SESSION

MANAGEMENT ISSUES, WEB TOOLS + PREDICTION AND FORCASTING METHODS

Chair(s)

TBA

Technical Indicators as Predictors of Position Outcome for Technical trading

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Abstract - *The objective of technical trading is to identify profitable conditions for the entry and exit of market positions. This paper explores the potential use of three common momentum indicators to classify the outcome (return) of a position defined by trading signals of a Simple Moving Average system. The collection of positions associated with each randomly selected security was grouped into outcome classifications. The outcome classifications and selected securities were formed into an Analysis of Variance experiment. If the observed values of a momentum technical indicator vary with position outcome, then it could be suggested the indicator has at least a minimal level of predictive power that could be used for estimating the return of future positions defined by a Simple Moving Average trading system. The mean observed values of the A/D Oscillator and the William's %R indicators varied with position outcome although no definitive conclusions were drawn as the assumptions for the Analysis of Variance experiment were challenged. The mean observed value of the Relative Strength Index indictor did not vary with position outcome*.

Keywords: Predictive Modeling, Technical Analysis, Technical Trading, Classification Predictors, Machine Learning.

1 Introduction

Technical Analysis is the systematic evaluation of past market data to estimate future price trends and make investment decisions [8]. To trade technically is to predefine the conditions for both the entrance and exit of a market position. With predefined conditions that denote the beginning and end of a market position, it is argued that the historic pricing of a security traded with a technical system can be viewed as a collection of historic market positions.

Associated with each market position is a set of market conditions that reflect the change in equilibrium of a security's price. It is suggested these market conditions can be quantified with the use of technical indicators and potentially used as predictors of market position outcome.

Using four randomly selected securities, this research paper investigates the relationship of three momentum based technical indicators to the outcome of market positions defined by a 21-day Simple Moving Average (SMA) trading system. The purpose of this research is to determine if technical momentum indicators vary with the classification of position outcome. The ultimate objective is to determine if the selected technical momentum indicators can be used as features in a prediction model to help form an expectation about position outcome at the time an entry signal is given.

2 LITERATURE REVIEW

2.1 Market Efficiency

Market efficiency refers to the speed that information is reflected in security pricing [7]. In a perfectly efficient market, new information concerning a security should be reflected instantaneously. However, if only some of the information is reflected in the security pricing instantaneously, and the remaining information takes a number of periods to be reflected (hours/days/weeks), then the market is less than fully efficient leading to short term mispricing and an opportunity to generate excess profit [3]. Markets cannot be fully efficient because of the costs associated with collecting and analyzing information, the cost of trading, and the limit of available capital to arbitrageurs [3]. As a result, security pricing generally reflects information up to the point where marginal benefits equal the marginal costs of information [7].

2.2 Behavioral Finance

There are several factors that influence stock prices including security performance, market trends, investor psychology, government influence, and changes in macroeconomic activity [17]. Many professional investors argue that markets are dominated by the emotions of fear and greed which leads to investors addressing risky choices based on emotion instead of fact. Some investors are reluctant to realize losses, take profits too quickly, or suffer from other instances of irrational behavior which all can lead to mispricing in the market [3]

Most importantly, investors do not appear to be consistent in how they treat economically equivalent choices if the choices are presented in different contexts. Framing effects have been suggested to have an impact on rational decision making [3]. A number of researchers stated that stock prices are

significantly correlated with the reaction to market event information [17]. Market participants tend to overestimate the probability of unlikely events occurring and underestimate the probability of moderately likely events occurring, causing the tendency of investors to overreact to good and bad news [2]. This notion can be supported by the historic 'rushes', 'booms', 'busts', 'bubbles', and 'market crises' which provide creed to the notion that markets are less than perfectly efficient [10].

2.3 Forecasting of Security Returns

There are several approaches described by various academics that attempt to predict future security prices. Traditional forecasting approaches include Auto Regressive Integrated Moving Averages (ARIMA) and Regression Analysis. An ARIMA model can be applied to predict future price movements in cases where financial time series data shows evidence of non-stationery. Regression Analysis can be used to model the relationship of market variables to security returns [11]. Fang and Xu investigated an approach that combines technical analysis and traditional time series forecasts. Their research suggested that technical trading rules and time series forecasts capture different aspects of market predictability [5].

