CUSTOMER E-LEARNING

by

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ABSTRACT

Customers in business to business relationships are increasingly being informed about products by company web sites rather than print materials. The first research question is whether design guidelines for business to business product information web sites should be developed from learning theory and instructional design concepts. The second research question is whether creators and users of web sites have similar web site perceptions and preferences. A literature review was combined with the results of a study of web site creators and users to develop design guidelines for product information web sites. This research found that creators and users of product information web sites perceive web site users as motivated to learn but that their primary objective is quick reference. Suggestions for design include considerations of time sensitivity, the need for interactive sites that adapt to user needs, collaboration facilities and multimedia.

Keywords: e-learning, communities of practice, corporate web site, B2B.

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1 OVERVIEW OF THESIS

1.1 Thesis Purpose

This thesis is at the juncture of education and business. My professional sales management experience in business to business (B2B) sales of technical products has taught me that a major component of selling is customer education. My thesis is that businesses can do a better job of customer education by incorporating aspects of e-learning, using instructional design principles, in their B2B product information web sites.

The increasing prevalence and use of the internet is encouraging the development of web sites for providing information to customers. Companies are migrating their information dissemination from print to the web. Web sites providing product information for B2B customers usually consist of printable documents that can also be read on a computer screen. Web sites are capable of much more than displaying representations of print documents. However other techniques that can be implemented on web sites such as social networking, animations, video and interactivity can have a high initial development cost. Companies are already starting to use some of these techniques but often are not sure which to use and how to use them. Some large companies such as Hewlett-Packard and 3Com have been recognized as having well designed B2B web sites but the evaluative dimensions are often limited to aesthetics and ease of navigation. There are rare cases of B2B web sites that have incorporated on-line

chat functions and product presentations using something other than a representation of a print document.

Design of print based documents has a long history. Techniques have been developed for the best, most effective and most efficient delivery of information using print media for most applications. B2B web site designers do not have long established techniques and design guidelines to work with. The purpose of this thesis is to take some initial steps towards determining whether learning theory and instructional design principles could be useful in creating product information web sites for the use of B2B customers.

1.2 Literature Review

The literature review is presented in the "Customer Learning" chapter. It examines the differences in training employees and training customers and some aspects of the business practice of customer relationship management. It also reviews literature on adaptive web sites, time and collaboration considerations that could apply to customers in B2B commercial relationships. This is followed by an overview of constructivist learning and activity theory, a look at formal, informal and incidental workplace learning and a recent history of corporate e-learning adoption generally.

1.3 Research Questions

The first research question is whether customers will accept content-rich, adaptive, interactive and collaborative B2B web sites as a way of becoming informed about products on the job as they work. The questionnaire was constructed to measure what features of a web site incorporating learning tools and principles would be

preferred. The second research question is whether creators of web sites perceive their audiences differently from the way that the audience perceives themselves and whether there are differences in content preferences between creators and users of product information web sites. The test is to compare the answers of creators and consumers of product knowledge web sites to determine if there is a significant difference between them.

1.4 Research Methods

Participants were contacted by email and invited to complete an on-line questionnaire as a creator or a consumer of product information web sites. Items 1 to 3 on the questionnaire asked both consumers and creators of B2B product information web sites direct questions about computer literacy and learning motivations of the audiences or users of the site. Items 4 to 16 determined preferences for content and mode of delivery on product information web sites.

1.5 Results and Discussion

Results were collected from 43 respondents; 15 creators and 28 consumers. A histogram of the results was plotted separately for creators and consumers. T-tests were used to compare means and determine whether the creators of web sites had a significantly different perception from the consumers of the web sites about web site audiences, content and delivery methods. A subsequent exploratory correlation was calculated between each of the items.

Creators and consumers of web sites perceived that users are motivated to learn when they visit a product information web site. Consumers had a significantly stronger

perception of themselves as motivated to learn than did creators of web sites. However, both consumers and creators indicate that someone accessing a web site is more interested in quick reference than learning.

The responses to the questionnaire indicated preferences for colour, applications, adaptive web sites and explanations. Most variables had means close to 50 on the 1 to 100 semantic differential scale, with large standard deviations. Opinions varied widely and were sometimes polarized. Correlations between items indicated that respondents who preferred having product application information on web sites also preferred explanations, training, collaboration, animations, adaptivity and interactivity. There were a significant number of creators and consumers who prefer B2B product information web sites that incorporate multimedia, adaptivity, interactivity and collaboration.

The study taken in conjunction with the literature analysis suggests some design guidelines that can be applied to B2B product information web sites. Customers must be able to access product information, explanation and examples in a fashion that allows them to understand what they need to know in a timely fashion. Web sites should be able to adapt to a users needs by being interactive and showing information at a level of complexity suitable to the user. Determining user needs and knowledge levels without time-consuming questioning may be approached by allowing user selection of knowledge level, maintaining contact information files or monitoring web site use to determine user capabilities. Web sites should also provide tools for communication and collaboration from company to customer and between customers. The establishment of the web site as part of the community of practice within the industry is an objective that fits with theories of constructivist learning. Multimedia are favoured by web site users but should be

incorporated only as support for customer reference and learning. The customer's job situation must also be taken into account. Different product information must be supplied to customers who are designing, installing and maintaining products. Some customers may have new modes of access to the internet such as cellular phones with small screens.

1.6 Significance of the Study

This thesis examined whether communication with customers can be improved by applying principles of instructional design. It has delved into an area of B2B customer communication that is a huge part of the world economy. Advertising alone is a multi-billion dollar business worldwide without even counting other marketing expenditures on direct sales and training to inform customers. As the internet becomes ubiquitous and companies communicate with their customers via web sites, they are no longer bound by the limitations of print. The central finding of the thesis, that customers perceive themselves as learners while still valuing web sites as reference resources, has the important implication that designers who create web sites for B2B customer support should consider how instructional design principles can be applied without hampering the ability of customers to easily find information to complete immediate business tasks. The work presented here indicates that businesses should begin treating customers as intelligent partners and assist them to learn about the products on offer rather than having a primary focus on convincing customers to buy.

2 CUSTOMER LEARNING

This section explores literature from various topics within the fields of education and business including learning theory, instructional design, educational psychology, customer relationship management and e-learning. The literature was searched for research that pertained to corporate e-learning and especially customer learning that could assist with developing B2B product information web sites.

2.1 Training Employees versus Training Customers

Within companies training is often provided via internal training departments or by external training companies. It is usually the company, not the employee that defines what is to be taught and how best to deliver the training. An internal company department with a task to accomplish will explicitly specify who is to be taught and what is to be taught. For example, a training department will be told by the product management department that they will be teaching the sales force about the features of a new product being introduced to the market and what applications that product can be used for.

In contrast, customers determine what they want to know or learn. It is more difficult to predict what customers will want to know when they visit a product information web site. The customers will have varied information needs and the web site designer must anticipate those needs. Therefore the typical model of the trainer defining the training and how it will be delivered is not sufficient for designing instruction for customers.

For our purposes we therefore define customers engaged in an independent search for information as autonomous learners who according to Goodyear (2000) can be characterised as non-compliant learners. If a web site does not engage a customer within a reasonable amount of time, they will simply move on. The content must be sufficiently interesting, engaging and pertinent to hold their attention. Because customers are not a captive learner group such as students or employees, they must be motivated to access information or participate in training. In most cases there is a mutual benefit to both buyer and seller, but often the primary benefit is to the seller in that the buyer will appreciate the seller's goods and continue to or start to buy them. Sometimes in B2B relationships the seller will pay the buyer to attend training or the training may be held in a resort setting with other activities designed to encourage the seller to participate in the training. Sometimes the training can take second place to the other benefits such as camaraderie, fine meals, entertainment and recreation. Examinations and other forms of formal learning assessment are usually not provided.

Other differences that need to be addressed are noted in Table 2.1 (O'Leonard, 2004).

Table 2-1 Employee and Customer Training Comparison adapted from O'Leonard (2004)

	Employee Training	Customer Training
Driver	Human resources department	Sales or product management departments
Skill Level	Known skill levels	Wide variety of unknown skill levels
Motivation	May be required or voluntary but never paid for by employee and often "time off work."	Motivation may be higher, especially if they are paying for the training.
Expectations	Varies with the learner's attitude and previous training experiences	Usually high, especially if they are paying for the training.
Technology	Usually internal infrastructure and probably behind a firewall.	Must be available externally to the company's facilities.
Learner Data	Learners are known. Information is from human resources department.	Learners are often unknown. Information from sales, customer relationship management software or self-registration.
Rules	Manager approved learning plans or certification	Many possibilities include training credits for sales, bundled with products, E-Commerce registration, etc.

Employee training is usually the responsibility of the human resources department which tracks courses taken and accomplishment levels on employee records. This makes it possible to offer new training at a suitable level to a particular employee. Customers are the responsibility of sales or product management departments. It would be useful to know the skill levels of individuals at different customers so that a B2B web site could adapt to their knowledge levels, however, this information is usually not available. It is difficult to maintain accurate training records on individuals within a customer company because of employee turnover and the lack of testing at training courses given to customers.

There is no clear distinction between employees and customers regarding the levels of motivation to learn and expectations of the training because other factors come

into play. One crucial difference is whether the individual is paying for their training. Free training may be perceived as less valuable than training that is paid for. A person who paid for training will likely have higher motivation and expectations of the training. Employees most often receive training at no cost to themselves other than their time commitment. In contrast, customers sometimes pay for training and want to get their money's worth.

2.2 Customer Relationship Management

Customer relationship management (CRM) is a business approach that deals with the relationship between a business and its customers (Payne & Frow, 2005). CRM's basic purpose is to manage and improve a company's relationship with a large number of customers. CRM has been the driver for the development and sales of software packages for sales force automation, call centres, web sites for customers to place orders, mass email and literature distribution, customer data mining and other software tools for understanding and communicating with customers.

CRM software is evolving along with the internet. Initial business software development was used for applications that were primarily internal to a company such as accounting, production and human resources. The only functions external to the company were customer invoices and perhaps some marketing activities such as mass mailing. The advent of the internet enabled email, corporate web pages and web-based ordering. Now internal company software, referred to as "back office," could be integrated with the "front office" or customer oriented software for sales force automation and web-based ordering.

A central tenet of CRM is that customer satisfaction includes not just product satisfaction, but satisfaction with the entire relationship with the supplier (Payne & Frow, 2005). Communication of product and application information is part of the customer-supplier relationship. Customer information needs to extend beyond the basic price and product benefits and features, to application information, design, ingredients, engineering details, testimonials from satisfied users, product application examples and general information about the company producing the product. Companies that manufacture and sell many different products can have huge amounts of information for customers. One of the key aspects of CRM is that the information should be tailored to the customer's need. The customer's level of understanding and familiarity with a company's product offerings determine their ability to absorb the information. This is most crucial with complex products; however there are many instances where relatively simple products can be misunderstood. Adaptive web sites that can discern a customer's knowledge level would be most useful in this area.

Ensuring customers understand the product that a company produces is important. Usually the largest and often the most expensive departments are the sales and marketing departments. If there is a small direct sales and marketing presence within the company, there is usually an alternate distribution channel to the final consumer. Wholesalers and retailers that perform the sales and marketing function take a mark-up to do so. Part of the cost of doing business is advertising, product literature, signage, trade show booths and other customer communications. Whether done externally or internally, there is a significant expenditure to ensure customers know and understand what a company produces and sells.

Company sales forces have traditionally been a large component of CRM but Wilson (2000) put forward the idea that there will be fewer sales people in firms engaged in B2B selling because of closer connections between the seller and the buyer. He describes integrative selling relationships where the seller has a person working at the buyer's location with the authority to order products from the seller. The advantages of this partnership are daily interaction with the customer, the seller becomes a part of the buyer's team and co-operation is improved. Close electronic ties between companies such as Electronic Data Interchange (EDI) systems and extranets characterize this type of relationship. An integrative selling relationship has benefits to both parties. However justifying the expense of a full time employee dedicated to one buyer would likely only be possible with the top few purchasers in most markets. There will be pressure to provide the same type of service for smaller purchasers and this is where adaptive web sites designed to service specific customers' information needs may be used.

2.3 Adaptive Web Sites for Customers

One of the challenges of providing customer information is the variations in customer knowledge levels, time available to learn, ability to learn, motivation to learn and other personal, social and environmental factors. When designing a customer information web site and choosing its content, it may be wise to use software that provides choices as to level of difficulty or interest area and perhaps even software that automatically adapts to customers' needs. Designers of web sites that want to adapt product information offerings to customer needs could learn from adaptive instructional systems that adapt to different learners. It is recognized that instruction should adapt to the student, in fact, apprenticeship and one-to-one tutoring could be said to be forms of

adaptive instruction. Adapting instruction to the student has been recognized as an important factor in learning success since the fourth century BC (Corno & Snow, 1986).

Unfortunately, one-to-one tutoring is expensive. Companies' outside sales forces inform customers about products and how they work, are applied, their composition, how they are manufactured and any other information that the customer desires to know. Essentially this is a one-to-one, learner driven interaction with the customer setting the learning agenda. The sales force tends to concentrate their efforts on the most important customers that purchase significant quantities of their product because a customer visit is expensive - one sales call costs about $200 (Marchetti, 2000).

Considering the expense of one-to-one instruction and the belief that adaptive instruction is critical to educational success, it is no surprise that there have been years of research into systems and technology to make mass education more adaptive to the learner's needs and capabilities. Aptitude-treatment interaction models that adapt instruction to the student's learning characteristics and capabilities might give direction to providing more individualized instruction (Cronbach & Snow, 1969). One possibility with this approach would be to allow the customer to choose the media they prefer. For example, a service technician could choose to learn about installing a product by watching a video. A design engineer could choose to read product specifications and examples of how to install the product.

Micro-adaptive instructional models can monitor learner's responses and modify the system based on the student's speed of response or success level as they work with a computerized learning system. One of the challenges with automatically adapting the offerings of a web site to a particular user is that a customer's interaction with the web

site may be brief and it is necessary to monitor someone over sufficient time to determine their aptitudes. Educational research into web-based adaptive learning will likely decrease the monitoring time required and advances in artificial intelligence (AI), fast networks and computer hardware may make automatically adaptive web sites more of a possibility for customers. Instructional Transaction Theory is an approach to instructional design that lends itself to adaptive instruction (Merrill, 1999). The example used in Merrill's article uses knowledge objects that are manipulated by an algorithmic instructional system that the learner manipulates. It is in effect a sophisticated interactive simulation engine that allows learners to explore an application such as installing or removing a technical product in their own fashion and at their own speed.

Computerized Adaptive Testing (CAT) could also be provided as part of customer education. Usually, suppliers do not have the opportunity to test customers and customers do not seek testing. However, testing is necessary when a customer is required by law or by a distribution contract to be certified before being allowed to sell a product. CAT would allow the wide range of knowledge and capability that customers may have to be taken into account in the testing procedure. Initial questions answered correctly would elicit more difficult questions and incorrect answers would subsequently lead to less difficult questions (Wainer, 2000).

2.4 Customer Self-Regulated Learning

Customers faced with a problem they need to solve in a limited time have an urgent requirement for the knowledge they need to solve that problem. As they access a B2B product information web site in search of that knowledge, they are engaged in self-regulated learning. The phases of self-regulated study are; perceiving the task, setting

goals, enacting tactics and adapting tactics for self-regulated learning. Computer technologies can provide the tools for self-regulated learning and can actually assist a learner while they are studying (Winne & Stockley, 1998). A computer program called gStudy has been developed to allow students to study HTML documents and at the same time to use study tools such as highlighting and creating notes from templates. The key feature of the program is that it keeps track of how the tools are used and what course content is accessed by the student as they are studying. With the student's permission the data log is uploaded to a server for analysis. This program has been used at Simon Fraser University by students in an introductory Psychology course and the data logs provided useful information for the study of self-regulated learning (Winne et al., 2006). In a similar fashion, customers could use gStudy software to read corporate, product or application information and the data logs could provide information on which products different customers accessed, for how long, in what order and what notes they made. This unique feature of gStudy software for companies supplying HTML documents to their customers means that without using valuable customer time the data logs can feed back information on which customers are accessing the documents, what is being read and even whether the information is understood. The data log could be analysed, almost in real time as the customer accesses the document and uses the gStudy tools to highlight and make notes. Simple note templates such as "Unclear Terminology" or "Item not Understood" being used by the customer would immediately give valuable feedback to the company issuing the document. Customers could be assisted by chats with customer service agents or perhaps in future with an Artificial Intelligence (AI) customer service agent.

The customer would have the benefit of an HTML document that could include animated graphics, video and links to anywhere on the web. Customers would be able to make notes on the literature that could be available to other users within the same organization that could be used in a collaborative fashion. Sales and marketing departments selling complex products that are difficult to understand and explain would benefit from the wider capabilities of html content. Difficult concepts could be explained and demonstrated with active and interactive content such as Flash, video files and audio.

2.5 Learning Objects

Learning objects are digital resource that can be reused to support learning (Wiley, 2002). There are various learning object standards such as Sharable Content Object Reference Model (SCORM), the IEEE Learning Object Metadata standard, the IMS Learning Resource Meta-data specification and the CanCore Learning Object Application Profile. Learning objects can be described, exchanged and used by learners and e-learning software. There are thousands of learning objects on the web and there are repositories that include specialized search engines such as Multimedia Educational Resource for Learning and Online Teaching (Merlot) at http://www.merlot.org. Merlot includes learning objects for business, marketing and sales as well as other areas. Merlot also provides a facility for peer reviews and ratings of the learning objects. The use of learning objects is an ideal way of assisting a customer with basic non-company specific information or explaining industry standard references by directing them to a learning object or incorporating it on a B2B web site. This will also hold down the cost of developing a web site.

2.6 Individualized and Personalized Customer Learning

Learner centric learning is learning that is individualized and is according to the learner's interest and capabilities (Ong & Hawryszkiewycz, 2003). A customer wants to learn what they need to know when they need the information. Learner centric learning should be sufficiently flexible that a customer can solve real-life problems in real-time, sometimes just-in-time and have that as a learning experience. Course development takes too long for on-demand learning. Moreover, adult learning should be problem-centred and shift control to the learner (Weintraub & Martineau, 2002).

Personalizing education and the learning process has benefits that actually improve learning. Personalized messages caused better retention and transfer in experiments with pedagogic agents (Moreno & Mayer, 2000). It is possible with current technology to make a customer's experience more personal than reading a piece of literature that is printed in the thousands and is the same for everyone. If the customer comes to a web site that greets him by name, knows his level of knowledge and general interest based on previous visits and treats him accordingly, this will not only be appreciated but can contribute to more effective learning.

Education could be perceived as a customer benefit provided that the customer feels that there is something to be gained by the education. The objectives of the education should be established by taking customer needs into account. Customer education must balance customer benefits with the supplier's corporate requirements and costs.

