US-China Education Review B 6 (2011) 797-808
Earlier title: US-China Education Review, ISSN 1548-6613

Learning Financial Reports From Mixed Symbolic-Spatial Graphs*

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Mixed visuals of numbers and graphs are available in various financial reports that demonstrate the financial status and risks of a firm. GWN (graphs with numbers) and TWG (table of numbers with graphs) were used as two alternative visuals derived from the actual data of two large public companies, one from food manufacturing industry (food) and another from retail department stores (retail). To study learning gain from exposure to visual representations, two influencing constructs were employed from the information processing literature, IL (information load) and CL (cognitive load). An online survey was sent out to 828 alumni and students from the graduate program of information technology in business of a large university. The overall response rate was 19.7%. Results showed that perceived learning was slightly higher when they used GWN than TWG. The difference in means tests showed significant differences in the comprehension, application and analysis of learning levels using GWN visual and insight learning level using TWG visual. It was apparent that spatial graphs induced less cognitive process than symbolic numbers in a table. Respondents felt that their learning increased with a greater amount of data being perceived as depicting. In contrast, learning was negatively related to CL, indicating that the more complex the data was perceived, the less learning gain the subjects thought they had. Longer EXs (experience with financial reports) has some bearing on learning, but different LSs (learning styles) did not influence any level of learning.

Keywords: financial report, LS (learning style), spatial table, symbolic graph

Introduction

Quite a few studies on when to use tables and when to use graphs were conducted with variations in the use of different graph types and the manipulation of patterns and colors of the graphs (Few, 2004). However, a review of visualization research in the business setting suggests a need to go back to its fundamental quest, whether or not the information provided to users fits their needs; in this case, whether the way the information is presented will fit the information processing tasks of users (Vessey, 1991; 1994). Computer-generated charts and graphs have been used to augment texts and numbers since the very beginning because they are efficient and effective representations of business information (Eve, 1984; Potts, 1975; Roa, 1985). Mixed research results have been found on the effect of data representation on decision performance using tables versus graphs. Sometimes, table representations result in better decisions at other times graphs are better (Benbasat & Dexter,

* **Acknowledgement:** The authors wish to acknowledge the research support from the "Integrated Innovation Academic Center: IIAC" Chulalongkorn University Centenary Academic Development Project and Chulalongkorn Business School. Our special thanks go to the respondents for their kind cooperation and valuable inputs in providing information for this study.

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1986; Vessey, 1991, 1994). This line of research examines information processing tasks as an important factor that influences the cognitive fit of decision-makers. It has been argued that the type of information processing task must fit the type of data representation.

Nevertheless, it appears logical to argue that the visual representation of complex data will enable naive learners to acquire knowledge and understanding of unfamiliar turf (i.e., a new organizational setting) more quickly. It is also highly likely that these visual cues will create too much reliance, so that other important messages via text-based or tabular data may easily be bypassed. In his later work, Amer (2005) found that adding horizontal gridlines to correct graphic displays could result in an unintended consequence, since it seemed to create a visual illusion in the mind of the decision maker.

As Ackoff (1967) pointed out in his classic article, more is not always better. Managers might not always know what they want when being questioned by an information system designer. Even though a manager gets the information he/she needs, there is no guarantee of making a better decision, since the process itself is very complex and the system might not be able to produce the needed information at each step along the way. Although visualization research tends to focus on decision-making, there is another strand of research dealing with knowledge creation and learning. As in an old saying, “Seeing is believing”. One would expect that report users would be able to attain a higher level of learning, if they were to see information that fits their thought processes. Thus, the challenge is to determine how to come up with a visual that is familiar, meaningful and thought-provoking so that a new insight may be brought to report users.

Study Framework and Hypothesis

In the endless applications of information visualization in business, the majority is still based on financial information. Graphs versus numbers representing the spatial versus the symbolic have been extensively studied. In an earlier work, Tanlamai and Soongswang (2009) found mixed visuals to be the most acceptable visuals. However, it is not clear that which particular type of visual contributes to learning. In the present study, two alternative sets of visuals, GWN (graphs with numbers) and TWG (tables of numbers with graphs) were constructed. The basic question asked in this study is whether the two alternative visuals would influence the information processing load of a financial report user that, in turn, would affect his or her learning levels.