Although multivariate models have been widely used for predicting security pricing and stock market movements, several machine learning techniques are now becoming more common [17]. Neural Networks (NN) have the ability to extract useful information from large sets of data [11]. Over the last decade, NNs have shown to better estimate future security returns over some traditional approaches, but have the tendency to over fit the data or find a local minima solution [17] [14]. Tsai & Wang proposed a stock price foresting model that combines a Neural Network and a Decision Tree to guard against over fitting [14]. Weckman & Agarwala investigated the sensitivity of different technical indicators in an Artificial Neural Network (ANN) used to forecast n-periods into the future [15]. Case Based Reasoning (CBR) can reuse past cases (or historic market positions) to estimate the outcome of new opportunities [17]. Support Vector Machines (SVM) are based on statistical learning theory and are able to find a globally optimal solution [17]. Leung et al. presented a structural support vector machine (SSVM) model with a complex graph input to represent relationships between various companies as factors that affect the stock price [9].

Both traditional multivariate models and machine learning techniques require a set of variables, commonly referred to as a feature set, that can be used as predictors of expected return over some future investment horizon. This research paper uses a 21-day Simple Moving Average trading system to define the entry and exit points of a position. The objective is not to forecast the security pricing n-periods into the future, but to estimate the return of a position defined by the Moving Average System which can vary dynamically in length. If the observed values of technical momentum indicators vary with historic position outcomes, then it may be possible to utilize technical momentum indicators as features within a classifier model to predict the outcome of future positions defined by a technical trading system.

2.4 Review of relevant Technical Analysis Indicators

2.4.1 Simple Moving Average (SMA)

A trend is the general direction of the market or price of a security and can vary in length and intensity [12]. A moving average can be used to smooth short-term fluctuations of security pricing and highlight longer-term trends or cycles [11]. During a period when the market of a security is trending, moving averages can be effective in timing position entry and exit signals [8]. The Simple Moving Average (SMA) is defined as the mean of the most recent n-observations and can be calculated as followed:

$$SMA_t = \frac{P_{t-n+1} + P_{t-n+2} + \cdots + P_t}{n} = \frac{1}{n}\sum_{i=t-n+1}^{t} P_i, n \leq t$$

2.4.2 Accumulation/Distribution Oscillator

In 1972, Jim Waters and Larry Williams published a description the Accumulation/Distribution (A/D) Oscillator. The oscillator defined by Waters and Williams uses a unique form of relative strength to measure the implied direction of the day's trading [8]. The A/D Oscillator is calculated as followed:

$$ADO_t = \frac{(H_t - O_t) + (C_t - L_t)}{2 \times (H_t - L_t)} \times 100$$

The maximum value of 100 is reached when a market opens(O) at the low(L) and closes(C) at the high(H). The Waters-Williams A/D Oscillator inherently adjusts to higher or lower trading ranges (volatility) as a result of the divisor being a multiple of the day's trading range [8].

2.4.3 Williams' %R

Williams' %R is a momentum indicator that measures overbought/oversold levels by showing the current closing price in relation to the highs and lows of the past n-observations [1]. The purpose of the indictor is to convey whether a stock or commodity is trading near the high or the low of its recent trading range. Williams' %R is different from stochastics as it measures the strength of the market close compared to the high of the past n-periods [8]. As the close gets stronger the value of %R gets smaller. The William's %R indicator value can be calculated as followed:

$$\%R = \frac{Buying\ Power}{Range} = \frac{\max_{t-n}(High) - Close_t}{\max_{t-n}(High) - \max_{t-n}(Low)} \times -100$$

2.4.4 Relative Strength Index (RSI)

Developed by Welles Wilder, the Relative Strength Index (RSI) is a momentum oscillator that measures the velocity and magnitude of directional price movement. The RSI computes momentum as a ratio of higher closes to lower closes to measure the internal strength of a security [1]. The RSI is expressed as a value ranging from 0 to 100 and is calculated as follows:

$$RSI = 100 - \left(\frac{100}{1 + RS}\right); \qquad RS = \left(\frac{AU}{AD}\right)$$

- AU = the average upward price movements during the past n-observations.
- AD = the average downward price movements (stated as a positive numbers) during the past n-observations.

Wilder suggested the significant threshold levels for the RSI indicator are 30 and 70 [16]. The center line for the Relative Strength Index is 50. If the relative strength index is below 50, the given security's losses are greater than the gains. When the relative strength index is above 50, the gains are greater than the losses over the previous n-observations.

