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The role of audio-visual metaphors to communicate customer knowledge

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1. Introduction

The increasing complexity of organisations and volatility of markets led to a dramatic shift from information to knowledge societies (Thierauf 1999; Goh 2005). Although the volume of knowledge triples every eighteen months, its concept is still not completely well-defined (Becerra-Fernandez, Gonzalez et al. 2004). Knowledge elicitation can take place not only within the organisational boundary (Davenport and Prusak 1998), but also beyond, in which the active customer engagement is sought. Customer Knowledge (CK) is considered as the most valuable type of knowledge (Rowley, Kupiec-Teahan et al. 2007), due to its important role in the value creation and sustainability (Goh 2005). However, CK is not easy to gather, identify, interpret and integrate, due to the multiplicity of the customer's communication channels (Bueren, Schierholz et al. 2005). This called for the integration and management of CK elicited from different channels (Bueren, Schierholz et al. 2005), and hence to the synergy between Customer Relationship Management (CRM), and Knowledge Management (KM) in E-Business environments (Tiwana 2001; Bueren, Schierholz et al. 2005). The concept of CKM is widely used to refer to the synergy between two management tools, namely KM and CRM. In CKM contexts, it is important to consider that human experts, in general, tend to be reluctant to share knowledge, due to the fear of losing social power and intellectual rights (Davenport and Prusak 1998; Gibbert, Leibold et al. 2002). In deed, Dealing with customers exacerbates the problem, due to their position outside the organisational boundary and in a click away from competitors (Gibbert, Leibold et al. 2002). However, this demands higher levels of knowledge-based social interaction to take place in a platform supported by the organisation, especially on the web channel (García-Murillo and Annabi 2002). It is possible for the web channel to offer multimedia interactions to enable collaboration and self-services, and more importantly motivate further customer-web interactivity (Senger, Gronover et al. 2002). Although the potential of interactive multimedia interaction is well recognised to address lack of trust and information overload (Gibbert, Leibold et al. 2002), empirical studies that evaluate this role is generally lacking in the current literature to CKM. Therefore, this chapter describes an investigation into the use of multimodal metaphors to communicate CK, compared to text with graphics. This comparative evaluation measured traditional usability attributes, including effectiveness, efficiency, and user satisfaction.

	KM	CRM	CKM
Knowledge sought in	Employ, team, organisation	Customer database	Customer expectations, and innovation
Underlying principle	Employ knowledge integration	Customer knowledge discovery	Elicitation of customer experience and expansion of its sharing and use
Objectives	Cost and time saving, avoidance of re-inventing the wheel	Marinating customer base	Collaboration with customers to gain jointly created value
Measures	Performance against budget	Customer satisfaction and loyalty	Performance against rivals in terms of innovation and growth, and contribution to customer success
Advantage	Customer satisfaction	Customer retention	Customer success, innovation
Rewards recipient	Employee	Customer	Customer
Customer role	Passive consumer	Captive, tied by loyalty schemes	Active partner in value-creation process
Firm role	Motivate employees to share knowledge	Build long lasting relationships with customers	Transforming customer from passive to active role in co-creation of value

Table 1. Differences between CKM, CRM, and KM (adapted from (Gibbert, Leibold et al. 2002)).

2. Customer Knowledge Management (CKM)

The externalisation of KM constitutes CKM, due to the great similarities between them in terms of aims, objectives, techniques, and outcomes (Lopez-Nicolas and Molina-Castillo 2008). When considering the external perspective of KM, it is important to consider the application of its associated process of generation, storage, sharing, and utilisation of knowledge that resides in customers’ heads. Another argument suggested that CKM is neither an evolution of CRM, nor application of KM in CRM; it is a combination of both (Feng and Tian 2005). CRM and KM have several differences and similarities (Gebert, Geib et al. 2002). KM and CRM have, to some extend, similar goals, as they help organisations to grow, innovate and compete against competitors (Gebert, Geib et al. 2002). Table 1 differentiates CKM from both KM and CRM. Generally speaking, CKM aims to support knowledge-based interaction, reduce customer waiting time, improve quality of services, increase transparency, increase customer satisfaction and loyalty, which eventually lead to increasing revenue and lower costs (Bueren, Schierholz et al. 2005). In brief, CKM is an external perspective of KM.