Figure 1 shows the constructs to be examined in the study. The variable of interest is “learning” because it is the cumulative process of recognizing, acquiring and creating knowledge. However, according to Dale’s (1969) cone of experience, people generally remember verbal symbols (what they read and hear) less than what they see (visual symbols) and what they do (i.e., role-play, experimentation and direct experience) (Website http://en.wikipedia.org/wiki/Edgar_Dale). The implications of this experience building perspective are that people can learn better, if they are exposed to useful, relevant graphics and visuals. They should be able to visualize and achieve clearer reasoning with mental images that fit the symbolic or spatial decision-making tasks (Dale, 1969).

The framework is based on the cognitive learning theory where a learner’s mental structure is constantly refined from processing information or visualizing symbols in their working memory (Sweller, van Merrienboer, & Paas, 1998). The refining process was addressed in Tanlamai and Tangsiri (2010) in their review of support theories of information and knowledge visualization research: the cognitive theory, the theory of visual thinking, the mental-model theory, the gestalt principles of visual perception and the general systems theory. Both CL (cognitive load) and IL (information load) are the attributes of the information or visuals processing that, in turn, influence user’s level of learning (J. M. Rose, A. M. Rose, & McKay, 2007). A

report user may have a greater CL on a GWN type of visual and a greater IL with a TWG. The former is a spatial-oriented visual and the latter is more symbolic.

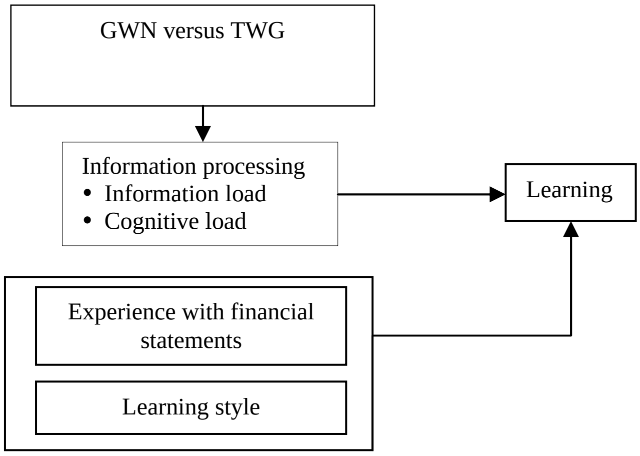

Figure 1. Study framework.

Based on this line of reasoning, the null hypothesis is stated as follows:

H_0: There is no difference between the two types of visual representations on the learning of users.

The study framework included two control variables: a user's LS (learning style) and experience. Among the four dimensions of LS, the visual-verbal dimension of the Felder and Solomon's (1998) LS (Website http://www2ncsu.edu/felder~public/ILSdir/ILAweb.html) will be included. It is conceivable that individuals with a visually-oriented style are likely to prefer processing visual data than those who are more verbally-oriented. Likewise, experience with financial statements is also included as another control variable.

Research Method

Sampling Frame and Data Collection

A Web-based survey was conducted with an online self-administered questionnaire. Graduate students from the MSIT (Master of Science program in information technology) in business programs from a large university in Thailand were employed for the purpose of convenience. Students from both regular and executive programs were included for five years (2004 to 2008). The evening classes were students who still work and take classes at the same time. Regular class students were not required to have any working experience prior to entering into the full-time program. Both groups had taken accounting and finance classes and were familiar with the concept and use of a balance sheet.

As shown in Table 1, the sampling frame comprised a total of 828 prospective graduates and alumni from a large university. The MIS major dominates the prospective respondents, accounting for 62.3%. AIS and SIT account for 25.5% and 12.2% of the total population respectively. The overall response rate was 19.7%, of which a greater proportion of responses were from regular students (59.5%) as compared to executive students/alumni (40.5%). The distribution of response rates for the three groups was similar, dominating by MIS for 55.8%, 29.4% for AIS and 14.7% SIT.

Survey Instrument

To develop the data collection instrument, the authors developed and used a Web-based survey by lime survey. A nominal fee was paid to the hosting site for every completed survey. No incentive was offered for

participation. The Web-based survey was used so that the colors and shapes of the visuals could be seen easily. GWN and TWG were used as two alternative visuals for two companies, one from the food manufacturing industry (food) and another from retail department stores (retail). All these visuals were static without drilled-down capability. This was to mimic the paper-based reports being used widely in publicly available financial data. The Likert scale from one to seven was used for all measures of the constructs shown in the study framework. The original survey instrument is in Thai language and the translated version is shown in Appendix A. Also, example visuals of one of the company data being used in the survey are depicted in Appendix B.