3 RESEARCH OBJECTIVE

3.1 Research Question

For the purposes of this research, a position is defined as the period between the entry and exit signals generated by a 21-day Simple Moving Average trading system. Although traditionally the response variable is the position outcome, this research is focused on the behavior of selected momentum indicators. Each of the three technical momentum indicators were considered for each position defined by the SMA trading system. The purpose of this paper is to investigate if the mean observed values of the chosen technical indicators vary with position outcome, where position outcomes are classified as Excellent, Favorable, Unfavorable, or Terrible. It was recognized that the technical momentum indicators may behave differently among securities, therefore, security was also considered as a factor.

3.2 Hypotheses

This research is designed around a difference question, specifically investigating if the observed technical momentum indictor, at the time of entry signal, varies among different position outcome classifications. This difference question is explored using a two-factor ANOVA ($\alpha = 0.05$). Each of the three selected technical indicators is evaluated independently. Correspondingly, the following sets of hypotheses are repeated for each of the selected indicators. So, if the mean observed value is statistically different among the outcome groupings and is independent of the security, then sufficient evidence exists to suggest that these indictors may have the potential to be a good predictor of the position outcome. For each of the selected indicators, we are investigating the following pairs of hypotheses:

1. ***H01***: μ Excellent = μ Favorable = μ Unfavorable = μ Terrible, there is no difference in the observed mean indicator value among varying position outcome classifications.
   Ha1: there is a difference in the observed mean indicator value among varying position outcomes.

2. ***H02***: μ NCI = μ NOG = μ PKT = μ SWS, there is no difference in the observed mean indicator value among different selected securities.
   Ha2: there is a difference in the observed mean indicator value among different selected securities.

3. ***H03***: The selected securities have no interaction with position outcome classification in terms of influencing the mean indicator observation value.
   Ha4: There is an interaction between position outcome classification and the different securities in terms of mean observed indictor value.

4 DATA COLLECTION

4.1 Trading Rules and Indicator Parameters

The Simple Moving Average indicator was used to form the technical trading system. The following rules were employed to denote the entry and exit points of a position. Only Long positons were considered.

Table 1: Position Entry and Exit Rules

Entry	*Exit*
Buy Long when the Closing price crosses above the moving average	Sell the long position when the Closing price crosses below the moving average

The timeframe parameter (n- observations/periods) was consistently set to 21 days for each of the indictors and the trading system (Simple Moving Average, Relative Strength Index, Williams %R). The value of 21 days represents a targeted trend of approximately three weeks and was chosen arbitrarily.

4.2 Securities and Data Used for the Analysis

This research uses four randomly selected securities from the S&P Small Cap 600 Index [4]. The four randomly selected securities are as follow:

Table 2: Selected Securities

Ticker Symbol	*Company Name*	*Industry*
NCI	Navigant Consulting Co.	Industrials
NOG	Northern Oil and Gas Inc.	Energy
PKT	Procera Networks, Inc.	Information Technology
SWS	SWS Group Inc.	Financials

For each of these selected securities, we collected data from Yahoo Finance through the period of January 1st 2009 to December 31st 2013.

4.3 MATLAB Simulation

A simulation tool was developed in MATLAB to support the research objectives. The simulation tool created a 'profile' for each of the selected securities. Within the profile, historic time series data was cross referenced with the 21-day Simple Moving Average trading system to generate a set of historic positions. Each selected security was simulated with End of Day data retrieved from Yahoo! Finance through the dates of January 1, 2009 – December 31, 2013. The number of positions for each security was dependent on the trading signals of the technical trading system. The calculations for each technical indicator were performed using the same historic time series data. The technical momentum indicator observation occurred at the time of a position entry signal.

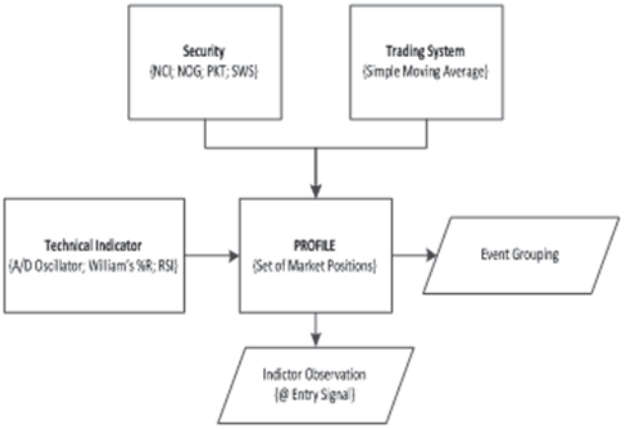

Figure 1: Conceptual Outline of Simulation Tool

Table 2 presents an illustrative example for a position entry and exit. The position entry signal occurred on Feb 5th, 2009 and the exit signal occurred on Feb 18th, 2009. The observational values for the three selected technical momentum indicators were measured at the time of the entry signal.