2.7 Time Considerations for Customers

If we envision a customer at work dealing with a task, there is a high probability that getting the task completed in as little time as possible is advantageous. According to Microsoft's Kai Ichikawa, "focusing on enabling learning at the time it is needed, in a manner that integrates with the users work or usage pattern is fundamental to ensuring success" (Aldrich, 2000, p. 35). Having information available for learning just at the time it is needed, is a useful feature of some discovery learning systems (De Jong & van Joolingen, 1998). A recent study found that 72% of companies surveyed acknowledged that some or most of their programs were time-critical in nature (O'Leonard, 2004). The usual approach to content development simply does not work for many companies who need just-in-time training. Companies must provide their employees and clients with knowledge and skills when they need it and in the delivery method that makes the most sense for individual learning styles.

Some learners use small hand held Personal Digital Assistants (PDAs) so they can learn anytime and anywhere (Gordon, 2003). Customers with web-enabled PDA's are able to access company web sites from anywhere there is internet service. Therefore, web sites will have to be designed to accommodate the smaller PDA screen. Levy (2004) referred to learning something before you need the information as "just in case" learning. He contends that this type of learning is good for foundational learning but is not suitable for learning on the job. He thought that what is needed is the performance support model which has targeted knowledge when and where needed. That would involve "just-in-time, personalized solutions, aggregated in real-time around the learner, by the learner" (¶ 6).

Cisco CEO John Chambers who stated in 2000 that "The next big killer application for the Internet is going to be education." (Moe, 2000, p. 11) was quoted in a 2005 as saying that Cisco's approach had been wrong-headed and "The most effective approach has been to dole out e-learning in pieces of about 10 to 12 minutes" (Sutton, 2005, p. 8).

2.8 Expert Assistance for Customers

As technology expands at an ever-increasing rate, there is a growing demand for learning, particularly amongst professionals and knowledge workers. It has been claimed that by the end of a four year engineering degree, half of what was taught in first year will be out of date (Bentley, 2000). Customers have a need for information, learning and expert assistance because many customers will regularly encounter problems that they have not seen before.

One of the first steps most people take when confronted with a problem that they are unfamiliar with is to ask someone, if possible an expert in the domain in question, how to solve it. Experts are fast and they quickly solve problems with little error (Chi, Glaser, & Farr, 1988). If a human expert is not available, an electronic performance support (EPS) system could provide expert advice from videos of people or AI avatars. It could also involve other computerized reference or advice support technologies such as computer-based expert systems that range from searchable lists of frequently asked questions (FAQ's) to AI systems.

The ultimate web based assistance from a customer's point of view would be expert tutoring at any time that they needed it. Most often the customer expectation is to

be told the answer or directed towards the right answer by a real human expert. However, it would be difficult and costly for a company to have enough real human experts constantly available to answer questions and help customers. It may be difficult to find enough experts to handle peak periods and it would be very costly to provide around the clock service. From a company's point of view, the ultimate learning and customer support system would provide the service levels the customer wants at a reasonable price. The ultimate EPS system would tutor many customers one on one, all at the same time with an artificial intelligence engine that would pass the Turing test or be indistinguishable from a human being (Turing, 1950). There are various intelligent tutoring systems such as AutoTutor (Graesser et al., 2003) that are endeavouring to be as effective as possible at tutoring. Likely, the most important aspect to a customer is that their question is answered intelligently and in a friendly and helpful manner whether it is by a human or an AI avatar.

2.9 Learning While Solving Job-related Problems

Customers are very open to learning when they face a problem that they can solve and learning is a by-product of the problem solution process. The process of learning while solving a problem or engaging in a new task is in some ways similar to how apprentices learn on-the-job. An expert can assist the apprentice to learn by asking questions such as is done in Socratic Case Based Teaching (Edelson, 1998) or Inquiry Teaching (Collins & Stevens, 1999) but that process involves more time than might be available if the problem needs to be solved right away. A customer that is visiting a B2B web site with a problem to solve might be interested in a short duration problem based lesson if it helps solve the problem they face. Computer simulations of real problems and

solutions with an interactive dialogue could be used. Despite the computer technology simulations should be and can be as natural as possible (Schank & Cleary, 1995).

Instructional design should take into account failure possibilities as well as exploration, doing and observation (Schank, 2002). The argument can be made that a lesson will have impact if the outcome is negative; in fact perhaps more impact (Schank & Neaman, 2001). People tend to remember when they make a mistake if they are aware of it. In a customer's case, in a real life situation, making a mistake to learn a lesson may not be advisable, however it may be possible to engage the customer, allow a mistake and then point it out and remedy it before the outcome becomes permanent. Learning by doing as exemplified by apprenticeship is one of the best ways to learn. Learning by failing is good too, but sometimes takes too much time for the necessary iterations and failure may not be acceptable depending on the real life circumstances. Roger Schank is a proponent of both learning by doing and learning by failing.

Allowing errors and pointing them out should not be construed as assuming that the teacher is all-knowing and learner is ignorant (Schettler, 2002). Sometimes the customer will have equivalent or better knowledge than the person creating the learning object for the supplying company. Computer based tools can enable and engage learners in complex critical thinking (Jonassen, 2000). The internet is a fantastic resource for many kinds of information gathering that are part of learning. Customers need to solve problems so learning while solving problems is a natural fit. An electronic performance support (EPS) system could be used by customers on the job as a tool to accomplish tasks.

In a review of animated interface agents, Dehn and Van Mulken (2000) evaluated whether animated agents used in e-learning and other applications contribute to improved motivation and cognition. They determined that there was no evidence that an interface with an animated agent has an advantage of over one without an animated agent. However, in more recent research (Atkinson, 2002), animated agents produced better results than text alone. E-learning is an evolving field that is dependant on complex and quickly evolving computer and software technology. The internet has had, and will continue to have, a huge effect on business communications. Internet access from business computers is now the norm. Multimedia capable computers that can handle video and presentation graphics and have speakers are commonplace in offices. It will be increasingly possible to assist customers over the internet using adaptive web sites and AI agents.

2.10 Constructivist Learning and Activity Theory

Activity theory as applied to learning takes into account factors external to the individual and the knowledge they are dealing with. An activity system includes the subject and their objective, as well as the community of practice they are part of and other factors that impinge on the activity system such as tools and rules. Vygotsky developed the genesis of activity theory in the 1920's based on a Marxist idea that it is social experiences that shape consciousness. An activity system has been proposed as a unit of analysis for organizational learning (Virkkunen & Kuutti, 2000).

Recent learning theories take into account the social aspects of how people learn with others and as part of a group. Instructional designers have progressed through behaviourist/empiricist theories and cognitive/rationalist theories to

situative/constructivist theories (Collins, Greeno, & Resnick, 1996). The constructivist approach to instructional design emphasizes situated learning. Understanding is developed through situated use (Brown, Collins, & Duguid, 1989) and on-the-job learning, if it involves social interaction, real problems and real activities. Moderate constructivists have called for learners to construct their own knowledge (Molenda, 1997) and computer software has been designed to create constructivist learning environments (Dede, 1995) that immerse learners in computer based virtual environments. A student could use an avatar, a virtual being in a virtual world, as though they were in a real environment learning a task or solving a problem. A customer could train by doing virtual maintenance on a product in a three-dimensional virtual space that would simulate a real life environment. A group of customers could train in the same virtual space and could assist each other with solving problems.

Activity theory has been used to evaluate learning and learning conditions in many workplace situations, for example to research air traffic control (Owen, 2001) and labour safety inspectors (Virkkunen & Kuutti, 2000). Activity theory is able to provide a framework for the factors that affect a person's learning in a workplace environment such as co-workers, acceptable behaviour, informal, incidental and formal learning. This has particular importance for a company trying to design a product information web site for its customers. It is easy for a designer to overlook factors that are not part of their own work environment. It encourages taking into account factors that may influence a customer but which are not part of the environment that a company's own employees would normally be subject to. Designing a web site, learning object, e-learning course or any other learning content that does not take into account the work environment of the

various customers that the learning is aimed at may hinder the customer's learning experience. Task analysis is essential to good instructional design (Jonassen, 1999) and situated learning and constructivist learning environments require an activity based method of analysis. Task analysis for a B2B product information web site will require the designer to anticipate the reason a customer may visit the site, what their information needs are likely to be and what the customer's environment is. The site will have to updated and modified over time as customer needs and situations change.

2.11 Collaboration and Communities of Practice

In 2001 a group of five evaluators from Indiana University's Center for Research on Learning and Technology (Graham, Cagiltay, Lim, Craner, & Duffy, 2001) used a set of seven principles of effective teaching (Chickering & Gamson, 1987), to evaluate face-to-face and on-line university courses. The first two principles were "good practice encourages student-faculty contact" and "good practice encourages cooperation among students." Student-faculty contact and cooperation among students are recognized as essential components of effective teaching. Constructivist learning theory considers knowledge to be socially constructed and therefore it is important to encourage co-operation and communication among learners. Communication and collaboration between customers can assist customer learning. It is possible to achieve communication between customers visiting a B2B web site by various electronic means such as asynchronous discussion groups, synchronous chats, email and shared on-line environments.

Shared on-line environments are very popular in computer gaming. Groups of gamers can form teams despite being geographically separate. They are each represented

in three-dimensional space by their avatar. Multi user dungeons (MUD) have been around for ten years (Brown & Duguid, 1996). Computer simulation research has proven that higher quality dialogue contributes to better learning (Pilkington & Parker-Jones, 1996). Despite distances that often cover different time zones, gamers working together in a virtual world can cooperate and function well as a team by communicating via voice over internet protocol (VOIP). If a virtual environment were created that represents the environment in which a company's products are used, a corporate avatar could show a customer how they could be applied. A customer or customer group could be taken on a plant tour of a virtual copy of the real plant; perhaps with live feeds from cameras within the production areas showing what is happening real-time at the real plant. If each of the customers had an inexpensive web cam on their computer, they could see each other. Studies of video-interactive distance learning have shown high student satisfaction (Guzley, Avanzino, & Bor, 2001).

There are many collaborative tools for e-learning, but they are not being used as extensively as they could be (Bonk, 2002). Computer supported collaborative work (CSCW) and its effect on instructional design has been studied and it has been suggested that the additional complexity of the instructional design may well be handled by engaging in CSCW for instructional design teams (Ganesan, 2002). Once groups of learners are involved in collaborative learning there is now the possibility of peer and co-assessment (Sluijsmans, Dochy, & Moerkerke, 1998).

It might be possible to develop a community of users of company products that could help each other with application and use information (Kim, 2000). Customers have contributed to product development ("The rise of the creative consumer," 2005)

exemplifying company-customer partnership. The ultimate in market research occurs when the product user is directly helping to define new products.

In B2B marketing, customers are usually referred to at the level of a company whereas in business-to-consumer marketing the customer reference is at an individual level or perhaps aggregated as a group of individuals with common traits. However, it is important to remember that B2B marketing still deals with individuals. The fact that they are employed by or are acting on behalf of a particular business will affect their behaviour and purchase decisions, but their interests and needs are individual and extend far beyond their jobs. One of the ideas central to constructivist learning is that formal and informal social associations influence individuals. Formal influence can be a professional organization's code of conduct. Informal influences can be as simple as the opinions of co-workers shared over coffee. The opinions and shared knowledge of other practitioners within the domain is important to learning. Web site designers may find that their web site can go beyond the simple one-to-one relationship between a customer user and a web site. The idea of a customer's community of practice and the communication capabilities of the internet could perhaps be harnessed to create socially constructed knowledge.

Apprenticeship allows workers to enter the culture of practice (Brown, Collins, & Duguid, 1989). Once a learner engages in authentic activity by solving ill-defined problems, they no longer behave as a learner, but as a practitioner. The key aspect for customer learning is that collaboration with other customers allows individuals to learn from others in their field through social interaction. Often the way people actually work is quite different from what is described officially in operations manuals and organization charts. Informal communities of practice have tremendous influence and contribute to

organizational learning. For example, Xerox photocopier service technicians solved a difficult diagnostic problem by telling each other stories and comparing experiences until they solved the problem. Later the success story was passed on within their community of practice over a cribbage game (Brown & Duguid, 1991). This informal dissemination of information was eventually incorporated into a computerized database where service reps could submit tips. The tips would go through a sequence of steps beginning with a local service expert and through committees where they were checked, duplicates eliminated and disputes resolved until finally the tips are put up on the web for worldwide dissemination.

> Those who submit good tips earn positive recognition. Because even good tips vary in quality, reps, like scientists, build social capital through the quality of their input. At a recent meeting of Xerox representatives in Canada, one individual was surprised by a spontaneous standing ovation from co-workers who were expressing their respect for his tips (Brown & Duguid, 2000, p. 80).

Communities of practice are an important part of constructivist learning theories and the internet is a new media that can be used to leverage the natural way that humans learn. The ability to access vast amounts of information means that to some extent education becomes information navigation (Brown, 2000). The idea of communities of practice does not detract from the individual as an individual. It is important to note that individuals often belong to more than one community of practice (Brown & Duguid, 2001). Also individuals are involved with others within their community of practice but outside their own corporate organizations. There could be a community of practice with members spread around the globe. Communities of practice can be very powerful

organizations for transferring and disseminating knowledge (Brown & Duguid, 2000). However they work best as informal or semi-informal groups and they resist rigidity (Wenger & Snyder, 2000). B2B web site design should allow for and even encourage communication within a community of practice regardless of the individual's locations.

Community of practice is a particularly important consideration for an organization dealing with customers. Communities of practice such as professional and industry organizations and unions can influence a customer by their particular culture and in some instances by binding regulations (Owen, 2001). There are many factors that influence a customer's view of the world that are not immediately perceptible to someone from a different organization. A major reason why outside sales forces go to a customer's place of business is that there are many clues that an experienced, empathetic sales person can pick up simply by being in the customer's environment. Another reason for visiting a customer is simple social interaction. Getting to know a customer is the foundation of establishing a relationship. A sales person can become a part of a customer's community of practice if they influence the customer on an ongoing basis in the course of doing business.

The question is whether a personal social relationship can be established and whether a company has any influence within a customer's community of practice if they are dealing with a customer via their web site. There are various ways to foster social contact from a web site including bulletin boards, instant-messaging or chats and online conversations that can even include video. Communities of practice often involve geographically separate people that have specialized interests or vocations. Companies could encourage formation of communities of practice of individuals that use their and

even their competitor's products, by utilizing their product information web site to establish communication forums.

2.12 Formal, Informal and Incidental Workplace Learning

Three types of workplace learning have been defined as formal, informal and incidental. Formal learning is typically institutionally sponsored, classroom-based, and highly structured. Informal learning is not typically classroom-based or highly structured, and control of learning rests primarily in the hands of the learner. Incidental learning is a by-product of some other activity such as task accomplishment. Informal learning can be deliberately encouraged by an organization or it can take place despite an environment not highly conducive to learning. Incidental learning, on the other hand, almost always takes place although people are not always conscious of it (Marsick & Watkins, 1990). Learning happens informally and incidentally outside the classroom as exemplified by service technicians at Xerox learning from the other members of their community of practice over meals and social engagements (Brown & Duguid, 2000). They were learning from other service technicians, often face to face, while at work and while socializing. The technicians were learning, but not formally in a classroom. When a customer visits a web site they may be engaging in informal learning or they may be there to accomplish some other task. In either case learning will likely take place either informally or incidentally.

In Canada during 2002 just over a third of working adults participated in formal job-related training (Peters, 2003). Formal, job-related training is defined as:

> Including courses or programs related to a worker's current or future job. These courses and programs have a structured plan whereby a student, led by a teacher or trainer, follows a planned program and receives some form of formal recognition upon completion, such as a certificate, diploma or degree (Peters, 2003, p. 6).

There is a huge business in North America in adult training for commercial and government enterprises and a great deal of time and money is spent on designing formal learning. However, formal corporate training is not the only way people derive the skills and knowledge that they use to do their jobs. Informal job-related training is:

> Training that involves little or no reliance on pre-determined guidelines for its organization, delivery or assessment, i.e. it does not lead to any formal qualification or certification. It must be undertaken by the participant with specific intention of developing job-related skills or knowledge." (p. 6).

There were as many people that had engaged in informal learning within the four week period prior to the survey as there were people that had done formal learning in all of 2002. The categories and frequency of informal training during the four weeks were "Consulted books/manuals/other documents 80%, Taught themselves by trying different methods, 70%, Used the internet or computer software 58%, Sought advice from someone 56%, Observed someone perform a task 49%," (p.31). Informal, self-directed training is more pervasive than formal job related training.

Marsick and Watkins noted that time and money spent in the workplace on formal learning versus informal and incidental was 17% formal and 83% informal and incidental. This has huge implications for workplace learning. Formal learning is usually

planned and has a curriculum. Informal learning is intentional but not highly structured. For example, self-directed learning, networking, coaching and mentoring are informal (Marsick & Watkins, 2001). Incidental learning is by definition unplanned and has no curriculum. There are four times as much time and money spent on informal and incidental on the job learning as is spent on formal company organized training.

In 2002, an extensive quantitative study of the workplace for small to mid-size businesses in the US concluded that job satisfaction was largely attributable to learning opportunities on the job and that of the formal, informal, and incidental learning opportunities, most were incidental (Rowden, 2002). Even museum visits are a form of informal education (Schauble, Leinhardt, & Martin, 1997). Games, especially computer games using interactive simulations or virtual worlds are being researched for their educational value (Rieber, 1996) and are being designed for effective learning (Houser & DeLoach, 1998).

The spectrum of learning environments and situations extend from the extensively analysed and researched formal learning settings, through informal individually driven learning, to incidental learning that happens by chance. Most often a customer learner in a business setting will decide what learning activity to engage in. Some will choose not to learn at all, but as lifelong learning becomes almost a requirement (Tuijnman & Bostrom, 2002) more and more customers will be interested in learning.

2.13 Corporate E-Learning Adoption

Corporations that have recognized the importance of having a knowledgeable work force have encouraged training for their employees. Corporate e-learning has

grown, but despite early forecasts in training industry periodicals of huge growth, there are still problems with drop-out rates and student motivation. Some companies are starting to provide e-learning for customers. E-learning is considered a means of establishing a better relationship with the customer and thereby achieving a competitive advantage by helping organizations better manage the customer experience and reduce cost and inconsistency (Kelly & Nanjiani, 2004).

The development of computer based or electronic learning can be traced back to the search for improvements in both the efficiency and the effectiveness of teaching. One-to-one teaching is the most expensive but also one of the most effective forms of teaching (Bloom, 1984). It assumes a qualified and capable teacher focuses all their teaching effort on just one student. Educational researchers and instructional designers recognized that students could work one-to-one with computers. They experimented with creating computer based learning environments that used the computer's capabilities for effective teaching.

Learning in a business context has long been considered an important aspect of a corporate organization. John Kenneth Galbraith first identified knowledge workers as a key component of organizations in the information age (Galbraith, 1967). Situated learning (Brown et al., 1989) and communities of practice are often found in a business context. Organizational Learning researchers have evaluated the ideas of learning workplaces and learning environments (Easterby-Smith, Crossan, & Nicolini, 2000). It is important for companies to manage knowledge within their organizations because knowledge is the key to innovation and competitiveness.