Table 1
Sampling Frame

Sampling frame	2003	2004	2005	2006	2007	2008	2009	Total	% of responses
Regular	66	60	56	62	52	51	49	396 (47.8%)	97 (59.5%) (24.5%)
AIS	19	18	15	21	15	14	9	111	
MIS	31	29	29	32	25	30	34	210	
SIT	16	13	12	9	12	7	6	75	
Executive	57	62	60	62	66	66	59	432 (52.2%)	66 (40.5%) (15.3%)
AIS	16	11	14	21	13	10	15	100	
MIS	37	44	46	33	50	52	44	306	
SIT	4	7	0	8	3	4	0	26	
Total	123	122	116	124	118	117	108	828 (100%)	163 (100%) (19.7%)

Notes. The MSIT program has three majors: MIS (management information systems), AIS (accounting information systems) and SIT (statistical information systems). For their undergraduate degree, many MIS students have backgrounds in engineering and biosciences, AIS in accounting and SIT in statistics.

Learning. To measure learning from exposure to the mixed visuals, the construct was developed based on Bloom's (1956) taxonomy. Like previous studies (Tanlamai, 2009; Tanlamai & Tangsiri, 2010), seven levels of leaning were included: knowledge, comprehension, application, analysis, synthesis, evaluation and insight. The subjects were asked to rate according to the Likert scale from one to seven, the extent of their learning about the financial status and risks after examining the visuals or date representations constructed from financial statements. To examine the unidimensionality and reliability of measures, four factor analyses were carried out for each set of questions, two GWNs and two TWGs for both the food and retail datasets. All relevant statistics as shown in Appendix B suggested that the learning construct is reliable and valid. At the end of the questionnaire, the subjects were asked whether they would be confident enough with the food's and retail's financial performance to invest in a large enterprise resource planning system, given that the real names of these organizations were known. The subjects were also asked to choose from three types of data representations—table only, GWN and TWG, their preferred choice that would enable the speed and ease of learning.

Information processing. The two sub-constructs, IL and CL, are based on the difference in an individual's cognitive processes and his/her spatial visualization capability (Zimowski & Wothke, 1986). In this study, IL was operationalized by two items, the amount of information being perceived and the adequacy of the information being presented. CL was also operationalized by two items, the perceived complexity of the information and the extent of time required in processing the information. The Pearson correlation coefficients between measures for each individual construct of the information processing, IL and CL were significant and highly significant. The correlation coefficients were 0.531 and 0.684 for the GWN datasets and 0.676 and 0.635 for the TWG dataset with all p-values = 0.000. Factor analysis also confirmed that the measures used for the

constructs and sub-constructs were reliable and valid.

Result

Descriptive Analysis

Respondent profile. As shown in Tables 2 and 3, the average age of respondents was 27.7 years old. They had had about 1.96 years of experience of financial reports. About 60% of respondents were from the regular program and 40% from the executive program. The proportion of majors among the respondents was similar to the sampling frame of the study. About one third of the respondents indicated that their LSs were verbal-oriented and two thirds visual-oriented.

Non-response bias. For the online survey, not only was an attempt made to compare non-response subjects with subjects from whom data had been used for analysis, but also incomplete responses by subjects who started the survey but did not complete their responses were carried out. The percentages of the three types of responses were similar in terms of majors and class types.

Table 2

Comparison of Respondent's Majors and Class Types

Response types	Total	Major			Class type	
		AIS	MIS	SIT	Regular	Exec
Complete responses	163 (19.7%)	48 (29.9%)	91 (55.8%)	24 (14.7%)	97 (59.5%)	66 (40.5%)
Incomplete responses	129 (15.6%)	26 (20.2%)	86 (66.7%)	17 (13.2%)	64 (49.6%)	65 (50.4%)
Non-responses	536 (64.7%)	137 (25.6%)	329 (61.4%)	60 (11.2%)	235 (43.8%)	301 (56.2%)
Total	828 (100%)	211 (25.5%)	506 (61.1%)	101 (12.2%)	396 (47.8%)	432 (52.2%)

In addition, as shown in Table 3, there was no difference between the complete and incomplete responses in terms of subject age (t = 1.68, p = 0.09), financial report experiences (t = 0.883, p = 0.38) and the LS of these two groups. For all respondents who had completed or had not completed the online surveys, the proportions of their LSs were similar.