Table 3: Example of a Position Defined and corresponding Technical Indictor observations

Date	Close$	SMA	Close - SMA	A/D Osc	Will %R	RSI
Feb 4	14.54	15.69	-1.15	37.2	-70.3	37.8
Feb 5	17.10	15.60	1.50	93.0	-28.91	44.7
Feb 6	17.55	15.57	1.98	76.5	-21.9	48.8
Feb 17	16.09	15.72	0.37	28.5	-41.3	50.2
Feb 18	15.71	15.74	-0.03	6.6	-47.6	51.6
Feb 19	14.94	15.85	-0.91	7.4	-66.4	57.0

Table 4 summarizes all of the identified historic positions of each selected security. The number of positions identified for each security varies. Note that the distributions of position outcome for each security have a large Kurtosis statistics and is slightly skewed.

Table 4: Historic Position Data, grouped by Security

Summary of All Position Outcomes (Returns as %)							
Sym	$\bar{X}$%	$\tilde{X}$%	σ%	Kurt	Skew	Min%	Max%
NCI	0.0	-1.3	5.7	6.0	1.9	-12.2	26.4
NOG	2.3	2.4	19.5	39.1	5.7	-22.4	142.0
PKT	0.8	-2.3	13.8	15.2	3.3	-23.0	80.6
SWS	-1.7	-2.3	5.1	23.8	4.1	-11.8	31.7

4.4 Analysis of Variance Experimental Design

The returns of the positions for each security were ranked and classified relatively into four equal quartile classifications. The top 25% of the greatest /best positions for a given security were classified as Excellent; the next 25% were classified as Favorable, and so on. The following table summarizes the position outcome classifications, by security, and the corresponding return statistics.

Table 5: Historic Position Data, grouped by Outcome

Summary of Positions, grouped by Outcomes Classification								
	Excellent		Favorable		Unfav.		Terrible	
Sym	$\bar{X}$%	σ%	$\bar{X}$%	σ%	$\bar{X}$%	σ%	$\bar{X}$%	σ%
NCI	7.6	6.0	-0.8	0.3	-2.0	0.56	-5.0	2.2
NOG	21.4	31.7	-1.2	0.8	-3.4	0.5	-7.2	4.3
PKT	16.9	19.2	-1.2	0.8	-3.5	0.6	-8.4	4.5
SWS	3.3	7.6	-1.5	0.4	-3.0	0.5	-5.5	1.9
	11.5	**19.6**	**-1.2**	**0.6**	**-3.0**	**0.8**	**-6.4**	**3.6**

The two factors within the ANOVA experiment are position outcome classification and security. The response variable is the observed technical indictor value. Each technical indicator is analyzed separately. The following is a table with the number of observations considered per combination, per technical indictor.

Table 6: Sample Group Sizes of ANOVA Experiment

		POSITION OUTCOME				
		Exc.	*Fav.*	*Unfav.*	*Terr.*	***Total***
SECURITY	*NCI*	19	18	19	19	**75**
	NOG	17	17	18	17	**69**
	PKT	19	19	19	20	**77**
	SWS	24	24	25	24	**97**
	Total	**79**	**78**	**81**	**80**	**318**

5 RESULTS

5.1 Accumulation/Distribution Oscillator

Table 7: A/D Oscillator Means Values, group by Outcome

	A/D Oscillator Mean Observational Value							
	Excellent		*Favorable*		*Unfav.*		*Terrible*	
Sym	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ
Ave	*78.0*	*14.7*	*74.4*	*15.0*	*77.5*	*13.6*	*81.7*	*11.9*
NCI	80.1	9.9	70.2	14.7	73.7	16.8	81.7	10.0
NOG	79.3	16.0	77.6	10.7	75.4	12.0	79.0	14.9
PKT	77.6	13.9	71.4	19.8	79.9	14.4	80.1	12.6
SWS	74.9	18.8	78.2	14.8	81.1	11.1	85.9	9.9

Table 8: A/D Oscillator ANOVA Table

Accumulation/Distribution (A/D) Oscillator ANOVA Table					
Source	*Sum of Squares*	*Degrees of Freedom*	*Mean Squares*	*F Statistics*	*Prob. > F*
Security	629.5	3	209.832	1	0.3918
Position Outcome	2099.9	3	699.98	3.35	0.0195
Security* Position Outcome	2078.4	9	230.928	1.1	0.3597
Error	63180.9	302	209.208		
Total	68088	317			