Just prior to the .com bubble bursting in late 2000 and into 2001 (Wikipedia, 2005), Merrill Lynch released a research publication that dealt with e-learning. In it, the Chief Executive Officer at Cisco Systems was quoted as saying that the next big killer application for the internet is going to be education. Merrill Lynch forecast an E-Learning growth rate from 2000 to 2003 of 63% per year (Moe, 2000). The general decline of the high tech industry after the bubble burst did hurt the e-learning industry but even prior to that, in the late 90's, corporate e-learning had declined and there were high drop out rates. At that time, the decline was attributed to poor customer experiences and poor implementations and the industry was working on the student motivation problem (Adkins, 2002). By 2005, 71% of businesses that had an extended enterprise delivered training to their resellers, sales agents and manufacturer's reps. Only 30 percent delivered half or more of their training via asynchronous e-learning (Rowan, 2005). The reasons given in the survey for non-participation were cost to the partner where courses were charged for, channel partners not having access to technology and lack of incentive.

Technological developments such as voice over internet protocol, collaborative games, artificial intelligence, avatars, high speed internet connections, wireless internet connectivity and shared electronic documents for collaboration will continue to effect the way individuals do business. In particular customers that may not feel they have the time for formal training will be interested in learning on-the-job as they work and reference product information.

3 RESEARCH METHOD

3.1 Research Questions

As customers use B2B web sites to access product information they are engaging in informal or incidental learning. The first research question is whether customers and creators prefer web sites with multimedia that incorporate concepts adapted from learning theory and instructional design such as interactivity, adaptivity, and collaboration. This question explores the willingness of users and creators to use and design web sites with this type of content.

The second research question is whether creators and consumers of B2B web sites have the same perceptions of the characteristics of web site users and preferences for web site design. If web site creators have a perception of audience characteristics that is different from how the audience sees themselves and if creators and consumers want different content and methods of information delivery, then the web site creators will not be fulfilling their users' preferences. This does not assume that user's preferences are necessarily the best for learning, but it would show that users and creators have different perceptions of what is best and what they would prefer. If the difference is large enough, creators may have problems with user acceptance of their web sites.

3.2 Participants and Web Based Survey Procedure

The research was conducted by web-based survey. The non-probability sample was a combination of purposive and quota sample. The snowball technique (De Vaus,

1995) was used. Those initially chosen were asked to select subsequent individuals that fit the required characteristics. An email was sent to senior managers of companies that create product information for customers and users of product information. The researcher personally knew each of the chosen individuals. They were from the Heating, Ventilating, Air Conditioning, Refrigeration (HVAC&R) and building controls industry and primarily from British Columbia, Canada. The HVAC&R industry consists of manufacturers, distributors, contractors and service companies that manufacture, install and maintain HVAC&R equipment in buildings. The equipment consists of air handling equipment such as fans, hydronic equipment such as boilers and pumps, air conditioning and refrigeration equipment. The equipment ranges in size from large chillers that supply the air conditioning requirements of large institutional buildings such as hospitals to small residential furnaces. Another important component of the HVAC&R industry are the consulting engineers that specify the equipment and design the HVAC&R systems in buildings. Most of the people in the industry make use of product information from B2B product information web sites. The participants were picked to be senior and influential representatives of the industry. It was most important for this exploratory research that the survey participants would take answering the questionnaire seriously. The participants were directed to a web-based questionnaire for creators of product information and one for consumers or users of product information.

The chosen individuals were asked to pass on the email to two other creators and users of product information. Initially selecting respected senior managers would ensure that the people that they passed on the questionnaire to would be well selected and that the subsequent respondents would also take the questionnaire seriously. The initial

individuals were asked to pass on the questionnaire to just two more people because unlimited choices in snowball samples can create over-representation of certain areas (Johnson, Boster, & Holbert, 1989).

All potential respondents were advised that their answers to the questionnaires were anonymous.

3.3 Questionnaires

The question of whether instructional design can inform the design of product information web sites for companies engaged in B2B sales involves a huge number of areas and there was a problem in designing a questionnaire that was short enough that busy executives would answer it in its entirety and still cover enough concepts for useful exploratory research. The literature review highlights many of the aspects of customer learning and learning in the workplace that could be applied to customers. The difficulty was in finding a way to design questions that specifically address different aspects of learning and instructional design so that relevant data could be collected. It is an imposing task to try to identify an aspect of a web site that is indicative of a consumer's interest in learning and measure that with a simple measure that could be quickly understood by a respondent.

The questionnaire items were presented in a semantic differential form (Osgood, Suci and Tannenbaum, 1967), with opposing properties presented at the left and right extremes of a horizontal scale. The subsequent items that addressed more difficult concepts such as adaptivity required short illustrative examples at either end of the semantic differential scale. Respondents could easily use their computer mouse to move a

pointer along the scale ranging from 1 to 100. Alternately, they could key in their response.

One questionnaire was designed for web site and product information creators and another was for web site and product information consumers. The topic of each item was the same for both groups. The only difference between the two questionnaires was the phrasing used to address each item depending on the person being asked to respond. For example, a designer would be asked about what they thought their web site should be like and a consumer would be asked what they preferred to have in a web site. Each questionnaire was organized into four sections. The first section asked creators about a few important characteristics of their target audience. The second section covered content, the third delivery method and finally there was a section on respondent characteristics such as age gender and position within the company. The items were intended to be able to be answered in the amount of time a busy executive would be prepared to expend immediately upon reading the email. The expectation was that if the person contacted did not answer the item right away when they opened their email in the morning, that there was a high probability that they would not come back to it.

The items moved from simple to more complex concepts. A semantic differential scale was used as a consistent method to collect results despite the fact that the items had to be slightly different if a creator or consumer were being asked. Also a semantic differential scale is less likely to introduce acquiescence bias or the propensity to respond positively irrespective of item contents when measuring positive psychological constructs than Likert-based response formats (Friborg, Martinussen, & Rosenvinge, 2006).

The web based questionnaire was set up to be an anonymous response to encourage participation. This could increase the likelihood of irresponsible answers but there is no suggestion of that in the data. Most busy business people are more likely to skip answering an item to save time rather than enter a random response. Also, because most of the respondents were individually chosen and known to the researcher, there should be an interest in honest answers leading to valid results.

3.4 Questionnaire Items

The questionnaires are provided in Appendix 1. The first three items in the questionnaires ask whether the web site audience are computer literate, are motivated to learn and are interested in quick reference or learning when they access a web site. Computer literacy is defined as "Not computer literate" or "Computer literate" and motivation to learn as "Unmotivated" or "Motivated." The "Quick Reference" versus "Learning" item was intended to measure a user's interest in learning while they are at the web site. A user interested in "Quick Reference" may just be looking for a piece of information that they will quickly forward to someone else and they have no interest in or need to understand the content of what they have retrieved. They have not accessed the site with the objective of learning and they will not be transformed by learning. They may not remember what they accessed at all. A user interested in learning is the opposite. They are in search of understanding and will have an interest in web content and methods that will help them learn. The learner may intend to learn when they visit the site and they will be transformed by what they have learned. The transformation may be small but they will have learned. If product information web site creators engaged in B2B sales don't perceive their customers as learners, there is less likelihood they will consider learning

theories when they design their web sites. If web site users are not interested in learning then there is less rationale towards designing web sites for customers informed by learning theories. The important aspect is whether users and creators perceive a learning interest when they use and design web sites.

Items 4 - 13 ask about web site content preferences. They start with simple concepts and move towards more complex ideas. The simplest items address preferences for graphics, colour, animation and audio. The more complex items are about abstraction, including product applications, including explanations and education, making the site interactive and making the site adapt to the user. The exact item wording and semantic differential scales used to ask about these concepts is provided in the results section below. The research intent is to determine whether there is a preference for web site content that is consistent with learning. For example, the real versus abstract item was included because many theorists concerned with constructivist and situated learning advocate using real problems and examples. Web sites are often designed by marketing departments which use advertising content which is often quite abstract. Instead of showing products in use in real situations, an advertisement would depict products out of context and sanitized. Instead of a photograph of a product in use, perhaps dirty and showing real people using it, advertising content would be a drawing or other abstract rendition intended to highlight product benefits. The product applications item is included because product applications explain how a product is applied, give examples of use or real problem solutions. A straight description would deal only with the product itself with no reference to how it is used. A straight description of a pump would refer only to the pump and a product application would include how to properly fit the pump into a

hydronic system. The explanations and education versus straight factual reference item is intended to determine the desire for having product information explained or simply presented as a fact. Simple facts such as "Power consumption - Running 5 watts; Holding 1.5 watts" are concise. Explanations require more space, can make a web site look cluttered and their detail depends on the level of user knowledge. For example "Power consumption – Running (regardless of load) uses 5 watts; Holding uses 1.5 watts (due to motion sensing ASIC that cuts back power use while the actuator is at rest). See transformer sizing for maximum VA amperage draw." is longer but includes more information. It may still not be enough information if the user would like to know what an ASIC is. The amount and level of information that needs to be provided will depend on the user. The interactivity and adaptivity items address areas of adapting instruction to the student, one-to-one tutoring and micro-adaptive instructional models. The intent is to determine willingness to interact with the computer at a B2B web site and whether the web site should deliver more or less complex information depending on user answers to questions.

Items 14 – 16 in the delivery section describe how the web site delivers the content. The items address whether the site should assist customers with problem solving, use of narrative, facilities for collaboration and whether the site should be for reference or training. The assistance with problem solving item is about electronic performance support and relates to adaptive leaning, constructivism and problem based learning. The use of narrative tests the reaction of users and creators of web sites to those learning theories that propose narratives or story-telling as being useful instructional techniques. The collaboration item asks whether users and creators think web sites should include

collaborative tools such as chats and bulletin boards to facilitate communication with other members of a community of practice. Finally, the last item is a summary item asking whether a product information web site should be a reference site versus a training site. This is a slightly different way of restating the quick reference versus learning item at the beginning using different terms. It allows another measure of whether users and creators perceive that B2B product information web sites are for reference or education and tests the semantic effect of "Quick Reference versus Learning" in the first instance and "Reference versus Training" at the end. Answering these items is the first step towards determining whether an instructional design approach informed by learning theory is a useful method of informing and communicating with customers.

4 RESULTS

4.1 Statistical Analysis

Descriptive statistics (means and standard deviations) and histograms were obtained for the creator and consumer responses to each item. Independent t-tests were used to compare the means between the two groups. Finally, correlations among all items were calculated. All statistical analysis was conducted using SPSS 14.0 for Windows, Release 14.0.0 (5 Sep 2005).

4.2 Limitations

Results were collected from 43 respondents; 15 creators and 28 consumers. There are naturally fewer creators than consumers, and the sample for the creator group was a limitation on the comparability of the creators' results with the consumers' results. There was less likelihood of a statistically significant difference being detected due to the small sample size. This is balanced to some extent by the fact that many of the creators were well qualified to answer the creator items. Many of the executives that responded to the items are senior people within their firms and are representative of the target population. The quality of the respondents may balance the limited time available and necessarily few items.

There was an error in the web-based questionnaire such that no results at all were received from consumers to the item "When accessing product information what % of the time do you use a paper document versus using a computer?" Fortunately that item was

not crucial to the study so that it was eliminated completely for both consumer and creator responses.

There were some differences in the items on the same topic because of the two different groups being addressed. The creators would answer the items from the point of view of a designer and their objectives would include designing a web site within a limited time and cost. The users have a different perspective and their objectives would be to have the best site possible regardless of cost considerations. The semantic differential method of collecting responses to items was used so that the possibility of different interpretations of the meaning of the items was minimised. Also, the wording on the semantic differential scale and the examples used were the same for both creators and consumers.

4.3 Audience Items

The audience is the group that will be using the web site and consuming the information. The intent of the audience items is to measure perceptions of computer literacy and motivation.

4.3.1 Computer Literacy - Item 1

Both creators and consumers gave a high rating for computer literacy. There is a statistically significant difference, $t(41) = -2.08$, $p = .04$ between the perception of the creators and the consumers. The consumers rated their computer literacy higher.

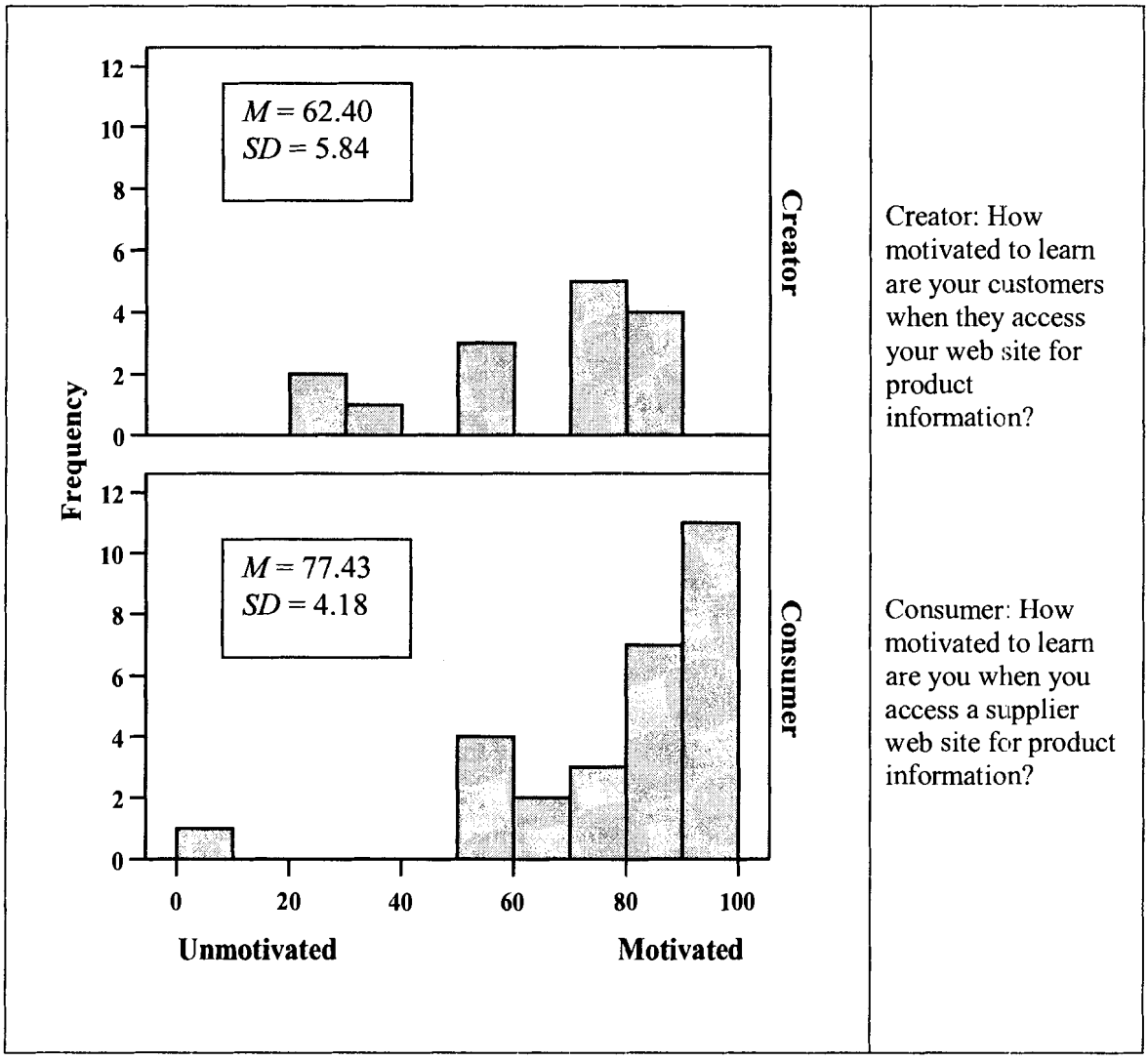

Figure 4-1 Perception of computer literacy of web site users.

4.3.2 Motivation to Learn - Item 2

Consumers gave themselves a high rating for how motivated they are to learn (M = 77.43). The web site creators ranked their audience's motivation to learn quite high (M = 62.40) but lower than the consumers rated themselves and there was a significant difference in perception between creators and consumers, t (41) = -2.11, p = .04.

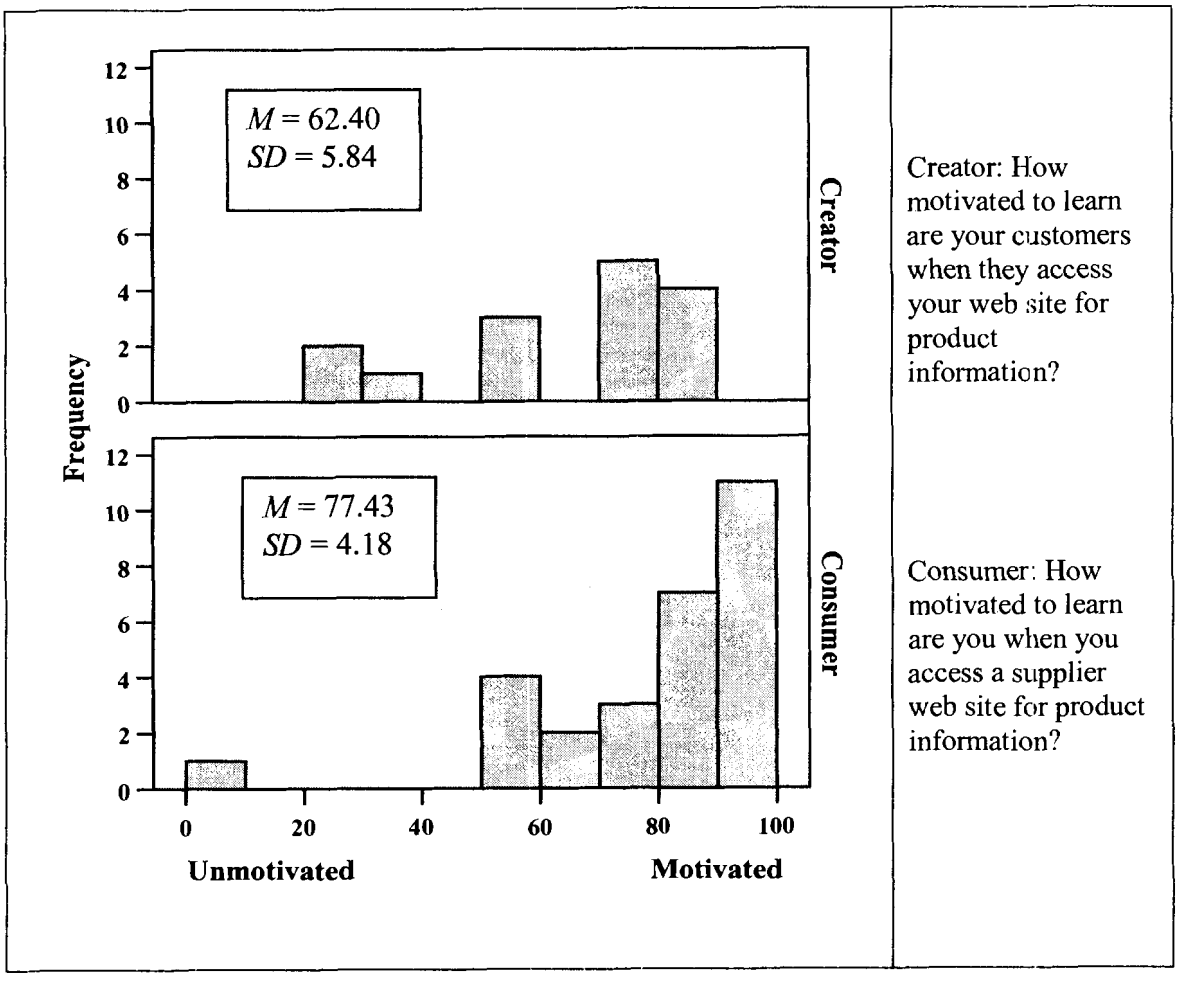

Figure 4-2 Motivation to Learn.