Table 3

Complete Versus Incomplete Online Responses

Response types	Total	Verbal LS	Visual LS	Age (Means, SD)	Experience with financial report (Means, SD)
Complete responses	163	54 (33.1%)	109 (66.9%)	27.66, 3.54	1.96, 2.57
Incomplete responses	129	46 (35.7%)	83 (64.3%)	28.35, 3.48	1.69, 2.49
		Difference in Means statistics		t = -1.68, p = 0.09	t = 0.883, p = 0.38

Notes. LS stands for learning style; SD stands for standard deviation.

Study Constructs

Since two companies, designated as food and retail hereafter, were used to set up mixed visuals in the present study, descriptive analyses showed the comparison of the two types of visuals, GWN and TWG. The descriptive comparisons included the two main study constructs: leaning and information processing variables—IL and CL.

Learning. Among all seven levels of learning, examining GWN data achieved a greater extent of learning than TWG data. On average, the mean scores from GWN were higher than those from TWG in both sets of data

(see Table 4). The highest scores were at the analysis level of learning (Mean = 5.21) and application level of learning (Mean = 4.85) from the food's GWN and TWG data representations (visuals) consecutively. Also, the majority of learning scores from food's data representations were higher than those from retail. In terms of visual placement, food's visuals were put before retail's, thus, there may have been some repeating measure effects from seeing one visual before another. *T*-statistics showed significant differences in the comprehension (p = 0.020), application (p = 0.039) and analysis (p = 0.002) learning levels using GWN visual and insight learning level using TWG visual (p = 0.029).

Table 4

Means and Standard Deviation of Learning With GWN and TWG Representations

Learning	GWN			TWG		
	Food	Retail	*t*-test	Food	Retail	*t*-test
Knowledge	4.90, 1.14	4.87, 1.02	0.587	4.77, 1.24	4.83, 1.14	-1.066
Comprehension	5.02, 1.11	4.87, 1.01	2.341^{*}	4.72, 1.27	4.74, 1.12	-0.215
Application	5.06, 1.15	4.93, 1.02	2.081^{*}	4.85, 1.24	4.77, 1.16	1.296
Analysis	5.21, 1.19	4.98, 1.07	3.089^{**}	4.80, 1.25	4.78, 1.21	0.289
Synthesis	4.47, 1.23	4.53, 1.06	-0.727	4.47, 1.29	4.43, 1.11	0.561
Evaluation	4.76, 1.19	4.76, 1.05	0.000	4.67, 1.23	4.64, 1.13	0.457
Insight	4.37, 1.07	4.51, 1.06	-1.902	4.23, 1.25	4.37, 1.13	-2.198^{*}

Notes. $^{*}p <= 0.05$; $^{**}p <= 0.01$; $^{***}p <= 0.001$.

The average scores of GWN-learning and TWG-learning were used in factor analysis. A single factor each was found from the operationalization of seven levels (items) of learning with a total variance explained of 76.59% for the former and 84.32% for the latter. According to Hair et al. (1998), the KMO (Kaiser-Meyer-Olkin) measure is used to determine whether the given data is sufficient for a factor analysis and the value above 0.9 is highly acceptable. Hair et al. (1998) also recommended the use of Bartlett's test of Sphericity to test the overall significance of all correlations within a correlation matrix. If the correlations are statistically significant, using the significant level of less than or equal to 0.05, the given data is suitable to use a factor analysis. The KMO values in this study were more than 0.9 in both cases and the Barlett's tests were significant. All factor loadings were greater than 0.8. The corresponding Cronbach coefficient alphas are 0.949 and 0.969, indicating highly reliable scales that will be used for further analyses (see Appendix C).

Table 5

Preferred Visual Type on Learning Attribute

Preferred visual/learning	Table (number only)	GWN	TWG
Learning speed	2 (1.2%)	101 (62.0%)	60 (36.8%)
Learning ease	3 (1.8%)	100 (61.3%)	60 (36.8%)

When asked to choose which type of data representation would increase learning speed and learning ease, the subjects indicated that they preferred GWN representation (see Table 5). In fact, speed and ease of learning were treated the same way by the respondents, recalling that the GWN representations were constructed as spatial table type of graphs and the TWG were tables of numbers with row-by-row comparative bar-graphs.

Information processing. Similar descriptive data was analyzed. The results in Table 6 show the information processing factors of food and retail to be in the opposite direction from learning. Repeating measures from food to retail made the subjects increase the loads of their information processing. Instead of being more familiar with similar visuals, the subjects seemed to think the second set of financial reports (retail)

contained slightly greater amount of information and had more complex data depicted to be processed. However, there was no statistical difference between both IL and CL when the respondents answered the questions pertaining to food first and retail later.