With this huge contribution, there are several CKM outstanding issues, including lack of trust, and information overload. Interactive multimodal is identified to have the potential to address these issues. For example, the lack of trust (Davenport and Prusak 1998; Gibbert, Leibold et al. 2002) can be tackled by optimising a customer-company dialogue (Interaction), and building an environment of care, trust and mutual empathy (Gurgul, Rummyantseva et al. 2002). More importantly, interactive multimedia systems are proposed to tackle trust and interactivity issues (Gibbert, Leibold et al. 2002). Another example is information overload (Bueren, Schierholz et al. 2005), which can be tackled by integrating the visual presentations of information with auditory ones (Brewster 1997). In summary, it can be said that CKM

encounters the lack of customer's trust, and information overload, which can be tackled by incorporating multimedia systems.

A great deal of emphasis is placed on rethinking the role customer can play in innovation through the five styles of CKM: *prosumersim (co-production)*, *team-based co-learning*, *mutual innovation*, *communities of creation*, and *joint IP ownership* (Gibbert, Leibold et al. 2002). With focus on E-Business and software application suitability, two CKM styles were considered for further elaboration, namely COC and co-production.

2.1 Communities of Customers (COC)

COC constitute a group of users who share the same culture, value, interest, and objectives, and exchange product-related knowledge (Rowley, Kupiec-Teahan et al. 2007). When considering that customers share opinions about products and services (contributors), and evaluate opinions of peer customers (seekers) for their own benefits, it is important to consider that the organisation also reduces the overhead associated with handling customer enquiries, which leads to various organisational benefits, such as time saving and cost avoidance (Cheung, Shek et al. 2004). Furthermore, Amazon.com case study represents the typical example of COC, in which E-Business customers share experience about products (reviews), and knowledge about customers is discovered (recommendations) in this context (Gurgul, Rumyantseva et al. 2002). It is argued that 62% of the online purchases were driven by customer reviews and website recommendations (Cheung, Shek et al. 2004). Another argument presented in the case study of Flexifoil International (Rowley, Kupiec-Teahan et al. 2007) suggested that increasing interactivity of web-based systems has contributed substantially in the rising sales figures. With these two arguments in mind, it can be investigated whether an interactive COC platform would outperform interactive non-COC, or static COC platforms. In summary, fostering COC is linked to various personal positive gains, such as continuous access to knowledge and information, as well as organisational benefits, such as cost time saving, cost avoidance, and increasing sales.

2.2 Co-Production

The customer participation in product and service creation has shown to have a positive influence on the successfulness of New Product Development (NPD), and innovativeness of products and services (Salomo, Steinhoff et al. 2003). However, the choice between product innovativeness and speed to market involves trade-off. A study (Fang 2008) on addressing the trade-off between idea novelty and speed to market indicated that the customer's participation as co-developer has a considerable positive effect on product innovativeness, but it undermines speeds to markets, particularly in high process interdependences. In general, harnessing customer competencies has shown to be a major contributor towards various benefits, such as organisational growth, innovation and competition against aggressive rivals (Gebert, Geib et al. 2002; Gebert, Geib et al. 2002). In particular, an experimental study (Matthing, Sanden et al. 2004) on the originality and value of user ideas suggested that observing customer real actions during co-production improves the anticipation of customer future needs. It provides predictions, which are more accurate, than that provided by the traditional knowledge discovery techniques. This suggestion aligns with other proposals that customers can easily generate novel ideas more than developers can, whereas professionals create products that are more reliable (Kristensson,

Gustafsson et al. 2004). Also, a study (Bendapudi and Leone 2003) on the psychological implications of customer involvement in self-service co-production revealed that the participated customers expressed more positive feelings toward the experience, compared to those who did not participate in co-production. Another investigation (Auh, Bell et al. 2007) into the role of co-production to support competition in the financial services industry and its effect on customer loyalty revealed that co-production relates positively toward both attitudinal and behavioural customer loyalty. In summary, it is possible to say that the customer participation in co-production is linked to not only economic benefits, but also customer positive attitudes, such as satisfaction and loyalty.