4.3.3 Quick Reference versus Learning - Item 3

Both creators and consumers thought customers were more interested in quick reference than learning when accessing web sites. The consumers seemed to lean more towards learning than the creators but the t-test result t (41) = -1.66, p = .11, indicate that the difference was not statistically detectable for this sample.

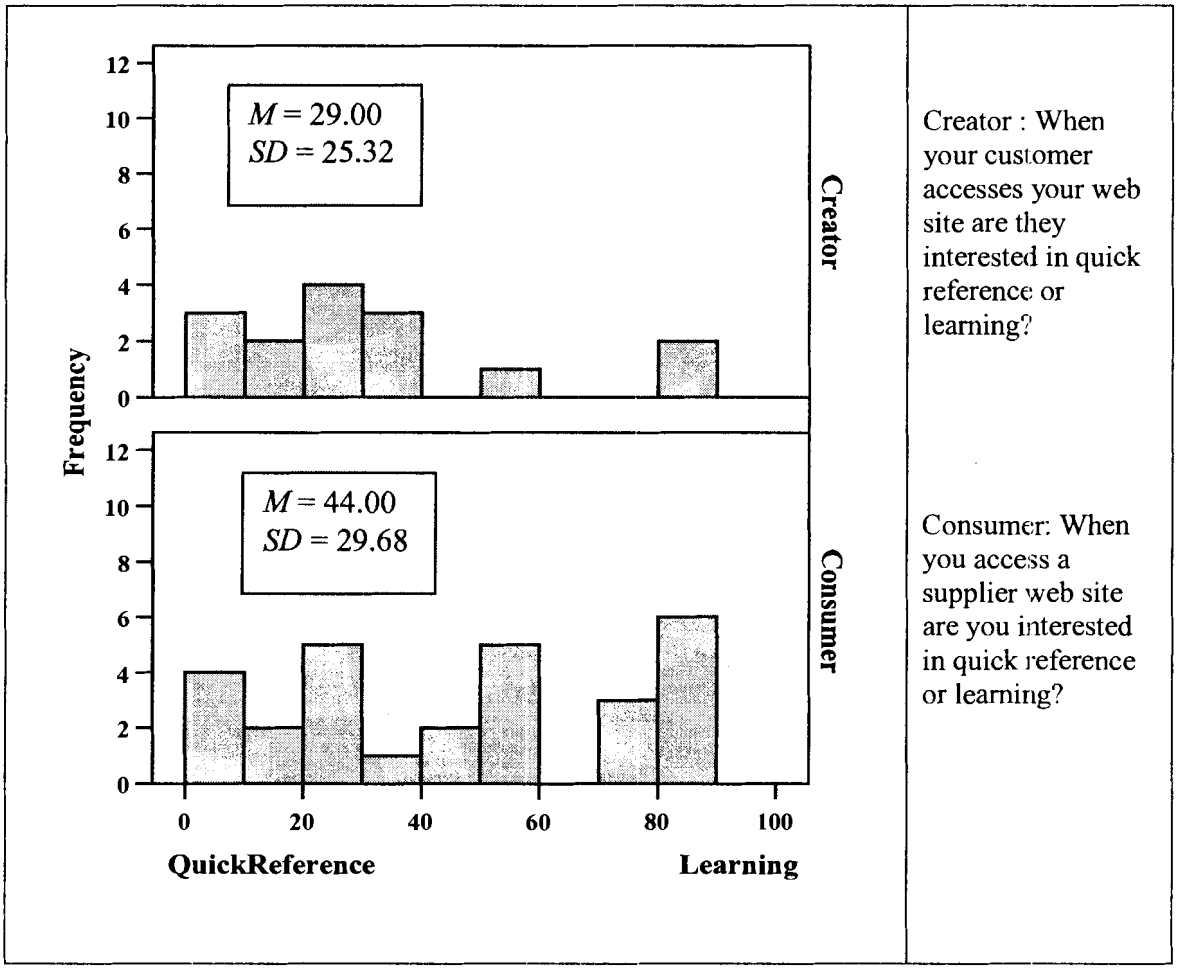

Figure 4-3 Quick Reference versus Learning.

4.4 Content Items

4.4.1 Real versus Abstract - Item 8

Creators and consumers were both more interested in real content on web sites. There was a wide range of responses and the difference of 8 in the means was not statistically detectable t (40) = -1.12, p = .27.

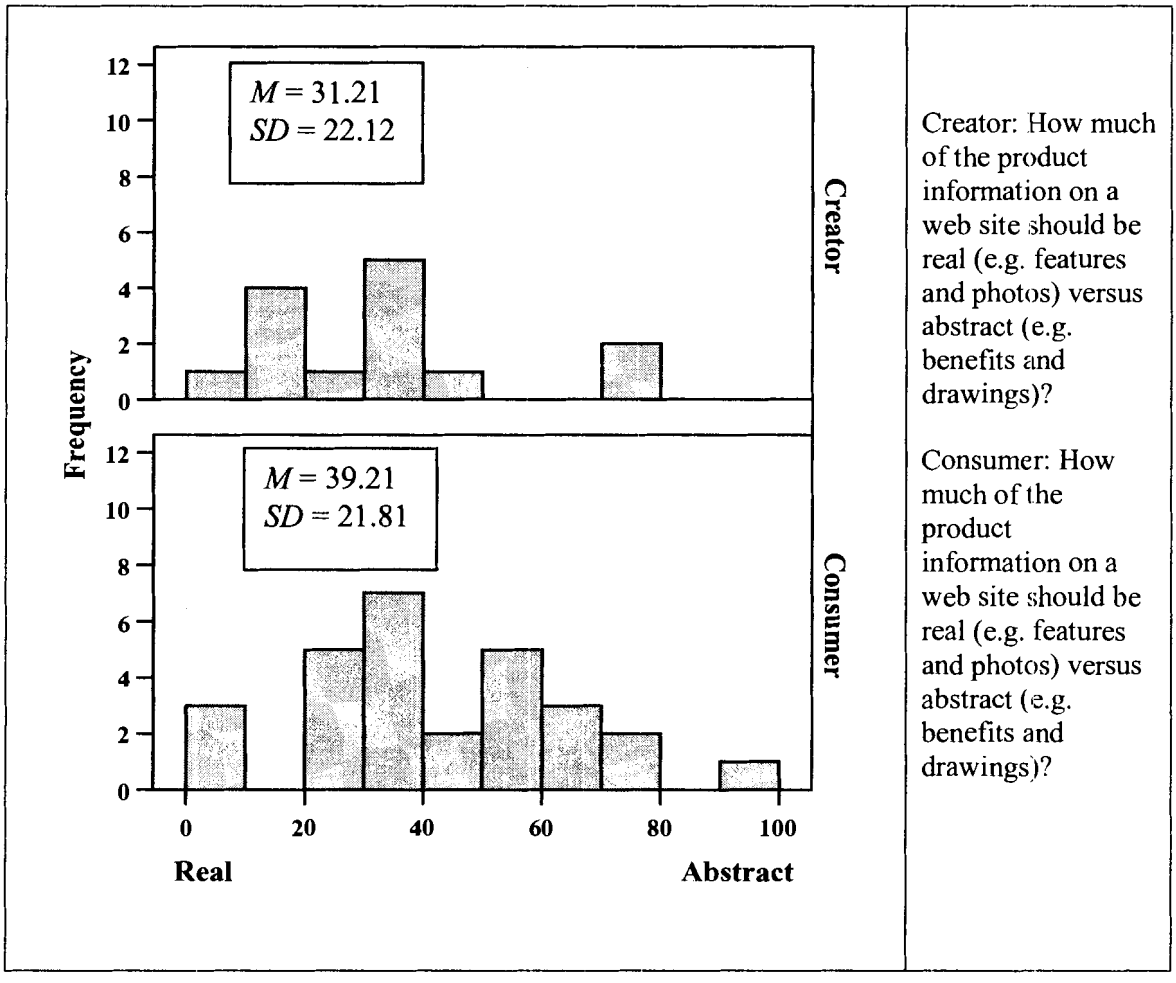

Figure 4-4 Real versus Abstract.

4.4.2 Description versus Application - Item 9

Both creators and consumers preferred a higher proportion of applications, examples and problem solutions than straight description on a product information web site. The difference between creators and consumers was not statistically detectable t (40) = .41, p = .69. Both creators and consumers prefer applications information.

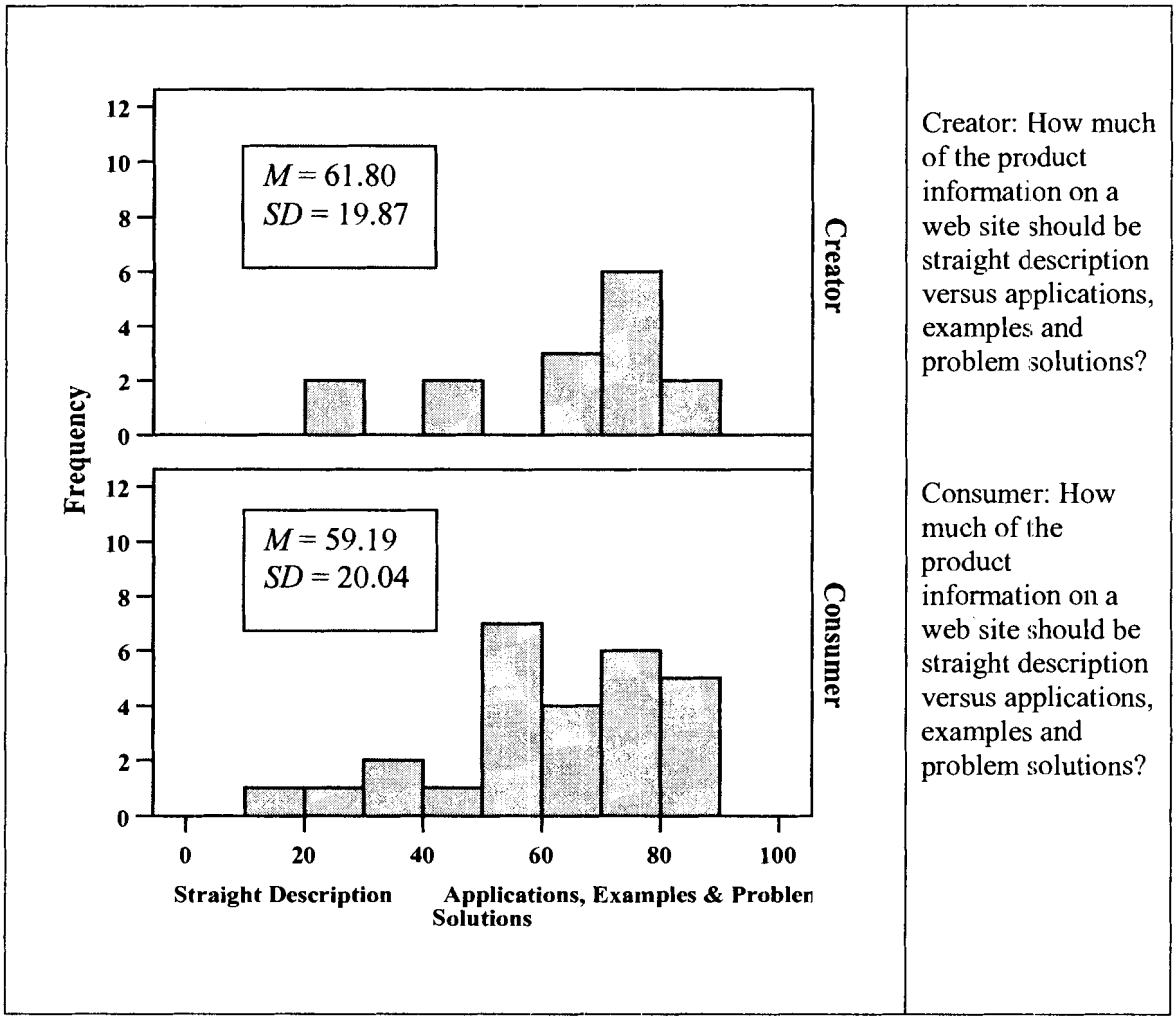

Figure 4-5 Descriptions versus Applications.

4.4.3 Facts versus Education - Item 10

The average preference for both creators and consumers was for an equal amount of straight factual reference versus educating and explaining. There was no statistically detectable difference between the groups t (37) = -.11, p = .91. The creators and consumers both had a wide range of responses on this item.

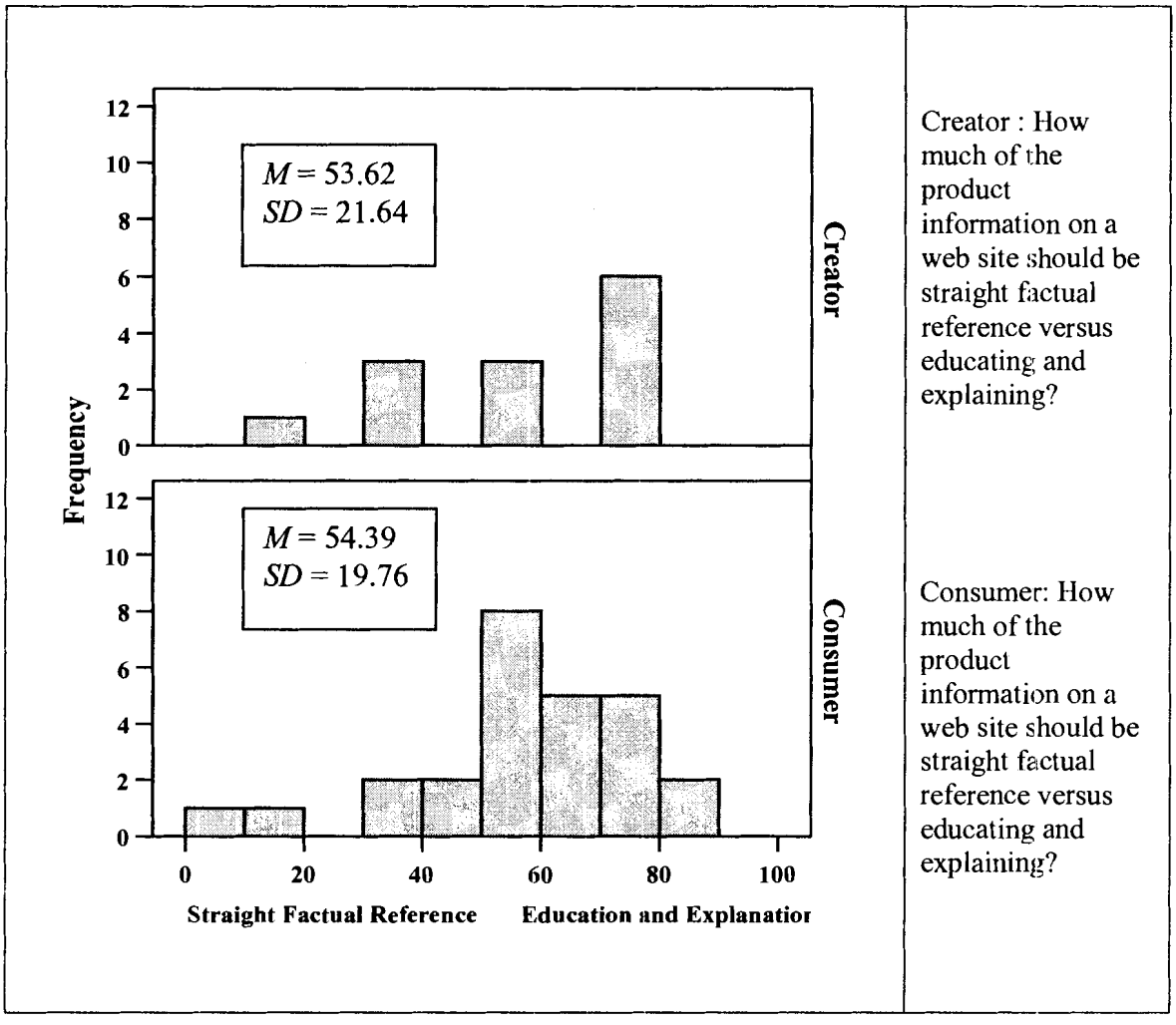

Figure 4-6 Facts versus Education.

4.4.4 Interactivity - Item 11

The average preference for the product information on web sites to be interactive by asking and answering questions was 37% and 38%. There was a wide range of responses from both groups and there was no statistically detectable difference between the groups t (40) = -.21, p = .84.

