhat notorious as unreliable subjects. The instrument items, while maintaining internal validity, may have not been adequately adapted to the focus of the particular exercise.

Nevertheless, the findings regarding strategic importance as an antecedent of usefulness, and as a construct that is separate from personal relevance, is an important finding with interesting implications for practical applications. As businesses move towards distributed information technologies, such as enterprise resource planning systems, a strategic understanding of a system's usefulness could possibly mediate a reluctance to use a system—particularly if it appears that personal productivity may suffer. If this is the case, training interventions that emphasize the strategic importance of a particular technology could be developed to overcome personal reluctance, thereby improving user acceptance. A rigorous development of strategic importance as a component of user beliefs and intention to use, may enlarge our understanding of this process, perhaps increasing its effectiveness.

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APPENDIX A MEASUREMENT SCALES

Cognitive Absorption

Temporal Dissociation

1. Time appeared to go by very quickly while I was working on the Web assignment.
2. I lost track of time while using the Web.
3. I found that the time flew by during the Web assignment.

Focused Immersion

1. While completing the Web assignment, I was able to block out most other distractions.
2. While completing the Web assignment, I was absorbed in what I was doing.
3. I was immersed in the task of completing the Web assignment.
4. While completing the Web assignment, I was not easily distracted by other attentions.
5. While on the Web, I found my attention was not easily diverted.

Heightened Enjoyment

1. I had fun interacting with the Web for this assignment.
2. Using the Web for this assignment provided me with a lot of enjoyment.
3. I enjoyed this Web assignment.

Control

1. When using the Web for this assignment, I felt in control of the material.
2. Using the Web for this assignment allowed me to control my computer interaction.

Curiosity

1. Using the Web for this assignment excited my curiosity.
2. My interaction with the Web during this assignment made me curious.
3. Using the Web to complete this assignment stimulated my imagination.

Information Quality

1. The quality of financial information I can gather and analyze on the Web is high.
2. I have no problem with the quality of financial information I can obtain and analyze on the Web.

Result Demonstrability

1. I have no difficulty telling others about the results of using the Web to gather and analyze financial information.
2. I believe I could communicate to others the advantages/disadvantages of using the Web to gather and analyze financial information.
3. The advantages and disadvantages of using the Web to gather and analyze financial information are apparent to me.
4. I would have no difficulty explaining why using the Web to gather and analyze financial information may or may not be beneficial.

Personal Relevance

1. Using the Web to gather and analyze financial information gives me an important personal advantage.
2. Using the Web to gather and analyze financial information is relevant to my personal financial decisions.
3. I believe the information I obtain and analyze through the Web is helpful in making personal financial decisions.

Perceived Ease of Use

1. I find the Web easy to use as a tool to gather and analyze financial information.
2. Interacting with the Web to gather and analyze financial information does not require a lot of my mental effort.
3. I find it easy to get the financial information I want using the Web.
4. My interaction with the Web as a tool to gather financial information is clear and understandable.

Perceived Usefulness

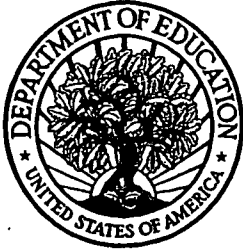
1. Using the Web improves my ability to gather and analyze financial information.
2. Using the Web to gather and analyze financial information enhances my effectiveness in making decisions.
3. I find the Web to be useful to me in gathering and analyzing financial information.
4. Using the Web-based increases my productivity in gathering and analyzing financial information.

Behavioral Intent

1. Assuming access to the Web, I intend to use it for gathering and analyzing financial information.
2. Given access to the Web, I predict that I will use it to gather information for making financial decisions.
3. I believe that I will continue to use the Web for information when faced with financial decisions.

Strategic Importance

1. I understand that using the Web to gather and analyze financial information could give businesses an important strategic advantage.
2. I understand that using the Web to gather and analyze financial information could be relevant to making important business decisions.
3. I understand that the Web can provide important tools that could help businesses gather and analyze information to their strategic benefit.



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