3. Customer Interaction

Knowledge exchange between customers who share the same background and interest led to an increasing demand for direct interactions with customers and effective CK elicitation (García-Murillo and Annabi 2002). The customer's interaction needs to be managed and aided, especially in the web-based environments (Senger, Gronover et al. 2002). CKM facilitates instance delivery of knowledge and real-time offers to customers involved in the web-based interaction (Pan and Lee 2003). This argument is in agreement with other work in literature (Massey, Montoya-Weiss et al. 2001). Another argument suggests that real-time customer interaction and fostering COC contribute positively toward the improvement of CK elicitation (Gibbert, Leibold et al. 2002), and exploitation (Lesser, Mundel et al. 2000). Customer interaction (Dous, Salomann et al. 2005) can be whether face-to-face or Electronic (Gurgul, Rumyantseva et al. 2002). The former helps transferring tacit knowledge and the latter utilises the electronic means to deal with both explicit and tacit knowledge (Mertins, Heisig et al. 2003). Moreover, compared to human-to-human dialogues, it is argued that IT with the aid of multimedia can tackle knowledge hoarding by improving perception of trust (Senger, Gronover et al. 2002). In summary, the role customer interaction is identified to be contributing toward the improvement of CK elicitation, and hence organisational growth.

Typically, innovative interaction is curial to improve the user's performance, as opposed to the traditional interaction. In CKM, it is more suitable to gather CK directly from customers, compared to the sale representative approach (Gibbert, Leibold et al. 2002). Although, little effort has been devoted to examine the role of multimodal interaction in CKM, there is a general agreement that user interface can be enhanced by the introduction of auditory stimuli, including speech (Kehoe and Pitt 2006), earcons (Rigas, Memery et al. 2000; Alty and Rigas 2005; Rigas and Alty 2005), and auditory icons (Cohen 1993; Gaver 1997). In fact, previous work in multimodal interaction literature (Alty and Rigas 2005; Rigas and Alty 2005; Alsuraihi and Rigas 2007; Alsuraihi and Rigas 2007; Kieffer and Carbonell 2007; Rigas and Alsuraihi 2007) carried out traditional usability evaluation to measure effectiveness, efficiency and satisfaction. For example, an experimental work (Rigas and Ciuffreda 2007; Rigas and Ciuffreda 2007) was carried out to investigate the usability of using multimodal metaphors in browsing internet search results. The experiments aimed to address the identification of document relevancy, and found that the multimodal approach can improve presentation, and hence the browsing process. This view is supported by other work in literature (Rigas and Bahadur 2006). Therefore, it is important to examine the hypothesis that the use of multimodal interaction in the context of CKM can improve usability, compared to text with graphics.

Condition		Communities of Customers (COC)				Co-production CK		Product Information	
		Trends	Reviews	Ratings	Intelligent advices	Cost	Comparison	Price	Features
VCKMS	Text		√			√	√	√	√
	Graphics	√		√	√				√
MCKMS	Text		√				√	√	√
	Graphics	√		√	√	√			√
	Speech		√				√		√
	Earcons	√		√	√		√		
	Auditory icons		√		√		√		√

Table 2. Differences between the VCKMS and MCKMS experimental systems

4. Experimental Platform

The experimental platform provided typical functions of web-based mobile phones retailing systems, and included an additional function labelled as co-production. With focus on the use of multimodal interaction, prior experimental studies suggested comparative evaluation between various conditions of user interface, which mainly includes visual and multimodal conditions. This experiment applied the same concept to Electronic Customer Knowledge Management Systems (E-CKMS). This involved developing an experimental E-CKMS with two interfaces: text with graphics (VCKMS), and multimodal with speech, earcons, and auditory icons (MCKMS). In VCKMS, the communication of CK utilised the visual channel only, whereas in MCKMS it utilised both visual and auditory channels. This required categorisation of CK and auditory and visual metaphors, and utilisation of a wide range of technologies. It can be seen that there were several CK types organised into six categories: trends, customer reviews, customer ratings, intelligent advices, co-production CK, and product features. In addition, there were two visual-only metaphors employed: text and graphics, and three auditory ones: speech, earcons, and auditory icons. Table 2 illustrates the differences between the VCKMS and MCKMS experimental systems.