Table 6

Means and Standard Deviation of Information Processing With GWN and TWG Representations

Information processing	GWN			TWG		
	Food	Retail	*t*-test (*p-value*)	Food	Retail	*t*-test (*p*-value)
IL	4.41, 0.86	4.49, 1.01	-0.878 (0.381)	4.50, 0.88	4.54, 0.91	-0.516 (0.606)
CL	3.95, 1.08	4.19, 1.14	-1.834 (0.068)	4.13, 1.05	4.26, 1.04	-1.097 (0.274)

Interrelationships

Learning from examining financial data in the form of GWN and TWG positively related to IL at significance level of 0.000. Respondents felt they learned despite of the increasing amount of data being depicted. In contrast, learning negatively related to CL, indicating that the more complex the data was perceived, the less learning the subjects thought they gained (r = -0.212, p = 0.007 for GWN; r = -0.190, p = 0.015 for TWG). IL and CL relate positively to one another (r = 0.176, p = 0.025) when the respondents see traditional table representation of financial data with supplemental graphs showing the trend of each individual line item (see Figure 7).

Table 7

Pearson Correlation Matrix

Visual→	GWN				TWG			
Constructs	Learning	IL	CL	EX	Learning	IL	CL	EX
Learning	1				1			
IL	0.697***	1			0.691***	1		
CL	-0.212**	0.073	1		-0.190*	0.176*	1	
4 EX (Experience with Financial Report)	0.228**	0.089	-0.025	1	0.057	-0.055	0.036	1
5 LS	0.068	-0.024	-0.168*	-0.077	-0.024	-0.009	0.123	-0.077

Notes. $^{*}p$ < = 0 .05; $^{**}p$ < = 0.01; $^{***}p$ < = 0.001.

Hypothesis Testing

To test the hypothesis of whether there is any difference between the exposure to GWN and TWG representations, the average responses were calculated from the mean responses of food and retail for all the study constructs, except for the two control variables. First, *t*-tests were used for information processing and learning constructs. Then, two simple linear regression models were constructed to see whether the GWN and TWG would differ, when taking control variables (EXs and LS) into consideration. The last part used correlation analysis to check whether the perceived learning would be reflected in the confidence towards the companies upon which the financial data was based, if the actual names were revealed to the respondents.

Information processing. The *t*-statistics testing the difference in the average means of IL between GWN and TWG showed no statistically significant across the two datasets, food and retail. The respondents did not perceive that there was too much information being depicted in the two companies' data. Nevertheless, there were significant differences between the means of CL between GWN and TWG depiction. Not only did respondents see the GWN and TWG representations as complex or requiring much effort in processing these

visuals, the latter was seen as more complicated. In other words, GWN induced less cognitive process than TWG ($t_{GWN, TWG}$ = -3.155, p = 0.002) (see Figure 8). Food company's data appeared to cause more CL than retail. This is perhaps due to the fact that food data was presented in the questionnaire before retail data.

Table 8

Paired Sample Test of Differences in Information Processing With GWN and TWG (p-value)

Information processing	Means, *SD*		*T*-test of GWN versus TWG information processing		
	GWN average	TWG average	Average	Food	Retail
IL	4.45, 0.72	4.52, 0.72	-1.968 (0.051)	-1.664 (0.098)	-1.003 (0.317)
CL	4.07, 0.76	4.20, 0.73	-3.155 (0.002)	-2.969 (0.003)	-1.463 (0.145)

Learning. By using different visual representations to learn about the financial status of the company and to determine whether an ERP (enterprise resource planning) investment should be made, the study hypothesized that there is no difference between the two types of visual representations on the learning of users. Similar *t*-test analysis was used to examine the mean differences of learning. As shown in Table 9, the analysis level of learning was different when the respondents examined GWN and TWG of food and retail. As such, the average means for the two datasets differed as well ($t_{GWN, TWG}$ for average analysis level of learning = 3.130, p = 0.002). A comprehension level was found in food but the extent of the difference was high enough so that the average means calculated from combining food and retail ended up as being significantly different ($t_{GWN, TWG}$ for average comprehension level of learning = 2.154, p = 0.033).