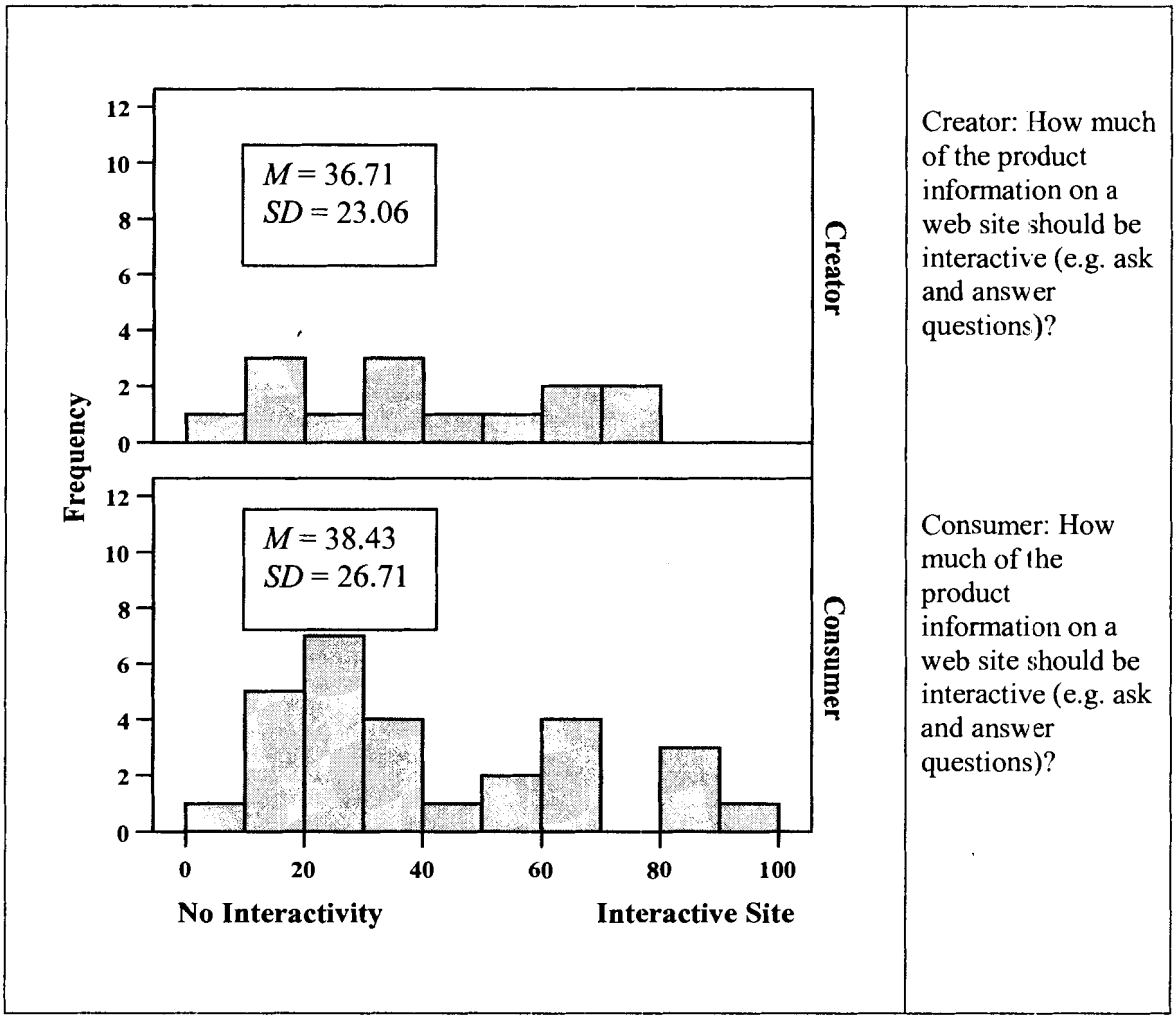

Figure 4-7 Interactivity.

4.4.5 Adaptivity - Item 12

On average creators had a 52% preference for a web site to be adaptive by providing more or less complex information depending on user answers to questions. Consumers had a slightly higher preference for adaptivity, however, there was no statistically detectable difference between the groups t (40) = -.66, p = .51. There was a wide range of responses from both groups.

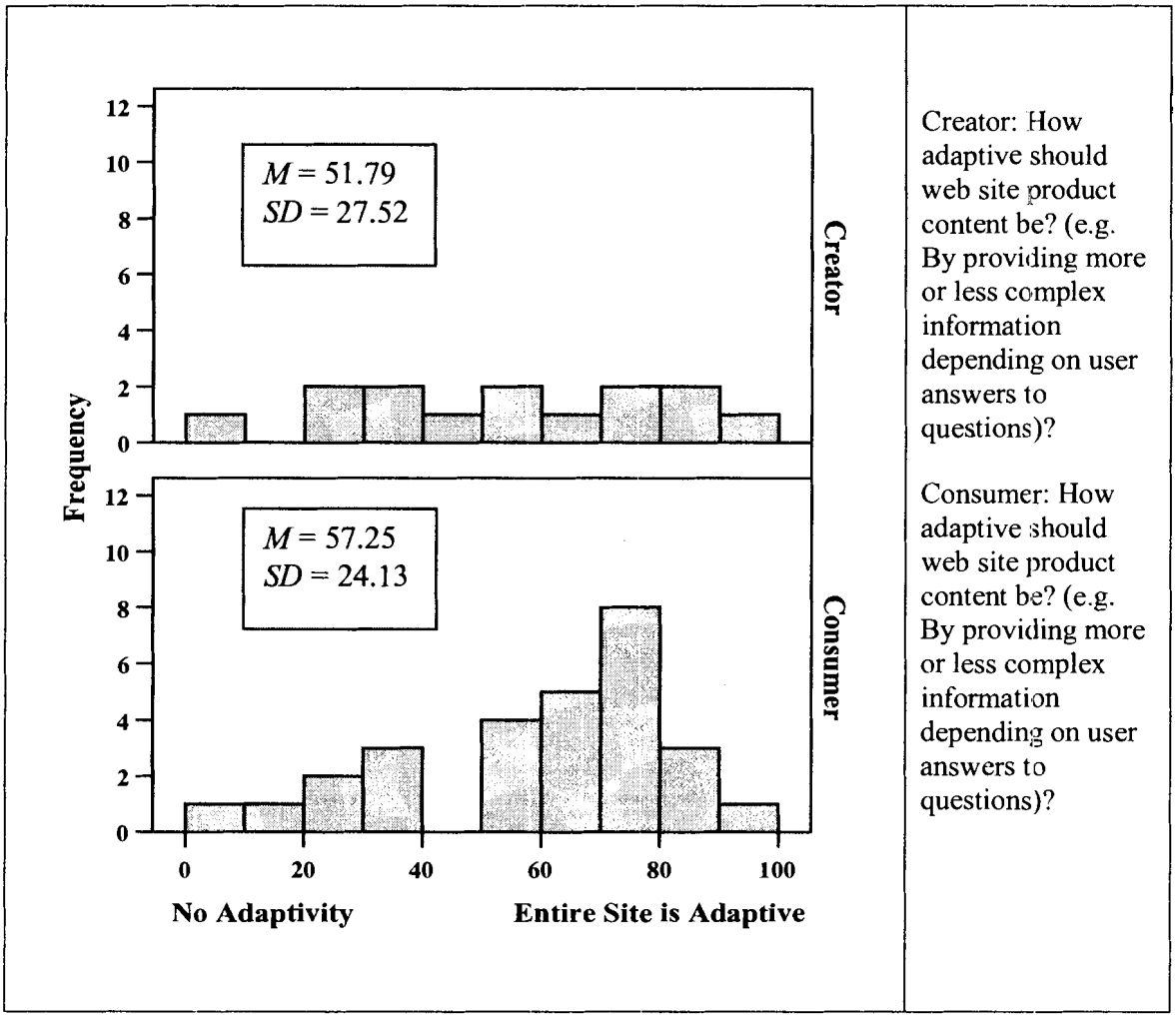

Figure 4-8 Adaptivity.

4.5 Delivery Items

4.5.1 Look-up versus Performance Support - Item 13

The preference for a look-up literature web site versus performance support (e.g. assist customers with problem solving) results ranged over the full spectrum. There was an even balance overall with both consumers and creators having means that fell in the middle of the scale. There was no statistically detectable difference between the groups t (40) = -.30, p = .77

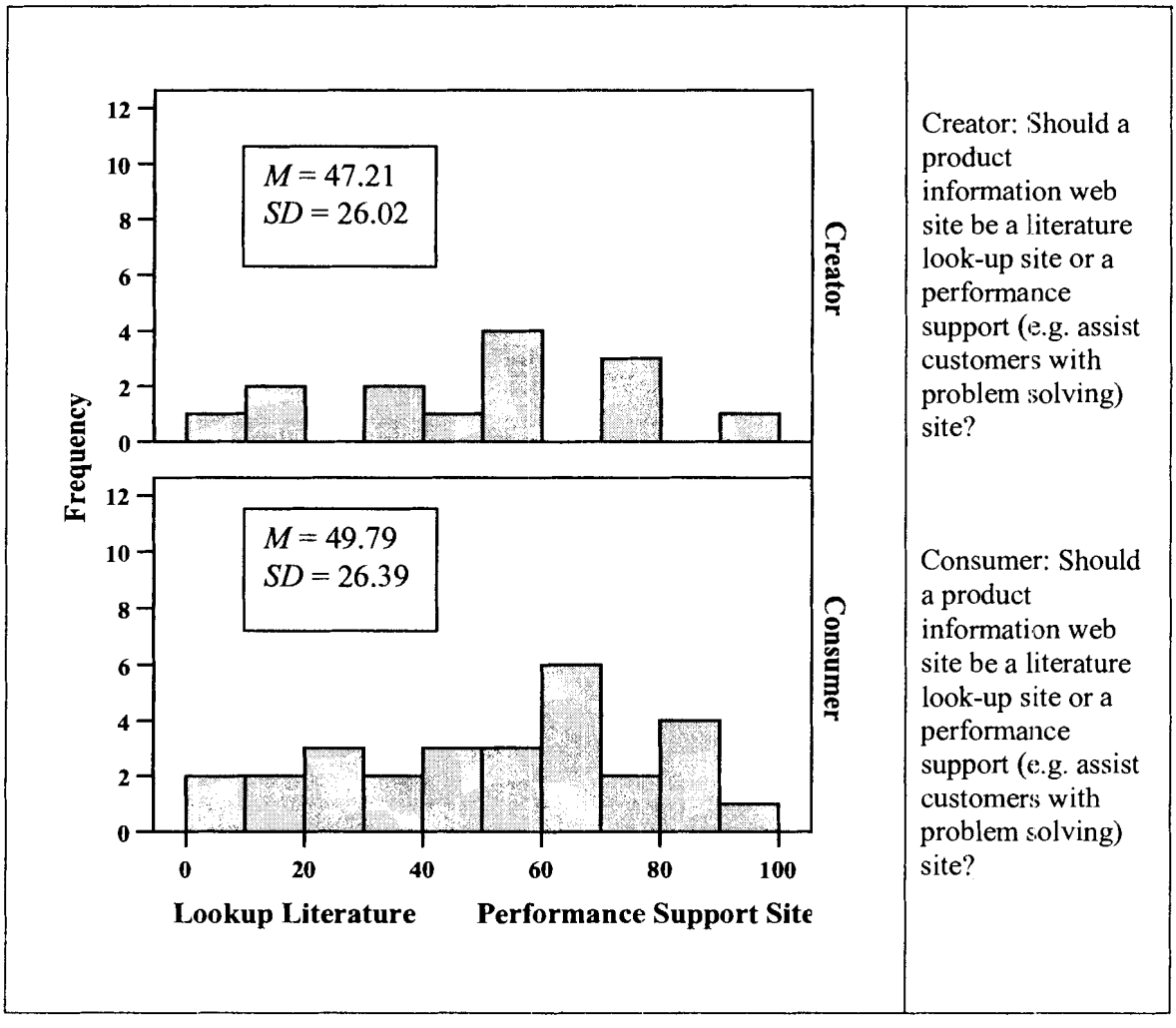

Figure 4-9 Look-up versus Performance Support.

4.5.2 Just the Facts or Stories - Item 14

The purpose of this item was to test receptivity to the idea that stories allow learners context and improve retention. Both creators and consumers showed a preference for facts rather than stories although there was a wide range of opinion from both groups. There was no statistically detectable difference between the groups $t(41) = .15$, $p = .89$.

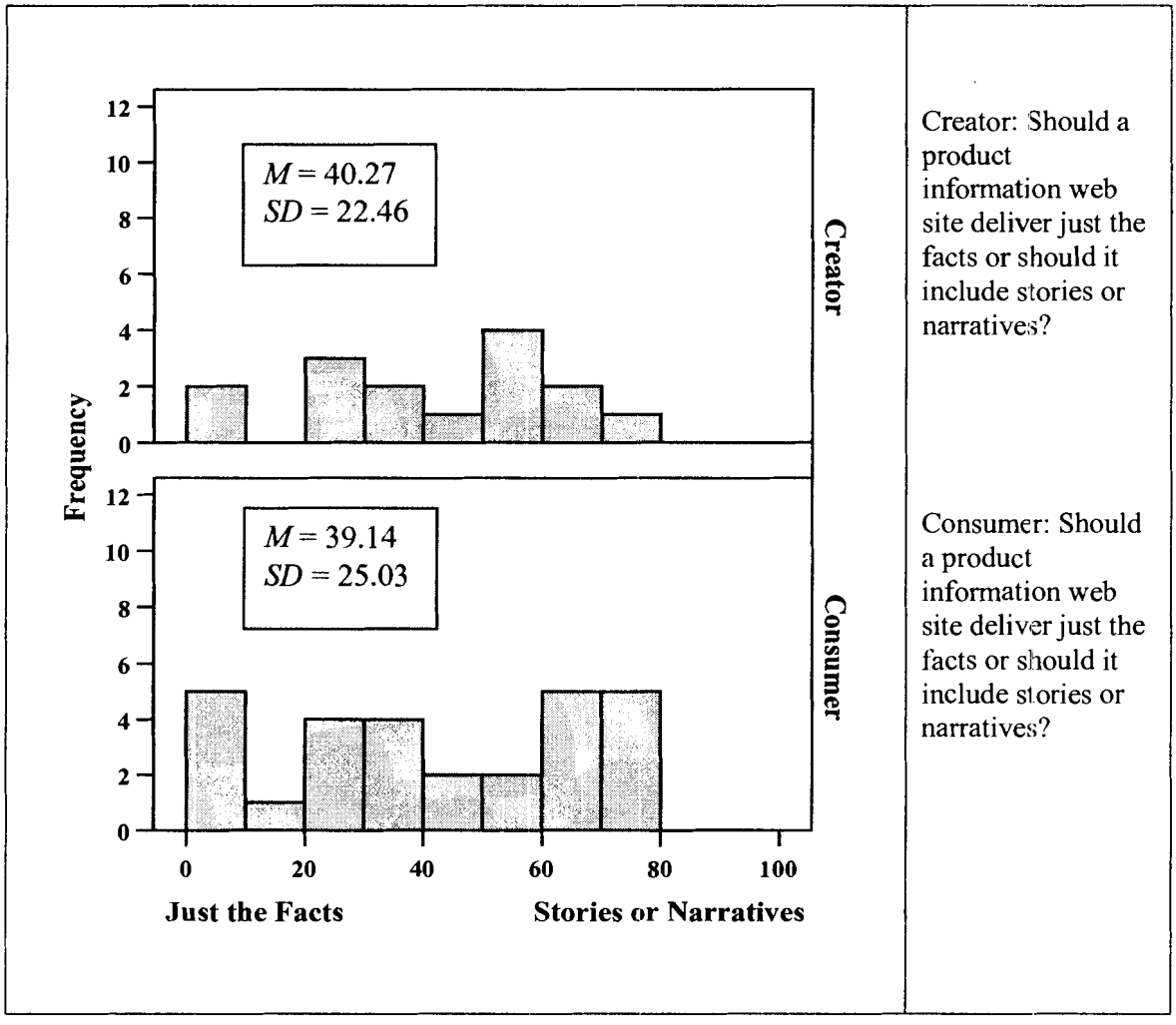

Figure 4-10 Just the Facts or Stories.

4.5.3 Collaboration - Item 15

The collaboration item that asked whether a web site should include chats or bulletin boards split the respondents. The histogram shows creators with no responses at all between 30 and 60 and all other responses clustered at the ends of the spectrum. Consumers had only one response between 40 and 60 and all other responses clustered at either end. There was no statistically detectable difference between the groups t (41) = -.14, p = .89.

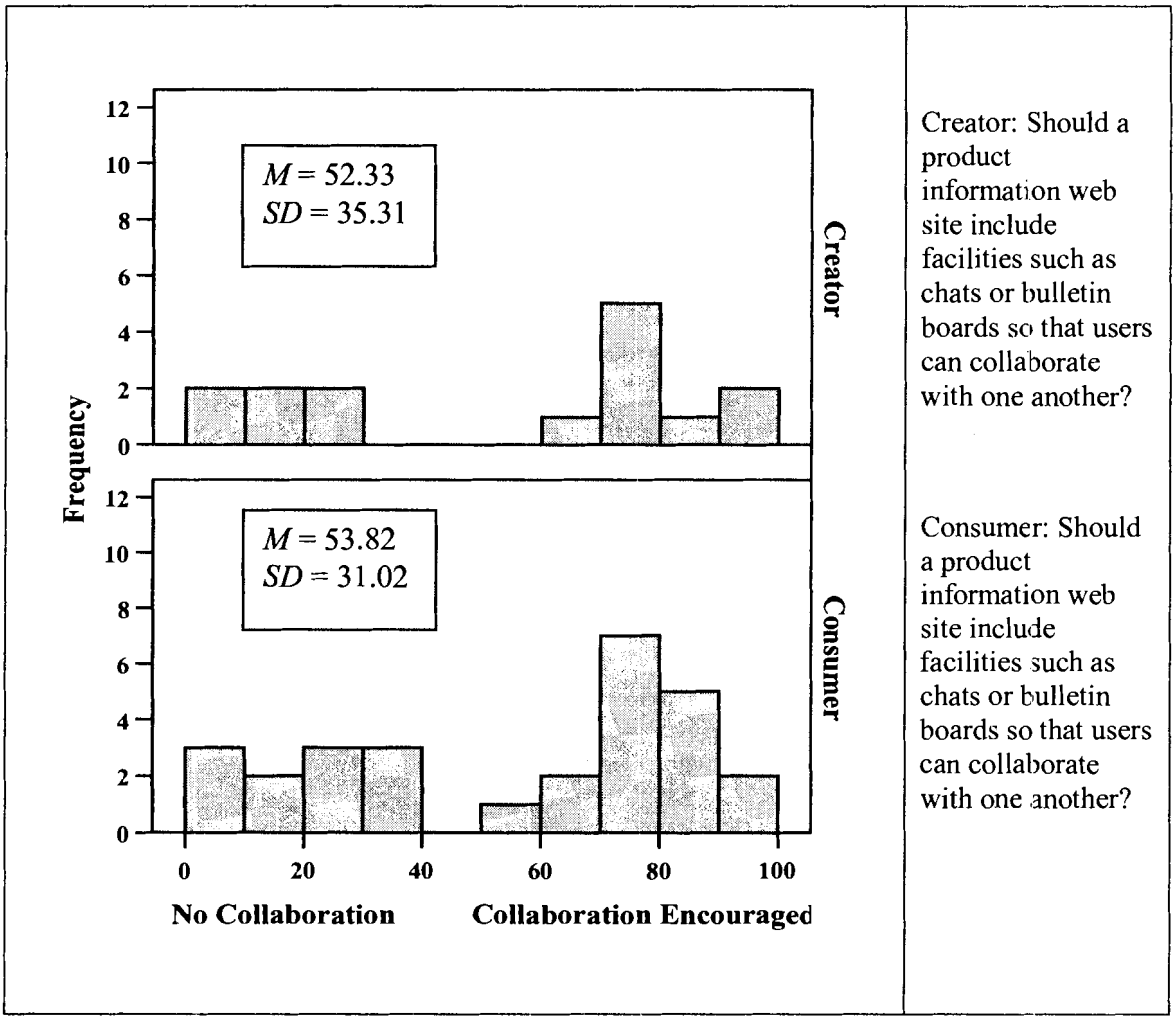

Figure 4-11 Collaboration.