In order to include sounds into the E-CKMS interface, several technologies, tools and sounds has been used. This included a speech agent (Microsoft 2006), a text-to-speech engine, environmental sounds (Gaver 1986), multi-timbre synthesiser software (Shah 2006), musical notes, and a sound recoding software (KYDsoft 2006). In addition, the empirically derived guidelines provided by Brewster (Brewster, Wright et al. 1995) were followed in the creation of earcons. For example, families of earcons was differentiated by employing timbre, including *guitar*, *violin*, *trumpet*, *drum*, *organ*, and *piano* (Rigas and Alty 1998). Further differentiation was made by utilising rising pitch metaphors. For example, *guitar* and *violin* were mapped to trends category to convey the best and worst rated products respectively, and rising pitch to communicate the product position in both lists. Furthermore, to present each individual earcons in a rhythmic form, the first note was accented, and the last one was played for a longer period (Brewster, Wright et al. 1995). Earcons were played in sequence (serial compound earcons), with a 0.1 seconds gap, so the user can make a decision where one note finishes, and when the other starts. In addition, the environmental sounds used were sound of *typing*, *cheering*, *clapping*, *laughing*, *gasping*, *foghorn*, *side whistle*, and *camera shot*. In brief, the experimental E-CKMS was implemented with two interface conditions.

Fig. 1. Snapshots of the VCKMS product catalogue (a), VCKMS co-production interface (b), MCKMS product catalogue (c), and MCKMS co-production interface (c)

4.1 Implementation of Product Catalogue

The implementation of product catalogue in VCKMS and MCKMS was consistent with Amazon.com interface. Both used the typical tabular catalogue, and presented product image, name, rating, and price. However, MCKMS introduced an additional feature, which optionally allowed the user to assess other product related knowledge from the catalogue. In MCKMS, there was a button associated with each product to communicate CK and product features by a serial combination of speech, earcons, and auditory icons. Figure 1 (a) shows the VCKMS product catalogue with visual presentation of product image, name, and price. Similarly, Figure 1 (b) shows the MCKMS product catalogue that communicated the same information visually, and provided an additional communication method to convey further information using the auditory channel. In summary, the tabular product catalogue was implemented in VCKMS and MCKMS to communicate basic product information visually. In addition, MCKMS can convey other CK and product features aurally.

4.2 Implementation of Co-Production

The co-production of Electronic Products (E-Products) is more suitable for online customers, because it do not require a complete line of production, instead only software is needed. E-Products requires only a software to be produced (Gurgul, Rumyantseva et al. 2002), such as the open source software and user innovation communities (Von Hippel 2001) presented

in Microsoft case study (Rollins and Halinen 2005). This avoids the repeated shifts from production lines to customer care departments and visa-versa (von Hippel 2001). This study considered co-production of billing schemes, due to its electronic nature (E-Products), which enables E-CKMS to produce trail products in the absence of a complete line of production. Billing scheme parameters were manipulated to examine the effect of such manipulation on the bill total. This manipulation provided customised billing scheme through several trail-and-error productions. In each trail-and-error, the trial was stored in an array to facilitate trials comparison, and hence supported customer decision making. In VCKMS, the trial comparison feature was lacking, because trials were presented in a tabular form. Figure 1 (c) shows the VCKMS co-production interface that uses texts with graphics to communicate basic co-production information. In MCKMS, a graph aided by auditory stimuli (speech, earcons, and auditory icons) was used to communicate the same information, in addition to trail comparison knowledge. Figure 1 (d) shows the MCKMS co-production interface that uses interactive graph to present co-production and trial comparison knowledge. The user was required to click whether the left vertical bars to facilitate trail comparison by musical notes or the right vertical bars to compare more than one trial by synthesised speech. In summary, the MCKMS co-production interface was implemented differently, in which an interactive graph and multimodal metaphors were used.