Table 9

Paired Sample Test of Differences in Learning With GWN and TWG (p-value)

Learning	Mean, *SD*		*t*-test of GWN versus TWG learning		
	GWN average	TWG average	Average	Food	Retail
Knowledge	4.88, 1.08	4.79, 1.19	0.932	1.268	0.400
Comprehension	4.94, 1.06	4.73, 1.19	2.154 (0.033)	2.537 (0.012)	1.358
Application	4.99, 1.08	4.81, 1.20	1.807	1.770	1.502
Analysis	5.09, 1.13	4.78, 1.23	3.130 (0.002)	3.594 (0.000)	1.972 (0.050)
Synthesis	4.50, 1.15	4.45, 1.20	0.540	0.052	1.042
Evaluation	4.76, 1.12	4.66, 1.19	1.054	0.749	1.196
Insight	4.44, 1.06	4.30, 1.19	1.423	1.246	1.358

Factor scores from average GWN and TWG learning were saved and used as the dependent variables in the simple linear regression analysis. Surprisingly, the adjusted R^2 for both GWN and TWG learning were the same, accounting for 29.4% (see Table 10). However, the Beta coefficient for the IL of the TWG model was slightly larger (0.598 for TWG as compared to 0.516 for GWN). Both coefficients were significant at levels of 0.000. The Beta coefficient for CL in the TWG model was significant at levels of 0.001. Experiences with financial reports contributed only to the GWN learning whereas learning style to neither type of learning.

When the actual names of food and retail were made known to the respondents, they were asked to rate the confidence they had in the financial performance and the risk assessment of the companies. The means of confidence ratings were moderate, 4.94 and 4.81 for food and retail consecutively. The two ratings related significantly to one another, r-confidence $_{Food,\ Retail}$ = 0.308 (p = 0.000). The correlation between food's confidence and GWN learning was 0.242 (p = 0.002); food's confidence and TWG learning was 0.086 (p = 0.277). Retail's confidence did not relate significantly to any types of leaning. Thus, the only clear relationship

found with this analysis was that GWN is prominent for learning the food's financial data.

Table 10
Regression Analysis

Dependent variable	Adjusted R^2 (%) *F* (*df*), *p*-value	Standardized beta, *t* (*p*-value)			
		IL	CL	Experience with Financial Reports	LS
GWN-learning (avg.)	29.4% 17.85 (4, 162)***	0.516 7.60***	-0.115 -1.697	0.241 3.639***	0.086 1.299
TWG-learning (avg.)	29.4% 17.88 (4, 162)***	0.598 8.40***	-0.247 -3.465***	0.034 0.507	-0.007 -0.102

Notes. $^{*}p < = 0 .05$; $^{**}p < = 0.01$; $^{***}p < = 0.001$.

Discussion and Conclusions

The mixed use of numbers and graphs to represent financial reports has become the de facto standard ever since spreadsheet software was introduced. Management and decision-makers want to be able to grasp performance and financial status and the risk of a company as quickly as possible. Graphic-oriented visuals are likely to facilitate an individual's learning process, because they require less CL and IL as compared to tables of numbers only. In the decision-making literature, what format the data should take depends on the kind of task that the person is working on (Huang, Chen, Guo, Xu, Wu, & Chen, 2006). According to cognitive fit theory, tasks that required symbolic data processing will fit more with symbolic data representation. Likewise, spatial data representation will fit more with the type of tasks that require the spatial processing of information. Graphics are typically referred to as spatial representations whereas numbers are symbolic. Although the question as to whether some level of learning takes place prior to decision-making is beyond the scope of this study, the present research argues the important of learning and its relationship to different types of data representations.

Contrary to previous research, GWN was rated higher than TWG in their contributions to learning (Tanlamai & Soongswang, 2009). Consistent to previous findings, analysis and comprehension levels of learning were found to be rated higher than other levels of learning (Tanlamai & Soongswang, 2009). For the IT (information technology) in business training personnel, spatial or symbolic representation of business data enable comprehension and analysis level of learning.

As expected, the present study also found spatial graphs to induce less cognitive process than symbolic numbers in a table. Graphs are easier to comprehend and understand, so they require few efforts to process the information. Although the amount of information was the same for the two visual representations, the respondents thought they needed to process a bit more information in the TWG than the spatial GWN. They also felt their learning increased, despite of the increasing amount of data being depicted. All in all, IL contributes to learning regardless of which type of visual is being shown, but CL will only contribute negatively to learning in the case of TWG.