4.5.4 Reference versus Training - Item 16

Both creators and consumers leaned more towards reference when asked how much a product information site should be a reference site versus a training site. Responses were over a wide range and there was no statistically detectable difference between the groups t (40) = .31, p = .76.

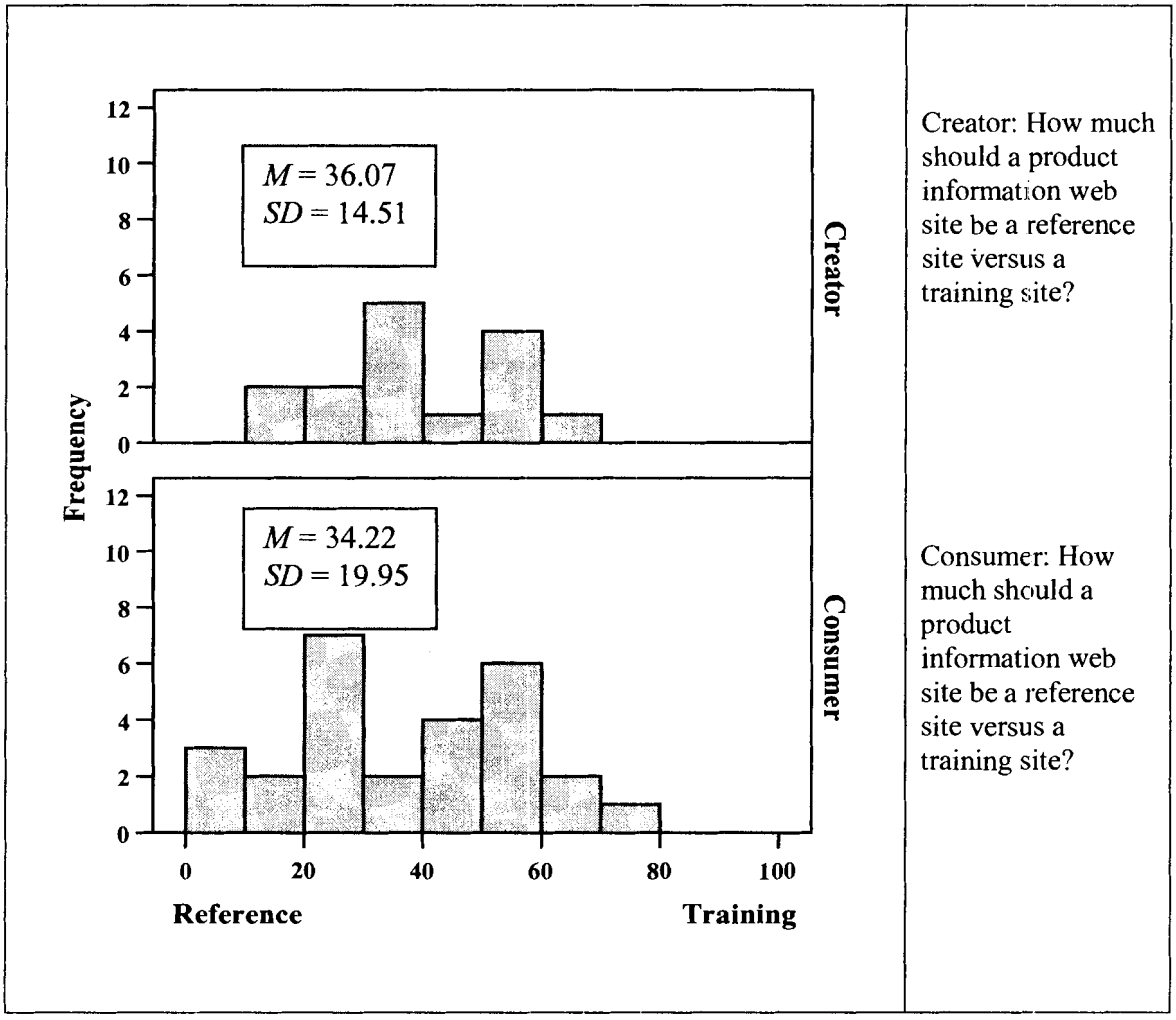

Figure 4-12 Reference versus Training.

4.6 Correlations between Items

Exploratory correlations between the questionnaire items were calculated and are shown in Table 4-1. The possible reasons for the correlations will be pursued in the discussion section.

Table 4-1 Pearson Correlations Between Questionnaire Items

Items	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Computer Literacy	.26	-.08	.04	.07	.19	.14	.21	-.10	-.22	.25	-.08	.26	-.15	.08	-.08
2 Motivated to Learn		.37*	-.22	-.19	-.01	-.15	-.06	-.12	-.21	.21	-.15	.05	-.08	-.10	.16
3 Quick Reference or Learning			.31*	.03	.04	.01	.00	.26	.22	-.13	-.01	-.12	.11	.05	.36*
4 Text vs. Graphics				.38*	.25	.09	.01	.27	.22	.17	.17	-.09	.08	.18	.26
5 BW vs. Colour					.38*	.12	-.40**	.31	.27	.10	.27	.02	.19	.31*	.23
6 Static vs. Animated						.75*	-.02	.40*	.49**	.34*	.22	.21	.00	.17	.17
7 Audio							.25	.22	.17	.21	.31*	.07	-.11	.27	.04
8 Real vs. Abstract								-.19	-.09	-.02	-.14	.06	-.14	.03	-.11
9 Descriptions vs. Applications									.60**	.35*	.39*	.04	.07	.41**	.52**
10 Fact vs. Explanation										.10	.20	.20	.29	.14	.16
11 Interactivity											.36*	.22	-.08	.24	.34*
12 Adaptivity												-.26	.27	.54**	.20
13 Lookup vs. EPS													-.08	-.01	.12
14 Facts vs. Stories														.30	.12
15 Chats															.42*
16 Reference vs. Training															

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

The descriptions versus applications item had the largest number of significant correlations with other items. It was positively correlated with the six items on animation, explanation, interactivity, adaptivity, collaboration and training.

The animation item had the second largest number of significant correlations with other items. It was positively correlated with the five items on colour, audio, application, explanation and interactivity.

The items on colour, interactivity, collaboration and training were each correlated with four other items.

5 DISCUSSION

Many B2B web sites rely on documents that were originally designed to be printed to display product information. The intent of this study was to explore methods of improving B2B product information web sites by employing learning theory and instructional design concepts that would make better use of computer capabilities and the internet. Many of the web site design concepts such as interactivity, adaptive content and collaborative tools that were derived from learning theory and instructional design had sufficient support to suggest they should be implemented in B2B sites. At the same time consideration needs to be given to factors such as timeliness and job situations that have particular importance to business customers.

5.1 Web Sites for B2B Customers

The users and creators of web sites had different audience perceptions but their preferences for content were similar. Their content presentation and interactivity preferences lead to suggestions for B2B web site design that are informed by learning theory and instructional design. A customer who visits a B2B web site to acquire product information will almost certainly learn incidentally and is ready for informal learning opportunities.

5.1.1 Web Site Creators

The second research item was whether creators and consumers of web sites have different perceptions of what web site audiences are like and what is desirable content. In

general, creators think that their audience is less computer literate and motivated to learn than the audience perceives themselves to be. For a truly valid measure of computer literacy, it would be necessary to test computer capabilities of the audience with an objective computer literacy test. However, the point of this item was to see if creators of web sites might hold back from using advanced technology because they feel their audience may not appreciate or be able to use it. Similar to the computer literacy item, web site creators do not think that their customers are as motivated to learn as the customers think they are. Web site creators will have to be careful not to make the mistake of underestimating their audience.

There was no significant difference between the means of the answers given by creators and consumers on any of the content items. There was a wide spread in the answers to most of the items which means that there are no established norms or standard forms for B2B product information web sites and a wide variety of opinions as to what should be included, but overall there was remarkable similarity between consumer and creator response to content. There is less likelihood of web site creators having problems gaining user acceptance because they both have similar content preferences.

5.1.2 B2B Customers

The audience items deal with whether consumers and creators of B2B product information web sites perceive web site users as computer literate, motivated to learn and having a learning interest rather than a quick reference interest when visiting the web site. These are crucial questions to the pragmatic proponent of customers as learners because web sites will be designed to service customer needs and desires. If there is a perceived demand for learning, web site designers will be more willing to incorporate multimedia,

adaptivity, interactivity and collaboration informed by learning theory and instructional design concepts into their web sites.

The audience section of the questionnaire asked directly about learning motivation and the learning versus reference objectives of web site users. Both web site creators and consumers perceive the audience as motivated to learn. However the responses to the next item indicate that both web site creators and consumers think that the audience is more interested in quick reference than learning when they visit a product information web site. The results indicate that there is a subtle distinction between a general motivation to learn and what is of most interest when a user accesses a supplier web site. The users are perceived as motivated to learn, but when the comparison is between quick reference and learning, quick reference carries more weight. It must be noted that the responses to the quick reference versus learning item were spread over the response scale, however on average when the time factor was introduced by using the modifier quick to describe reference, both creators and consumers thought customers were more interested in quick reference than learning when accessing web sites. This result, immediately after the learning motivation item, indicates a general acceptance of a learning motivation and how crucial time is. The first and more general item indicates that customers are perceived as motivated to learn while the second and more specific item highlights the fact that they often do not have much time to learn.

The importance of time is consistent with the impetus for just-in-time learning. Often the reason for reference activity having to be quick is that the customer has a problem or question that needs to be solved or answered without delay. A constructivist approach that emphasizes real problems and solutions would be useful to busy web site

users trying to access and understand complex products if pertinent answers are provided quickly enough.

One quick way to answer a question is to ask a co-worker, collaborator or expert who might know the answer, and thereby obviate the need to wade through a reference web site. This collaboration alternative is explored in the web site presentation section.

5.1.3 Web Site Presentation

The results show that there is a wide range of opinions held both by creators and consumers but on average both creators and consumers wanted a balance of text and graphics. This suggests a preference for more graphics than are typically provided in printed product technical information, but this may be because web sites tend to present more graphics than the industry's print communications. The black and white versus colour result indicated a preference for colour. Similar to the text versus graphics item, this could be attributed to the fact that web sites tend to show more colour than printed material. Once again there was a wide range of responses. There is a history of post-purchase product information being printed inexpensively on newsprint in black and white. The difference between what some consumers have come to expect on web sites versus the printed documents that have typically been offered in the past may explain the wide range of responses to the presentation items. It is possible that some respondents were reflecting the utilitarian view that nothing fancy has been required in the past and shouldn't be required in future. Others may have responded more to the "should be" aspect of the item and favoured graphics and colour in their product information.

The animation item was also a "should be" item but on average animation scored much lower than colour and graphics. This may be due to the fact that an animation takes time to watch and busy users may not feel they have the time to do so. This result taken in conjunction with the graphics preferences indicates to meet user preferences a B2B web site should be in large part graphical, and many of the graphics should be animated.

The audio preference item was intended to measure the desire for the web site to be able to be heard as well as seen. The result indicates that both consumers and creators think that a portion of a product information web site should have audio information. In my experience, this is much higher than B2B product information web sites are now. There was a strong correlation with desire for animation, and a weaker correlation with a desire for adaptivity. The results show that those respondents with a desire for multimedia such as audio and animation also may prefer a web site that can adapt to their information needs.

The item regarding real versus abstract asked whether web sites should have features and photos versus benefits and drawings. A feature of a product is an attribute such as a steel housing while a benefit is what the customer may derive from that feature such as assurance that the product will withstand impact. Photos are usually considered inherently more real than drawings or illustrations. Situated learning emphasizes real learning environments and the underlying intent was to measure whether users and creators of B2B web sites prefer real product features and photos versus more abstract benefits and drawings. The mean from all respondents indicate a preference for real rather than abstract information. Web site creators should concentrate on presenting real

examples and situations that users can relate to when highlighting product features rather than abstract and stylized advertising.

The descriptions versus applications item indicated a preference for applications, examples and problem solutions rather than product description. Understanding product applications requires a knowledge of how the product works and how it fits into a system, whereas descriptions simply describe a product's attributes without reference to how and where the product is used. The preference for applications information is evidence of a motivation to learn. A person interested in learning about a product would want to understand how the product was used and applied, what some examples of its application are and how it could be used to solve problems. This item had the highest number of significant correlations with other items. Desire for application information correlated strongly with desire for explanation, desire for training, desire for collaboration, animation, adaptivity and interactivity. These factors might indicate a person interested in learning but, despite the strong correlation with desire for training, correlations with motivation to learn and learning objective in visiting a web site were not detected. It is possible that there are creators and customers that relate to and prefer a full featured web site that incorporates many of the things noted above that make it capable of providing learning without being consciously committing to learning.

The item regarding whether a web site should include stories or narratives, alludes to some of Roger Shank's theories about retention of information learned through narratives. Respondents preferred facts to stories and there was no significant correlation with any other items.

There was a slight overall preference for education and explanation versus factual reference and a correlation between this preference and applications and with animation. The education and explanation item was intended to relate to learning motivation. However, it did not correlate significantly. It is possible that this item suffered from a bias introduced by the terms used in the semantic differential question. The preference for education and explanation could have been taken as indicative of a lack of knowledge or perhaps even to imply that the user needs help to understand. Most product information web sites have very little explanation, perhaps for fear of talking down to their customers or cluttering their web site. More explanation could be supplied without cluttering the web site by using links to descriptions and further detail or having users set their preferences for level of explanation and detail. Web site designers must be especially careful with the terminology within questions on adaptive web sites designed to determine knowledge levels not to use terms to which users would ascribe negative connotations such as amateur. Ideally the web site should determine a user's knowledge level or capability automatically without the user having to volunteer the information.

The item which asked how much a product information web site should be a reference site versus a training site may have been biased by a negative reaction to the word training either based on negative connotations about the need to be trained or possibly the time training takes. Average responses from both creators and consumers indicated that a product information web site should be a reference site. However, the item correlated positively with the items on quick reference versus learning, applications, interactivity and collaboration. Web site designers will have to be aware that if they build

learning tools into their web sites that the sites should not be perceived as training sites, but rather as product reference sites with advanced capabilities.

5.1.4 Web Site Interactivity

Most respondents believed that some proportion of product information on B2B web sites should be interactively presented. The example given for interactivity was to ask and answer questions and there was no clear preference for all product information to be interactive or for none of it to be interactive. Considering the importance of time to business people and the fact that some may consider answering questions to be time consuming and unproductive, this is probably no surprise. It does however pose a problem for web site designers trying to make sites adaptive to the user. How can they determine a user's skill level or knowledge without having them stop to answer a question? Ideally the web site should assess a user's competence automatically. It may be necessary for specialized software to monitor the areas on a web site that a user visits to assess their competence. Software used for researching self-regulated learning automatically tracks a student as they study (Winne et al., 2006). Similar software could track a user as they interact with a web site to determine their competence level. The web site could then be adaptive to a customer's skill level without having to ask the customer knowledge assessing questions.

On average there was a slight preference for adaptivity by providing more or less complex information depending on user answers to questions. This result may also have been biased by the "too busy to answer questions" factor noted above. If the web site adapted automatically to the user, adaptivity might be better appreciated. Adaptivity was

positively correlated with interactivity. Those in favour of adaptivity also tended to favour interactivity.

The histogram of the literature look-up versus performance support (e.g. assist customers with problem solving) item shows almost an equal number of responses right across the entire spectrum of answers. Electronic performance support (EPS) was a difficult concept to get across in a one line item, even with the explanatory "assist with problem solving." The overall mean result was right in the middle and there was no difference between creators and consumers. The intent was to determine if users prefer performance support so that they could be assisted with their problems and there was enough positive response that web site designers should probably include problem solving assistance on their sites. EPS should be user selectable so that users who are not interested can bypass it.

The collaboration item that asked about the use of chats and bulletin boards was intended to discern a desire to communicate with other users and be part of a community of practice. A look at the histogram reveals the responses were split with few in the centre and most to either end of the spectrum. There seem to be two groups of respondents, those in favour and those against collaboration. It is interesting that the creators were split on collaboration as well as the users. From a corporate point of view, sometimes companies want to completely control the message to customers and might not be interested in providing a forum for customer complaints. However, the creators had a similar split and a similar mean result to the consumers. Web site designers should take into account that there is a large group of users, about half, who would like collaboration facilities.

5.1.5 Web Site Design

Organizational learning literature, learning theory and contemporary instructional design research findings suggest a number of ways that B2B web sites could be designed to improve communication with and among customers. These design ideas taken in conjunction with the results from the research questionnaire can provide some direction to designers of B2B product information web sites. The results suggest that web sites should be time sensitive, interactive and adaptive, and should foster collaboration. They should use multimedia to assist learning and must take account of a customer's situation. Some design considerations and the associated learning and instructional design theories and principles are suggested under each of these topics below.

Quick Learning

An interesting contradiction in the questionnaire results was the difference between the high learning motivation response and the preference for quick reference over learning in the following item. These results taken together with references in e-learning and training trade literature on just-in-time learning, time-critical programs and the suggestion (Sutton, 2005) that the most effective approach to corporate e-learning is to deliver it in 10 to 12 minute chunks indicate the importance of time in a business context. Our first guideline should be to design sites that allow access to short, focused learning opportunities. Learning should be delivered in small bites as quick learning.

B2B product information web sites are not intended as formal e-learning sites with a course management system designed for foundational learning. Learning will be more informal and sometimes even incidental to the primary objective that the user has when they come to the site. A customer may just want a specific bit of information about

a product that they are quite familiar with but they need that bit of information to do a calculation or to answer a question. A key difference to a customer in a business environment between formal, and informal or incidental learning is time availability. There is usually no specific time set aside for informal learning, and incidental learning happens while a person is engaged in another primary task. A web site user's openness to informal learning depends on the primary task or problem that they are engaged with. If they happen upon an interesting learning opportunity while in search of the information they need for the primary task, they have to take into account the overall urgency level of the primary task and evaluate whether it is worthwhile to pursue the learning opportunity. Despite the lack of external facilitation and organization it is possible to encourage and enhance incidental and informal learning. Whether individuals decide to engage in learning while they are at the web site may depend on the urgency level of the problem at hand, whether they are motivated to learn and whether they see something that interests them. The informal and incidental learning model proposed by Marsick and Watkins (2001) suggest that critical reflection, stimulation of proactivity and encouraging creativity can enhance this type of learning. Web designers could encourage informal learning by provide facilities that automatically keep track of the documents and learning objects users have accessed. When a user returns to the site, they would be greeted by name and an unobtrusive window showing their personal log. The log would summarize what they have accessed and how long they have been on various parts of the site. This could be the basis for a measurement of expertise level which could also tie in with site adaptivity.