Complexity	Task code and description		Task requirements	Available selections
Simple	T1	Product selection in the presence of COC contexts	6	18
	T2	Product selection in the absence of COC contexts	4	22
Moderate	T3	Product selection in the presence of COC contexts	7	8
	T4	Product selection in the absence of COC contexts	5	9
	T5	Co-production with two trials	3	N/A
Complex	T6	Product selection in the presence of COC contexts	7	2
	T7	Product selection in the absence of COC contexts	4	2
	T8	Co-production with five trials	6	N/A

Table 3. Review of the eight common tasks, and complexity levels

5. Design of Experimental Study

This study demonstrates usability aspects of multimodal interaction in three levels of task complexity levels: *simple*, *moderate*, and *complex*. To disseminate the three complexity levels, two influential factors were proposed: *number of task requirements*, and *number of available selections*. The former reflects how many task requirements required to be fulfilled in order to consider the task as successfully completed, while the latter refers to the number of available products that when selected by the user, the task is regarded as accomplished. Three were eight common tasks categorised into simple (T1 and T2), moderate (T3, T4 and

T5) and complex (T6, T7 and T8) tasks. Table 3 reviews the eight common tasks and the two complexity factors. When the task is designed as complex, the number of task requirements was increased, while the number of available selections was decreased. More information on task levels, types and workload is provided in (Burke, Prewett et al. 2006). In brief, this study identified three complexity levels, and proposed two factors to differentiate these levels.

The task was also organised into two types: *COC* and *co-production*. The *COC* tasks referred product selection in the present and absence of *CoC* contexts. Types of products were phones and tariffs. The eight common tasks were six product selection tasks in the presence (T1, T3 and T6) and absence (T2, T4 and T7) of *COC* contexts, and two co-production tasks (T5 and T8). In product selection tasks, the user was provided with a scenario, in which the presumed task requirements were presented as user preferences. In T3, for example, a user was provided with a scenario: say that your phone preferences are, the phone should be among the top10 or intelligent advice lists, the phone should be a camera phone with capacity between 0.5 and 3MP, a 3G phone, and the number of positive reviews should be greater than the negative ones. It was worth noting that scenarios of product selection tasks in the presence of *COC* included at least one requirement from the *COC* context (e.g. rating, trends, and website advice), whereas in the absence of *COC* lacked the *COC* requirements.

This study evaluated the difference between groups to explore the cause-effect relationship between factors. A selected sample was instructed to use the two conditions in order to observe and measure of a set of three variables. Forty participants were selected randomly from the population, based on the non-probability strategy and convenience-sampling method (Salkind 2006). Participants were assigned randomly to two groups (n=20 each), and offered a short training session. Each group was introduced to examine a platform that they had not used or experienced prior to the experiment, to control user familiarity with the system. The two groups were provided with the mapping between information represented and the metaphors used to communicate them. The ability of users to interpret such metaphors was tested prior to the experiment through specially design tasks, in which users provided with help needed until the full understanding of the perceptual context is demonstrated. Subsequently, participants were asked to perform the eight tasks and fill a questionnaire devised for this study. The task order was balanced as so to eliminate any possible task learning effect.

Upon the completion of the eight tasks, a set of factors were quantified and measured. These variables were task completion rate and time as objective factors, and user satisfaction as a subjective dimension. The task completion rate and time were observed during the task performance to reflect aspects of E-CKMS effectiveness and efficiency. User satisfaction was measured by a set of questionnaire statements, to which the user's agreement/disagreement was sought (Jordan 1998). A six-point Likert scale ranging from agree strongly (6) to disagree strongly (1) was used (Salkind 2006). The satisfaction items included *Ease of Use* (EOU), *Extent of Confusion* (EOC), *Extent of Frustration* (EOF), *Ease of Navigation* (EON), and *Convenience* (CON). Based on the System Usability Scale (SUS) technique (Brooke 1996), user responses were summed up to generate an overall score for user satisfaction. In brief, E-CKMS interaction mode and task complexity denote the independent variables. In addition, E-CKMS effectiveness, efficiency, and user satisfaction represent the dependent variables.