As expected, the literature supports the hypothesis that learning negatively relates to CL. This is because the more complex the data, the greater is the effort needed for cognitive processing. This should be the same as the greater the amount of information, the more processing will be required and the perceived learning will be less. However, the empirical data showed a positive relationship between learning and IL. That is the more information being perceived; the greater level of learning has been reported. One possible explanation for this unexpected finding is that the more information a person thinks of having, the less the need to search for more

information and the less risk one will perceive. This is in line with the logical reasoning of perceived risk and information search behavior research. That is, the higher the risks being perceived, the greater will be the intended search behavior (Dowling & Staelin, 1994). Effectively, the relationship between learning and IL is likely to be mediated by perceived risk and intended knowledge acquisition activities.

Information technology in business personnel may have a different visual perception from other groups of financial report users, thus, future research should draw from the present findings and use other sampling frames, such as management or investors. A reexamination of the study framework using other sampling frames will ensure the finding's generalizability.

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Appendix A: Questionnaire Parts

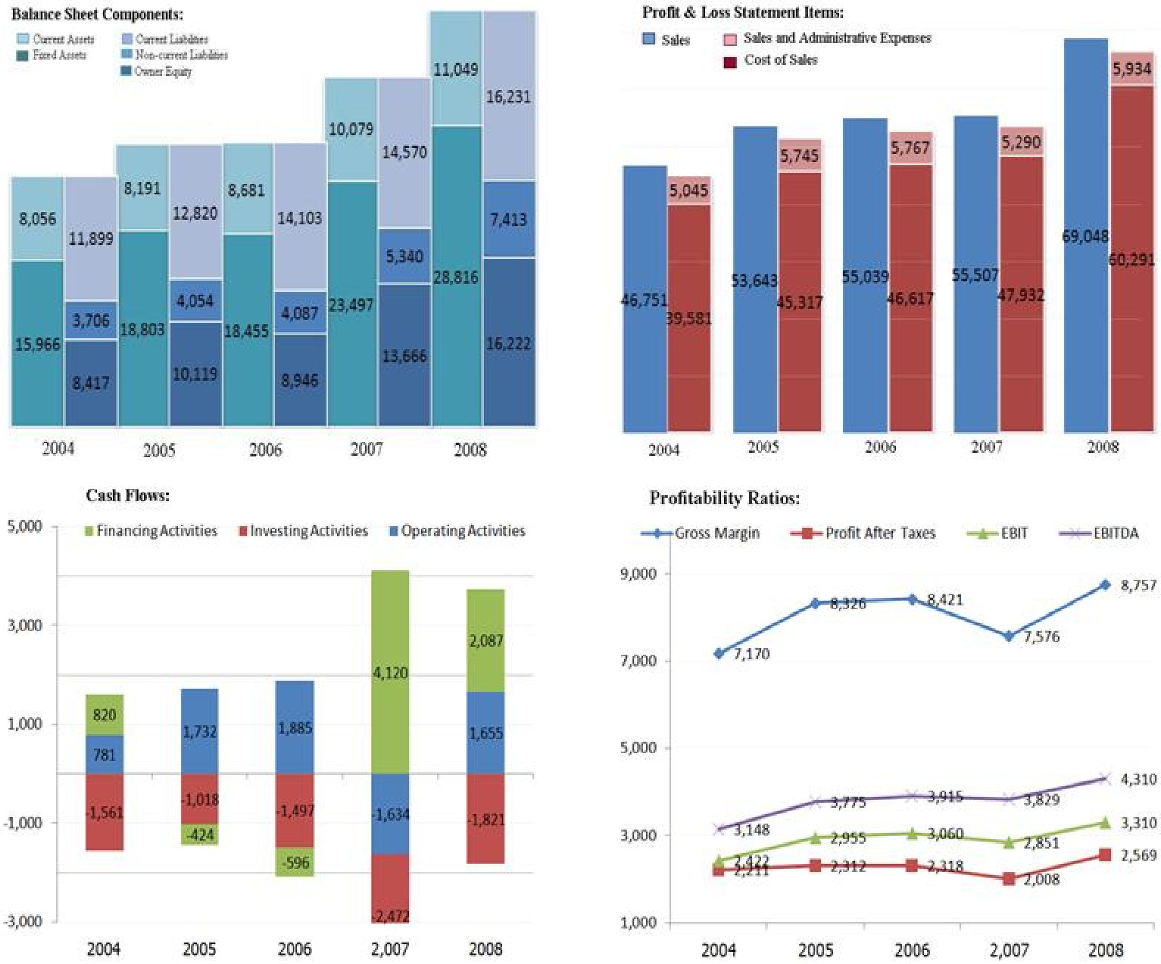
Instruction: You have been invited to be the consultant of a large ERP implementation project from two companies. You were told that each of these companies had an investment plan of about 200 million Baht. Before accepting the invitation, you

spent some time on studying the financial statements of each company in order to assess the status and risks as well as their investment capability. You informed the financial officer of each firm that you have time constraint and would like to have only a summary, which reports the firm's financial data. The reports you have received are shown in four sets, two for the food industry and two for retail stores. Only two sets of visuals will be shown here.