Any lessons, examples or explanations must be succinct. Site navigation must be as simple, intuitive and quick as possible. The use of highlighted links to more detailed explanations and examples will keep a web site uncluttered. The need for multimedia must be balanced with time to load large audio, video or graphic files. As speed of customer internet communication increases, the time to load consideration will be less relevant but it is still important to recognize that a customer is at the web site to do a job and access information, not to be entertained. Audio, video, graphics and any other presentations must efficiently deliver information. If customers do not think that the information delivered was worth the wait, they will be unsatisfied and leave the site.

Customers who can easily search for and access text information will want to be able to do the same with multimedia audio and video. Multimedia files need useful search terms and should be accessible from the same search tools used to locate text-based documents. Learning object standards can help define how to code product information including documents, spreadsheets, multimedia, slide presentations and other files for optimal retrieval.

Research in the fields of cognitive psychology and educational psychology especially as applied to speed of comprehension during e-learning can assist designers of B2B web sites. Dual coding theory (Clark & Pavio, 1991) and cognitive load theory (Sweller, 1988) would be especially helpful in determining how to use multimedia presentations on web sites to quickly present relevant product information to customers. The principle of dual coding theory is that if information is presented visually and verbally at the same time then recall is improved. Cognitive load theory deals with the working memory load that is required depending on how information is organized and

presented. The empirical evidence of the effect of using split-source or integrated instructions and diagrams (Chandler & Sweller, 1991) could be informative to web site designers.

Communication, Interactivity and Adaptive Web Sites

Two of the most frequently used strategies for self-directed training are to ask someone's advice and to use the internet (Peters, 2003). A B2B web site could be an excellent conduit for communication between the customer and the company provided the company has sufficient expert resources to satisfy customer information demand. A web site designer could establish a web based connection from the customer directly to a company sales person or a technical expert to allow them to respond directly to customer inquiries. As an interactive communication tool, video interactive distance learning has been shown to be effective and satisfactory (Guzley, Avanzino, & Bor, 2001). The simple addition of a web-cam, so that users of a B2B site could see the expert that they are dealing with, could improve interactivity. It would also allow the expert to do simple demonstrations and would make communications more real and more personal. As technology improves it should be possible to have two way video communication so that a user with a product problem could show the expert the situation rather than trying to describe it.

It is possible to see the expert and talk by voice over the internet . The problem is having enough experts and having them available when customers need them, especially if the customers are in different time zones from the experts. B2B web sites should be able to provide technical information at a level of complexity suitable to each individual user, when they want it and regardless of the number of users accessing the web site at

any one time. Web site designers need to satisfy product information requirements and answer customer questions as quickly and completely as possible while at the same time not stretching the expert resources available within the company. Possible automated solutions range from frequently asked question searches to artificial intelligence avatars with voice recognition that can answer a customer's question. There could be short video clips of expert opinion or explanation. The primary goal for such methods should be to enable customer communication and collaboration in a time-sensitive fashion.

The item regarding interactivity gave an example of interactivity as ask and answer questions. This was a precursor to the adaptivity item which gave as an example providing more or less complex information depending on user answers to questions. This line of questioning derived from the literature on adaptive learning systems. Users may recognise that a site should adapt to user knowledge levels but they are sensitive to the time it takes to interact with the web site to establish knowledge levels. B2B web sites should adapt to customers but should require minimal customer time to do so. This could be accomplished by having user-selectable complexity levels or by more advanced systems that track user actions and automatically adapt to the user.

Sites could also adapt to type of user by having the user select whether they are designing, installing or maintaining a product. This would determine further appropriate selections and the ranking of presentations. Other web site functions such as frequently asked questions that are pertinent to different users or search engines that take into account user type are relatively simple ways of making a site adaptive to the user. It would be necessary to code the content by type of user, knowledge level or whatever parameter is being used to differentiate users.

CRM systems that contain customer information could be used to make sites automatically adaptive to customers without forcing the user to answer questions. CRM software maintains information on customer organizations which is collected from the company's accounting and invoicing systems such as how long the customer has dealt with the company, what products the customer uses, where they are located and their payment practices. CRM also keeps track of the individuals who are contacts within each company. A contact logging onto the site would be greeted by name and information from the CRM system could be used to make the site adaptive. Over time, with the user's permission, the site could accumulate information about the customer. The advantage that a B2B site has is that business relationships can extend over many years and an investment in intelligent software that can make that relationship more personal will pay off over many years. Software that can monitor a customer's use of product information combines the advantages of feedback without a customer time commitment and collaborative possibilities within the customer organization.

Once the customer begins to feel that the B2B product information web site has transcended mere reference and is beginning to assist with solving problems and assisting with his job by being adaptive, the site has become an intelligently interactive tool. Tools are part of an activity system and a B2B product information web is a communications tool. Studies of workplace learning have shown how important informal learning, workplace culture and communities of practice can be (Owen, 2001). Web designers should take into account some of the socio-cultural factors in activity theory such as collaboration and communities of practice that affect the users of their sites.

Collaboration

A B2B web site can be a conduit for collaboration as well as communication between customers, between the customer and the company, or both. Collaboration can be differentiated from communication in that it implies that the participants are in pursuit of a shared objective. The level of commitment to a shared objective will vary depending on individual circumstance. Initial collaboration on a B2B web site may only consist of a quick bit of advice between customers. Fostering a collaborative community of practice so that users of company products can assist each other may be the quickest way for a customer to get an answer. The company should provide an easy-to-use vehicle for collaboration and should also foster use of the vehicle. The company is an important part of the community of practice and can encourage communication by participating and proposing collaborative practices among their customers. For example, the company could invite key customers to an open collaborative evaluation of company products and ensure that customer questions are answered in a timely fashion by company experts. It is critical to nurture the collaborative process in order to establish a vibrant working community.

The responses to the item about the use of chats or bulletin boards, from both web site creators and customers, were split so that there was a group very much in favour of no collaboration and another group that preferred a web site where collaboration was encouraged. Sociocultural factors are important aspects of learning in constructivist learning theory. Considering that roughly half of the respondents to the questionnaire wanted facilities to collaborate, as a design principle it makes sense to provide a method to be able to do so. Considering that we know that 80% of learning is informal, that customer information needs are often urgent (Weintraub & Martineau, 2002) and that

having enough human experts available at all times to handle peak information demand is expensive, it makes business sense to encourage collaboration among customers. Companies may be loath to facilitate customer collaboration for fear that negative product information such as product quality problems or perceived design flaws would have a natural forum. However, there are many forums where customers will talk to one another anyway. A collaborative forum monitored by and contributed to by the company will improve communication and bring to bear valid information on inevitable product problems. Half-truths and rumours about product problems fuelled by competitors can do much more damage to a product or a company's reputation than an honest and open forum.

B2B web sites often provide lists of URLs for external web sites with good reference information. A better way to assist customers with finding information external to a company's web site would be to use an industry-specific search engine. As learning objects proliferate users will appreciate the time savings inherent in being able to find good learning objects. Learning objects are being developed with domain-specific metadata and a company can show itself to be an industry leader by participating in the creation, definition and evaluation of learning objects. The evaluation process would be an excellent opportunity for a company to foster a community of practice by hosting a collaborative learning object review (Li, Nesbit & Richards, 2006). A company should try to be a good source of information to its customers regardless of the information source. Building a learning object search engine into the company B2B web site would improve external references and collaborating with customers to evaluate learning objects will strengthen the community.

Businesses that want to form partnerships with their customers may use computer supported collaborative work (CSCW) environments to work together on a project. A B2B web site could extend beyond dispensing product information to providing the tools to work collaboratively with a customer. Instructional design for networked learning deals with collaboration in a distributed learning environment which is very similar to CSCW in a work environment (Ganesan, 2002). Working together on a mutually advantageous project or collaborating on a custom product design with software from a B2B web site would establish a true working partnership. It would also allow the supplying company to share specialized application software and bring company experts to bear on the joint project. At the end of the project a co-assessment could provide the company with valuable feedback on customer satisfaction.

Customer Situation

Customers will have different reasons to visit a B2B product information web site. Their situations will be different based on their jobs, the task or problem they face, their urgency levels and other factors including the equipment they are using to access the internet. The challenge for a B2B web site designer is how to present product information in an easy-to-understand fashion for the varied types of users accessing the web site. For purposes of discussion, I will categorize customer users of B2B product information web sites by three basic types that correspond to the product use cycle. The earliest is the design stage when someone such as an engineer or designer is contemplating use of a product. The second is in the installation or production stage when the product is put to use. The final stage is for service, repair or maintenance through a product's usage life. Maintenance people concerned with maintenance tasks need task expertise while a designer is likely more concerned with domain expertise and a production employee may

be interested in either. Elaboration theory (Reigeluth, 1999) suggests different methods for sequencing the presentation of more complex information depending on whether task or domain expertise is required. The engineer interested in conceptual or theoretical information should have broad overview concepts or principles initially followed by more detailed information. The maintenance technician interested in learning a complex task should have a simple version of the task first followed by progressively more difficult iterations until they reach their task goal. The engineers' information may be presented as an overview in text or graphics with text links or cursor-initiated highlighting on a graphic that leads to the more detailed information. A maintenance technician might initially be presented with a simple simulation that gets subsequently more complex. Regardless of the tools used, the important contribution of instructional design is in the sequencing of presentation of complex information to users with different learning needs.

The user's location is a factor with two considerations. The first consideration is location as it applies to time if the users are in different time zones. The second is location as it applies to access to the internet because not all locations have internet access. These factors will affect web site design content and the process of accessing the information on the web site. Just-in-time learning suggests that a customer should get their learning just-in-time or just when they need it. A web site can offer instant access if the customer has access to the internet. Most offices have internet access and newer cellular phones have web access capability. However, mobile accessibility via a cell phone must take into account the size of the screen. If a company expects that a significant number of users such as maintenance personnel will be using cellular phone

size screens, they must design a portion of the site so that it is navigable from a small screen and the information that a user is likely to want must also be scaled to a small screen. A small screen is a limitation, but as more cellular phones have internet access and the capability to show detailed graphics and video, the opportunities to present detailed information increase. A maintenance technician in the field faced with a valve he has never dealt with before could access a knowledge object (Merrill, 1999) that would show component parts, explain functions and simulate trouble shooting the valve. The simulation software could be resident on the server and the cellular phone user would initiate simple commands. The user would be able to access critical information immediately at any time.

Multimedia

Survey respondents showed a preference for real content in colour, with examples, explanation and even animation and audio. The design principle that flows from this should not be to use multimedia as an end in itself but to support the objective of informing customers. Cognitive psychology can help inform web site designers of when and how examples and explanations can be more effective when presented with graphics or animation. Installation or use can be shown by animations that show how parts fit together, how to wire or product uses.

During the design stage an engineer or designer may need foundational or theoretical information that is general in nature. For example, if the product is refrigerant, the user may need to know how a particular product fits within standard classifications of refrigerants or chemical composition. There may be a need for underlying information such as how particular classes of refrigerants must be handled or studies on

environmental impact. Links or search tools for learning objects can serve to give customers access to foundational learning, standards and any information that another entity has authority to produce and will keep current. A company web site should concentrate on providing information on its products only and only author non-company product information if it is not available anywhere else or is not available in a form that the customer using the site can access easily and absorb easily. If the company has subject experts capable of creating valid information and the capability to present it in a new way such as an animation or video then they should consider creating a learning object and publishing it for general use within the industry. If it includes time sensitive information then the company must also be prepared to maintain it on an ongoing basis or be responsible for terminating the learning object. The positive aspect of publishing a learning object for industry use is that it positions the company as an industry leader.

5.2 Research Limitations

The main limitation of this thesis was not having a B2B product information web site to test consumer reaction. It is hard to know exactly how web users will react to a learning/reference web site without having one for them to try out. The questionnaires measured what the respondent, guided by the semantic differential and examples, perceived adaptivity or reality on a web site are. The survey participants responded with their perceptions of what the items asked rather than the specifics of a real site. This study is measuring reaction to a concept rather than a reality.

It is difficult to define the characteristics of a web site informed by instructional design. It is not possible to encapsulate the entire field of instructional design in a few simple questions. However, by measuring a concept, we can at least see if there is

acceptance of multimedia, adaptivity, interactivity and collaboration that would at least indicate an interest in areas that can be informed by learning theory and instructional design.

5.3 Future Research Possibilities

This thesis was intended to be exploratory research to determine if instructional design and learning theory can inform the design of B2B product information web sites. On the basis of the literature research and considering the ongoing need for improvements in communicating product information between businesses it would make sense to do more research in this area. The most obvious step would be to design a learning and reference web site for a company engaged in B2B sales that incorporated instructional design principles and research customer use and effectiveness.

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APPENDICES

Appendix 1 – Questionnaire Items

1. Creators: How computer literate are your customers?
   Consumers: How computer literate are you?
2. Creators: How motivated to learn are your customers when they access your web site for product information?
   Consumer: How motivated to learn are you when you access a supplier web site for product information?
3. Creator: When your customer accesses your web site are they interested in quick reference or learning?
   Consumer: When you access a supplier web site are you interested in quick reference or learning?
4. Creator: How much of the content of the product information on your web site should be text versus graphics?
   Consumer: How much of the product information content on a web site do you prefer to be text versus graphics?
5. Creator: How much of the content of the product information on your web site should be black and white versus colour?
   Consumer: How much of the product information content on a web site do you prefer black and white versus colour?
6. Creator and Consumer. How much of the product information on a web site should be animated? (e.g. video or moving graphics).
7. Creator and Consumer: How much of the product information on a web site should have audio (e.g. music, voice over, recorded information)?
8. Creator and Consumer: How much of the product information on a web site should be real (e.g. features and photos) versus abstract (e.g. benefits and drawings)?
9. Creator and Consumer: How much of the product information on a web site should be straight description versus applications, examples and problem solutions?
10. Creator and Consumer: How much of the product information on a web site should be straight factual reference versus educating and explaining?
11. Creator and Consumer: How much of the product information on a web site should be interactive (e.g. ask and answer questions)?
12. Creator and Consumer: How adaptive should web site product content be? (e.g. By providing more or less complex information depending on user answers to questions)?
13. Creator and Consumer: Should a product information web site be a literature look-up site or a performance support (e.g. assist customers with problem solving) site?
14. Creator and Consumer: Should a product information web site deliver just the facts or should it include stories or narratives?
15. Creator and Consumer: Should a product information web site include facilities such as chats or bulletin boards so that users can collaborate with one another?
16. Creator and Consumer: How much should a product information web site be a reference site versus a training site?

Appendix 2 – Questionnaire Data

Respondents numbered 1 to 28 are users designated U and 29 to 43 are creators designated C. Questionnaire items 1 to 8.

		Computer Literacy	Motivated to Learn	Quick Reference or Learning	Text vs Graphics	B&W vs Colour	Static vs Animated	% Audio	Real vs Abstract
		1	2	3	4	5	6	7	8
1	U	88	81	42	59	55	68	98	38
2	U	80	70	20	70	90	20	10	20
3	U	100	100	15	25	50	26	15	30
4	U	65	80	40	40	60	40	30	50
5	U	90	80	50	65	75	60	50	60
6	U	90	80	80	85	90		60	60
7	U	60	70	35	50	50	10	10	30
8	U	90	95	80	60	90	30	10	60
9	U	59	50	4	70	70	9	40	70
10	U	90	75	90	75	80	65		35
11	U	60	90	70	60	30	10	10	40
12	U	90	100	70	80	100	50	30	22
13	U	80	92	10	68	69	55	45	25
14	U	80	100	50	50	50	25	1	50
15	U	100	64	20	62	76	26	20	70
16	U	85	85	50	25	75	25	25	25
17	U	76	90	51	26	100	10	10	5
18	U	40	90	90	60	30	20	10	20
19	U	60	80	85	40	60	20	58	37
20	U	100	100	24	71		1	1	1
21	U	90	50	25	30	40	10	25	40
22	U	70	50	20	75	65	20	20	50
23	U	70	1	1		100	1	1	1
24	U	70	85	80	60	75	20	10	30
25	U	60	50	75	90	100	65	75	50
26	U	100	100	1	25	100	50	50	50
27	U	85	67	50	50	100	67	75	33
28	U	93	93	4	32	6	4	2	96

		Computer Literacy 1	Motivated to Learn 2	Quick Reference or Learning 3	Text vs Graphics 4	B&W vs Colour 5	Static vs Animated 6	% Audio 7	Real vs Abstract 8
29	C	67	87	39	42	80	15	5	36
30	C	75	20	15	65	50	15	15	75
31	C	75	25	1	35	50	50	100	75
32	C	90	80	30	70	90	10	10	30
33	C	80	50	20	75	100	50	20	15
34	C	50	70	25	40	40	20	20	10
35	C	60	80	80	60	70	5	5	40
36	C	48	78	52	63	79	1	1	36
37	C	72	73	22	67	93	58	20	1
38	C	75	33	1	80	100	50	28	15
39	C	82	78	23	30	75	31	31	34
40	C	81	50	80	75	90	20	20	35
41	C	60	75	10	25	75	50	50	10
42	C	25	50	1	25	100	25	1	25
43	C	87	87	36	5	30	2	3	

Respondents numbered 1 to 28 are users designated U and 29 to 43 are creators designated C. Questionnaire items 9 to 16.

		Descriptions vs Applications	Fact vs Explanation	Interactivity?	Adaptivity?	Look-up vs EPS	Facts vs Stories	Chats?	Reference vs Training
		9	10	11	12	13	14	15	16
1	U	76	62	40	82	35	12	78	17
2	U	30		10	70	25	70	80	30
3	U	85	75	80	80	75	1	80	20
4	U	60	80	20	60	45	50	30	40
5	U	70	60	65	50	45	40	35	45
6	U	60	65	80	85	60	70	80	
7	U	40	55	20	50	25	40	16	11
8	U	80	70	20	30	75	60	80	50
9	U	67	40	60	76	50	1	75	30
10	U	90	85	65	65	60	75	75	65
11	U	70	70	30	70	20	60	75	50
12	U	62	66	27	21	100	1	1	44
13	U	20	34	27	33	67	63	63	22
14	U	50	50	10	1	1	25	1	1
15	U	75	75	20	59	62	60	29	24
16	U	50	50	25	50	80	30	75	50
17	U	50	50	10	25	10	25	10	20
18	U	80	75	30	70	40	35	25	65
19	U	55	51	30	61	60	65	55	20
20	U	78	1	80	76	15	23	80	75
21	U	30	40	10	30	80	30	30	25
22	U	50	50	65	65	80	70	65	50
23	U			1	72	38	76	70	1
24	U	75	30	15	60	60	25	70	40
25	U	80	65	55	75	1	5	100	50
26	U	50	50	100	100	50	50	100	50
27	U	50	50	30	75	50	30	25	25
28	U	15	15	51	12	85	4	4	4

		Descriptions vs Applications	Fact vs Explanation	Interactivity?	Adaptivity?	Look-up vs EPS	Facts vs Stories	Chats?	Reference vs Training
		9	10	11	12	13	14	15	16
29	C	60	35	41	25	32	64	70	39
30	C	45		15		5	35	25	10
31	C	75	50	10	50	50	25	100	50
32	C	40	30	30	60	30	20	60	30
33	C	75	75	50	75	75	20	75	15
34	C	60	70	60	40	40	50	10	20
35	C	70	70	35	30	70	40	90	60
36	C	27	30	1	58	17	37	11	30
37	C	79	78	73	83	51	80	78	43
38	C	75	72	70	1	100	1	1	50
39	C	64		14	32	72	65	85	35
40	C	82	50	30	84	19	59	78	50
41	C	80	50	60	90	50	50	20	30
42	C	75	75	25	75	50	50	75	50
43	C	20	12		22		8	7	29

Appendix 3 – Secondary Results

Text Versus Graphics - Item 4

There was no significant difference between the consumer and creator responses, t (40) = -.78, p = .44.