Fig. 2. Mean values of task completion rate (a), task completion time (b), user satisfaction score (c), and frequency of user agreement on the five satisfaction factors (c) using the VCKMS and MCKMS experimental systems

6. Analysis of Results

Figure 2 shows the mean values of task completion rate (a), task completion time (b), user satisfaction (c), and frequency of user agreement (d) on aspects of satisfaction for using the VCKMS and MCKMS experimental systems. At a glance, the multimodal E-CKMS platform (MCKMS) was more usable than the control condition (VCKMS) as regards effectiveness, efficiency, and user satisfaction. In Figure 2 (a), it can be noticed that the two groups differ considerably in favour of the multimodal E-CKMS platform (MCKMS) with E-CKMS effectiveness. The task completion rate for using MCKMS (141 tasks, 86%) was considerably higher than using VCKMS (102 tasks, 68%). Chi-square results showed significant different between the two interaction modes as regards task completion rate ($\chi^2=26$, $df=1$, $p<0.05$). In Figure 2 (b), it can be seen that MCKMS outperform VCKMS with regard to E-CKMS efficiency. The mean value of task completion time for MCKMS was 20% higher than that for VCKMS. The t-test results showed that there was a significant difference between the two E-CKMS experimental platforms with regard to task completion time ($t_{37}= 6.004$, $cv=2.02$, $p<0.05$). In Figure 2 (c), it can be noticed that there was a considerable improvement in user satisfaction in favour of MCKMS. The mean value of user satisfaction score for using MCKMS was 19% greater than that for VCKMS. In addition, the t-test results showed a significant difference between the two conditions regarding the satisfaction score ($t_{38}=4$, $cv=2.02$, $p<0.05$). In Figure 2 (d), user responses suggested that the experimental condition (MCKMS) was easier to use, less confusing, and less frustrating. Actually, 90% of the users agreed that the MCKMS was easy to use, compared to 70% for VCKMS. In user confusion statement, 45% of the users agreed that VCKMS was confusing, whereas 90% disagree in MCKMS. In addition, 95% of MCKMS users felt frustrated, compared to 55% of VCKMS users. However, a 5% difference between the two conditions was found with regard to ease of navigation and convenience. 95% of MCKMS users agreed that it was easy to navigation, compared to all the VCKMS users. All the MCKMS users felt that it was convenient, compared to 95% of VCKMS users. In brief, the MCKMS has shown to be generally more usable than the VCKMS.

Fig. 3. Mean values of task completion rate (a) and task completion time (b) according to the three task complexity levels using the VCKMS and MCKMS experimental systems

6.1 Task Complexity

Figure 3 shows the mean values of task completion rate (a) and task completion time (b) according to the three task complexity levels using the VCKMS and MCKMS experimental systems. Overall, the effectiveness and efficiency of multimodal metaphors has shown to be influenced by the task complexity, as the more complex the task is, the more usable these metaphors become. In Figure 3 (a), it can be seen that the variance between VCKMS and MCKMS went hand in hand with the complexity level with regard to task completion rate. In the simple tasks, the completion rate was insensitive to the complexity levels. In contrast, the variance between the two conditions rose considerably in moderate and complex tasks. In moderate tasks, the completion rate for VCKMS was considerably lower than that for MCKMS. Chi-square results showed a significant difference between the two conditions with regard to moderate task completion rate ($\chi^2= 13.1$, $df=1$, $p<0.05$). In complex tasks, the completion rate for using MCKMS was considerably greater than that for VCKMS. Chi-square results also suggested that there was a significant difference between the two interfaces regarding the completion rate for complex tasks ($\chi^2=16.8$, $df=1$, $p<0.05$). In Figure 3 (b), the use of multimodal metaphors has shown to have a considerable effect on task completion time, particularly for complex tasks. It can be noticed that the completion of complex tasks were achieved significantly faster using MCKMS than VCKMS. Overall, the difference in task completion time between the two conditions went hand in hand with the task complexity, in favour of MCKMS. In the simple and moderate tasks, the mean value of task completion time for using VCKMS was slightly higher than that for MCKMS. In the complex tasks, the mean value for VCKMS was 22% higher than that for MCKMS. The difference in task completion time was found significant with regard to the performance of simple ($t_{38}= 2.2$, $cv= 2.03$, $p<0.05$), moderate ($t_{33}= 6.3$, $cv= 2.03$, $p<0.05$), and complex tasks ($t_{35}= 5.7$, $cv= 2.03$, $p<0.05$). In summary, the level of task complexity has been identified as a key factor that effects the contribution of multimodal metaphors to communicate CK. Using multimodal metaphors has shown to be more effective and efficient than the traditional visual information communication, especially for complex tasks.