After the respondents read each set of data, they were asked to answer 12 questions.

Knowledge of the firm's financial status	A great deal ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not at all
Comprehension of the firm's financial status	A great deal ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not at all
Application of financial data	A great deal ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not at all
Able to analyze the financial status of the firm	A great deal ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not at all
Able to synthesize the financial status of the firm	A great deal ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not at all
Able to evaluate the ERP investment project from the firm's financial data?	A great deal ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not at all
Gain insight about the financial status and performance of the firm	A great deal ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not at all
IL	A great deal ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not at all
Complexity of Information presented	Very complex ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not at all complex
Time spent	A lot of time ☐ ☐ ☐ ☐ ☐ ☐ ☐ Very little time
Adequacy of financial visuals on leaning the firm's financial status and performance	Very adequate ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not at all adequate
Rating of the solvency of the firm and its ability to invest in ERP project	Very solvent ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not at all solvent

Appendix B: Mixed Symbolic and Spatial Visuals—Example for the Food Corp



Balance Sheet	2004	2005	2006	2,007	2008	Graph
Total current assets	15,966	18,803	18,455	23,497	28,816	
Total non-current assets	8,056	8,191	8,681	10,079	11,049	
Total Assets	24,022	26,994	27,136	33,576	39,865	
Total current liabilities	8,417	10,119	8,946	13,666	16,222	
Total non-current liabilities	3,706	4,054	4,087	5,340	7,413	
Total Liabilities	12,124	14,174	13,033	19,006	23,635	
Total equity	11,899	12,820	14,103	14,570	16,231	
Total Liabilities and Owner Equity	24,022	26,994	27,136	33,576	39,865	

Profit & Loss	2004	2005	2006	2,007	2008	
Sales	46,751	53,643	55,039	55,507	69,048	
Costs of Sales	39,581	45,317	46,617	47,932	60,291	
SG&A	5,045	5,745	5,767	5,290	5,934	
Gross margin	7,170	8,326	8,421	7,576	8,757	
Interest expense	220	361	608	580	635	
Depre & amortization	726	820	855	978	1,000	
After-tax profit	2,211	2,312	2,318	2,008	2,569	
EBIT	2,422	2,955	3,060	2,851	3,310	
EBITDA	3,148	3,775	3,915	3,829	4,310	

Cash flows						
Operating Activities	781	1,732	1,885	-1,634	1,655	
Investing Activities	-1,561	-1,018	-1,497	-2,472	-1,821	
Financing Activities	820	-424	-596	4,120	2,087	

Appendix C: Construct Reliability and Validity

Construct: learning (seven items on7-point Likert scale)

Statistics (*N* = 163)	GWN foods	TWG foods	GWN retails	TWG retails
Cronbach's alpha	0.915	0.955	0.948	0.961
KMO	0.886	0.917	0.923	0.921
Bartlett's	771.65***	1145.77***	1048.81***	1270.91***
Factor loadings for each measure	0.77-0.88	0.86-0.92	0.83-0.92	0.85-0.92
First factor variance	66.39%	78.61%	76.42%	81.05%

Note. $^{***}p <= 0.001$.

Construct: IL and CL (two items each on 7-point Likert scale)

Statistics (*N* = 163)	Cronbach's coefficient alpha	First factor variance explained*
IL		
GWN foods	0.546	68.84%
TWG foods	0.735	79.08%
GWN retails	0.668	75.09%
TWG retails	0.742	79.59%
CL		
GWN foods V31, v32	0.688	76.24%
TWG foods V43,44	0.693	76.62%
GWN retails V55,56	0.761	80.77%
TWG retails V67,68	0.712	77.96%

Notes. *All statistics, KMO statistics and Bartlett's tests of sphericity, indicate appropriateness of the use of factor analysis. Factor loadings for every item (measures) are > 0.80. Except for one Cronbach's coefficient alphas, the rest are in reasonable range.