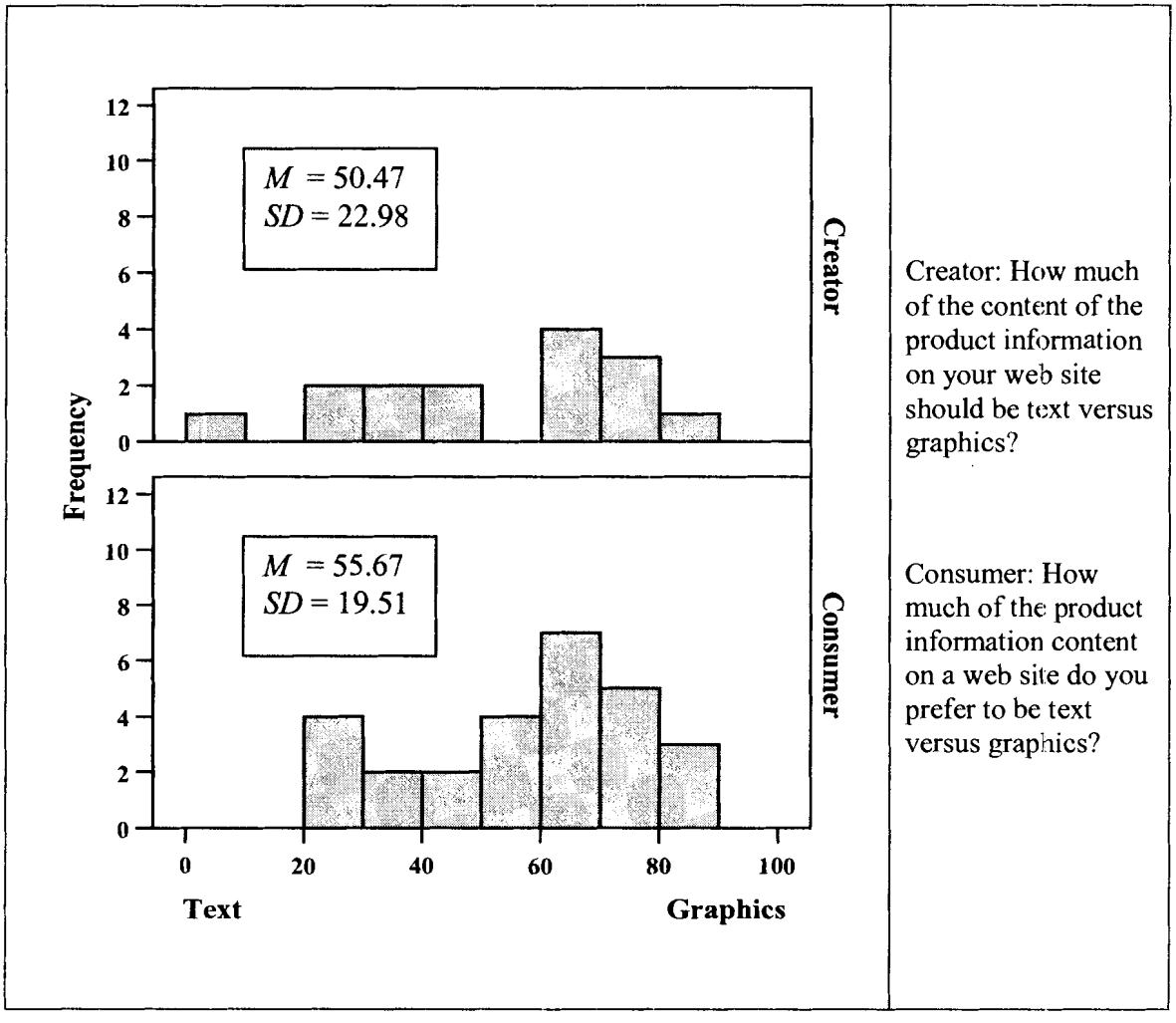

Figure 5-1 Text versus Graphics.

Black and White versus Colour - Item 5

The difference between creators and consumers was not significant, t (40) = .63, p = .53.

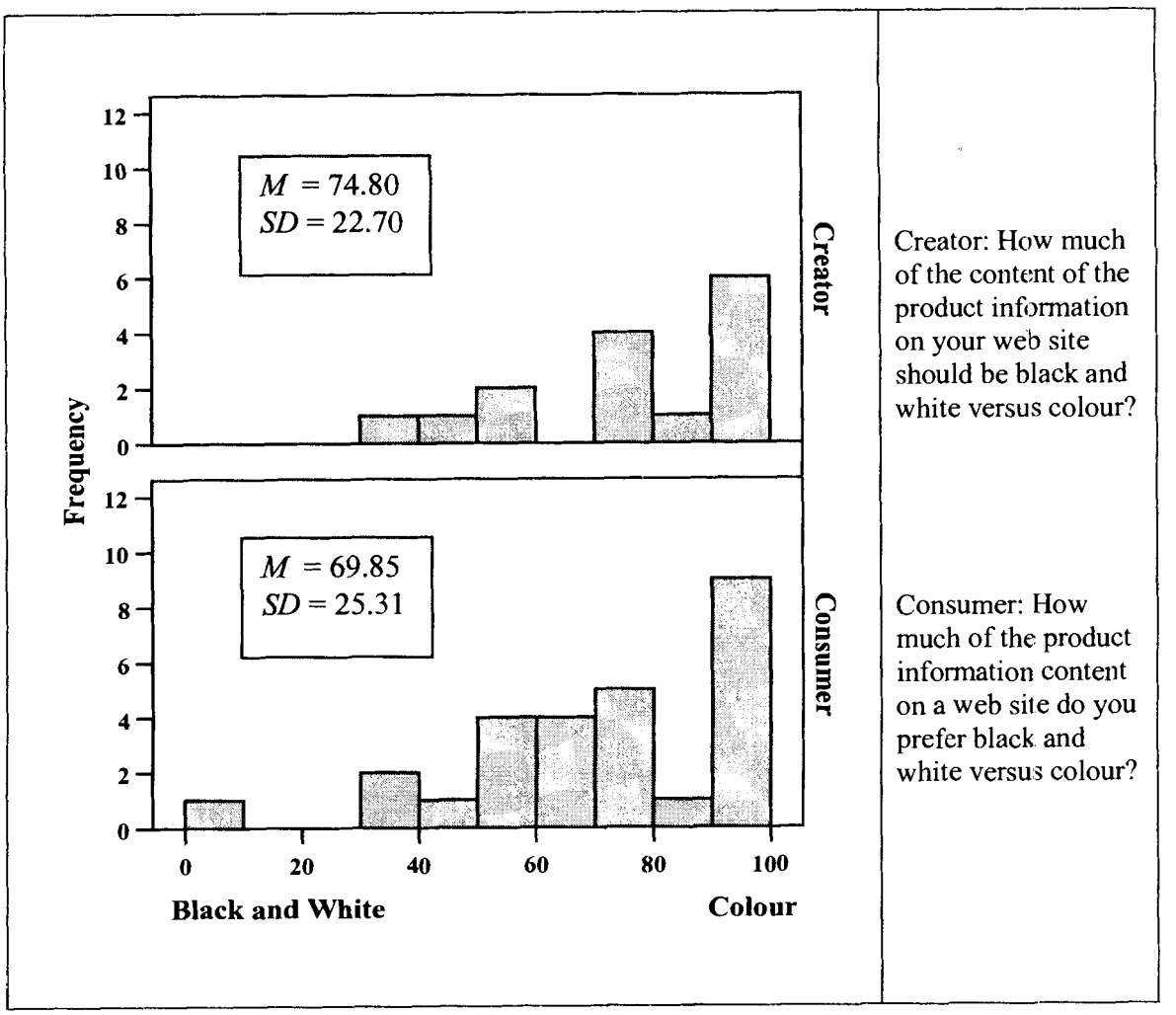

Figure 5-2 Black and White versus Colour.

Animation - Item 6

No significant difference between creators and consumers, t (40) = -.45, p = .66.

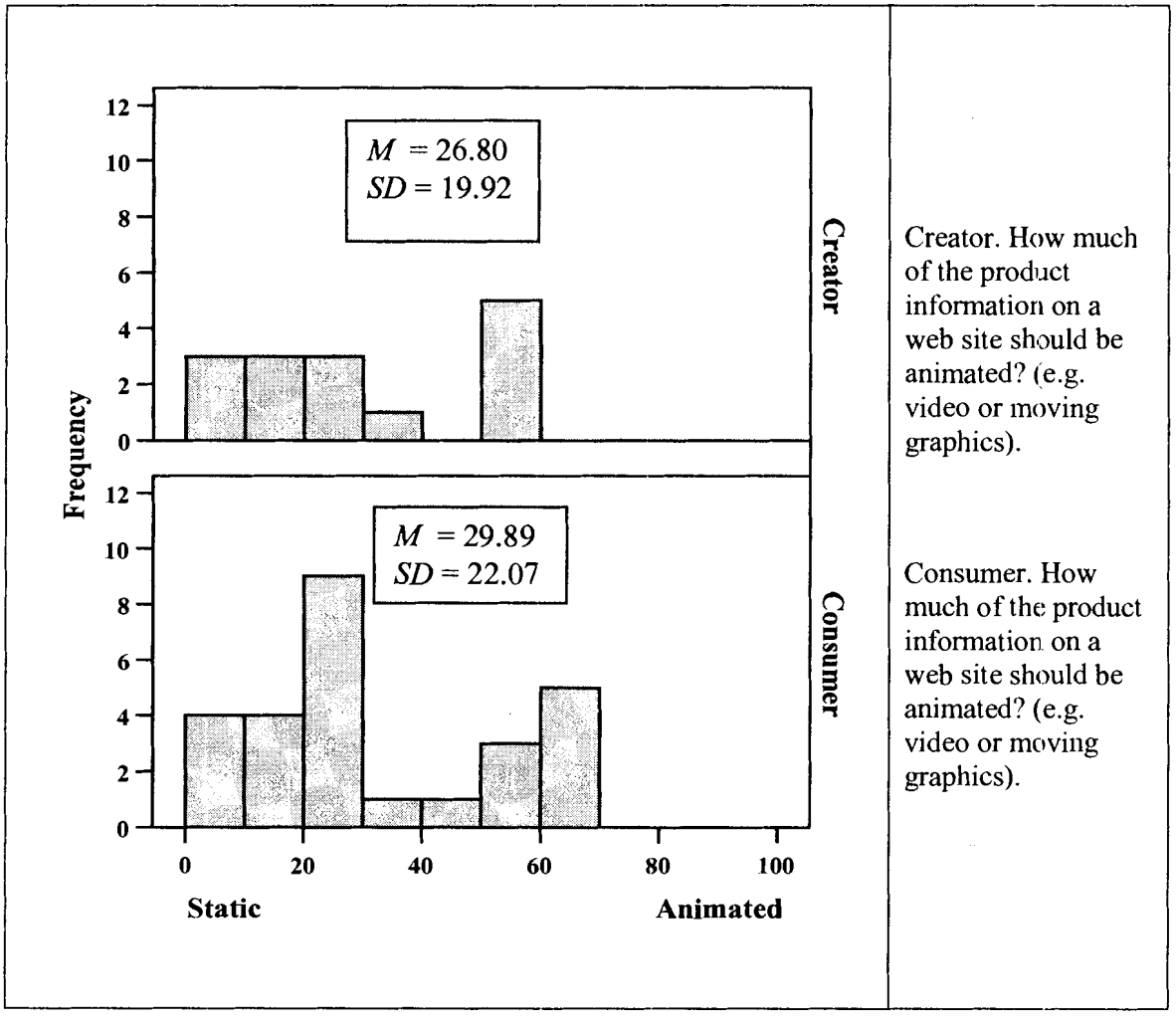

Figure 5-3 Animation.

Demand for Audio - Item 7

No difference between the groups was detected by a t-test, t (40) = -.88, p = .39. Figure 5-4 shows the response means, standard deviations and distribution for the demand for information in an audio format. Both groups expressed a low demand for audio.

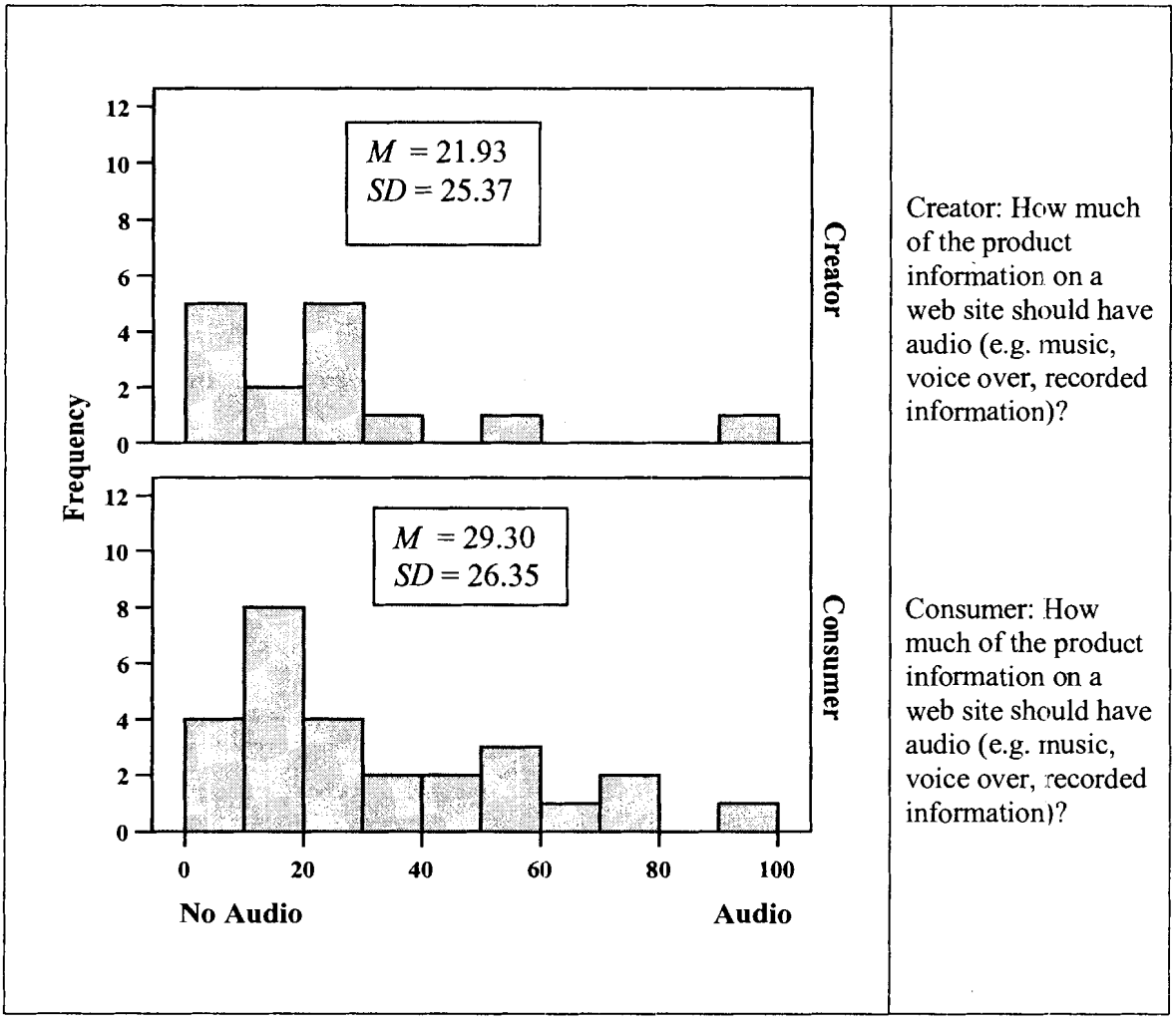

Figure 5-4 Demand for Audio.

Appendix 4 – Descriptive Statistics by Questionnaire Item

Statistical Analysis via SPSS 14 for Windows

Item	N		Mean	Std. Deviation	Range
	Valid	Missing			
1 Computer Literacy	43	0	75.53	16.92	75
2 Motivated to Learn	43	0	72.19	23.18	99
3 Quick Reference or Learning	43	0	38.77	28.85	89
4 Text vs. Graphics	42	1	53.81	20.69	85
5 BW vs. Colour	42	1	71.62	24.25	94
6 Static vs. Animated	42	1	28.79	21.14	67
7 Audio	42	1	26.67	25.94	99
8 Real vs. Abstract	42	1	36.55	21.98	95
9 Descriptions vs. Applications	42	1	60.12	19.77	75
10 Fact vs. Explanation	39	4	54.13	20.12	84
11 Interactivity	42	1	37.86	25.28	99
12 Adaptivity	42	1	55.43	25.11	99
13 Lookup vs. EPS	42	1	48.93	25.98	99
14 Facts vs. Stories	43	0	39.53	23.90	79
15 Chats	43	0	53.30	32.17	99
16 Reference vs. Training	42	1	34.88	18.03	74

Appendix 5 – Ethics Approval

FOR CONTACT IN REFERENCE TO THIS REVIEW

Application Number 37391

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Reference Ethics Policy 20.02: http://www.sfu.ca/policies/research/r20-01revised.htm

Notification of Application Status

Investigator Name Last
MacKie

Investigator Name First
Bob

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Investigator or Supervisor
Nesbit John

Co-Investigatorsors or Collaborators

Investigator Department
Interactive Arts

Investigator Position
Graduate

APPROVED
By Hal Weinberg at 12:11 pm, 3/6/06

Date Created	Date Modified	Code
2/27/2006	3/6/2006	37391

Experiment Title
Customer E-Learning

Amendments: Note that all ammendments must reference the Application Numer shown above.

Risk
Minimal

DORE Approval Date
March 6, 2006

Approval Status
Approved

Approval Start Date
3/6/2006

Medical or Relevant Review

Last Amended

Approval End Date
3/6/2006

Grant Funding Agency

Grant Funded No

Grant Title for funding agency

Grant Start Date

Grant End Date

Grant Track Number