Interface		Aspects of user satisfaction				
		EOU	EOF	EOC	EON	CON
VCKMS	Mode	4	3	3	5	5
	Frequency	16 (80%)	11 (55%)	13 (65%)	19 (95%)	20 (100%)
	Mean	3.85	3.45	3.10	4.95	4.45
MCKMS	Mode	5	2	2	5	5
	Frequency	18 (90%)	14 (70%)	14 (70%)	16 (80%)	17 (85%)
	Mean	4.80	2.20	2.20	5.00	4.95

Table 4. The mode, frequency of the mode, and mean values of the five aspects of users’ satisfaction for using two interaction modes

6.2 User Satisfaction

Table 4 shows the mode, frequency of the mode, and mean values of user satisfaction factors for using the VCKMS and MCKMS experimental systems. In general, the use of multimodal metaphors led to greater user satisfaction, and hence participants responded highly favourably to MCKMS. It can be seen that 80% of VCKMS users agreed slightly that the system was easy to use (EOU), whereas 90% of MCKMS users agreed moderately. In addition, over half of the VCKMS sample disagreed slightly that the system was confusing, whereas 70% of MCKMS users disagree moderately. Furthermore, 56% of VCKMS users disagreed slightly that they have felt frustrated during the interaction, whereas 70% of MCKMS users disagree moderately. It can be seen from the table that the 95% of VCKMS users and 80% of MCKMS users agreed moderately that it was easy to navigating through. Similarly, all VCKMS users and 85% of MCKMS users felt comfortable during the interaction. The Mann-Whitney results indicated that the difference between VCKMS and MCKMS was insufficient in both EON (U=183, cv=127, p>0.05) and CON (U=131, cv=127, p>0.05). However, there was a statistical significance found between the two conditions as regards EOU (U=79, cv=127, p<0.05), EOC (U=65, cv=127, p<0.05), and EOF (U=102, cv=127, p<0.05). In summary, it can be said that the greater user satisfaction was found by using multimodal metaphors, because participants expressed interest to, and rated in favour of MCKMS over VCKMS.

7. Conclusion

There has been an increasing demand for modern organisations to have real-time interaction with consumers, because their views or perceptions are often used for innovation. Typically, interfaces are used to elicit customers’ views within E-CKMS. Therefore, interface design and customer interaction are important to the organisation. There are few CKM empirical studies, which investigated whether or not these technologies can be put into practice. Therefore, this experiment tested the hypothesis that multimodal interaction can improve E-CKMS usability as opposed to text with graphics. This involved implementing control and experimental E-CKMS experimental platforms (text with graphics and multimodal), which were evaluated by two independent groups of users (n=20 for each group). Results showed that the use of multimodal metaphors in E-CKMS was more usable than text with graphics. Although this experiment has proven to be successful, it is essential to introduce multimodal metaphors of social presence, such as avatars with facial expressions. It is important to

examine several combinations of multimodal metaphors and evaluate the social aspects of avatars in order to promote further understanding and identify sources of variance between text with graphics and multimodal E-CKMS.

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