5.2 Williams' %R

Table 9: Williams' %R Means Values, group by Outcome. Note: The means have been multiplied by -1 in this table

	Williams' %R Mean Observational Value							
	Excellent		*Favorable*		*Unfav.*		*Terrible*	
Sym	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ
Ave	*40.4*	*13.0*	*43.9*	*9.5*	*42.2*	*10.6*	*36.9*	*14.4*
NCI	37.1	12.1	39.5	10.6	44.1	7.6	37.3	14.0
NOG	37.5	10.1	48.6	8.4	42.9	10.3	39.4	8.2
PKT	44.4	17.5	48.8	7.2	40.3	11.4	38.1	18.7
SWS	42.8	12.5	38.7	11.9	41.5	13.3	32.7	16.7

Table 10: Williams' %R ANOVA Table

Williams' %R ANOVA Table					
Source	*Sum of Squares*	*Degrees of Freedom*	*Mean Squares*	*F Statistics*	*Prob. > F*
Security	918.8	3	306.281	1.85	0.1387
Position Outcome	2118.8	3	706.264	3.35	0.0058
Security* Position Outcome	2430.6	9	270.064	1.63	0.1064
Error	50087.1	302	165.851		
Total	55572.6	317			

5.3 Relative Strength Index

Table 11: RSI Means Values, group by Outcome

	RSI Mean Observational Value							
	Excellent		*Favorable*		*Unfav.*		*Terrible*	
Sym	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ
Ave	*49.4*	*6.7*	*50.4*	*7.0*	*50.7*	*6.6*	*50.6*	*6.8*
NCI	49.1	6.5	52.0	7.8	52.1	7.9	51.6	6.8
NOG	50.3	6.6	49.8	6.8	49.5	6.3	49.9	6.1
PKT	48.7	7.4	49.1	6.7	49.4	5.8	49.7	8.3
SWS	49.7	6.4	50.5	6.5	51.9	6.4	51.2	5.9

Table 12: RSI ANOVA Table

Relative Strength Index (RSI) ANOVA Table					
Source	*Sum of Squares*	*Degrees of Freedom*	*Mean Squares*	*F Statistics*	*Prob. > F*
Security	185.53	3	61.8423	1.28	0.2811
Position Outcome	80.44	3	26.8134	0.56	0.645
Security* Position Outcome	102.26	9	11.3618	0.24	0.9892
Error	14584.98	302	48.2946		
Total	14964.97	317			

5.4 Interpretation of Results

The maximum value of the Accumulation/Distribution (A/D) Oscillator is reached when the market opens at the Low and closes at the High. Larger A/D Oscillator observations suggest greater market sentiment towards an upward price movement. The distribution of the observed values is skewed towards the higher end of the scale. This was expected as observations were recorded at the time of a Long entry signal from the 21-day moving average trading system. The Simple Moving Average trading system generates an entry signal when the close crosses the 21-day average. For the close to cross the average, the security pricing needs to advance upward pass the average value. The A/D Oscillator only takes into consideration the high, low, open, and close price points of the given period/day rather than taking into account a series of periods (n-observations). This led to significant volatility among the A/D Oscillator observations. Although the F statistic of the ANOVA experiment suggested that position outcome varied among outcome classifications, the distributions of observations among the outcome classifications challenged the assumptions of ANOVA. Correspondingly, the hypotheses associated with the A/D Oscillator are neither confirmed nor rejected.

The Williams %R indicator observations are measured on a negative scale ranging from −100 (lowest) up to 0 (highest).

An observational value of −100 occurs when the close is at the lowest low of the past n-observations/days, and an observational value of zero occurs when the close is at the highest high of the past n-observations/days. Similar to the A/D Oscillator, the distribution of observed Williams' %R values are skewed towards the higher end of the scale, suggesting the indicator correctly identifies upward price movements. Similar to the A/D Oscillator, the F statistic of the ANOVA experiment suggests position outcome influences the value of the William's %R indictor as hypothesized although the assumptions of ANOVA were challenged. The hypotheses associated with the William's %R indictor are neither confirmed nor rejected.

The Relative Strength Index measures momentum by oscillating between 0 and 100 with an observational value of 50 representing market neutral momentum. Wilder suggested the n-observations parameter be set at 14 periods opposed to the 21 periods selected for this experiment [16]. The mean observed value was approximately 50 among all outcome classifications which suggested the RSI indictor provides little value for predicting future position outcomes. The F-statistic rejected the hypothesis that a difference in the mean observed value exists among the varying position outcomes. The observations of the Relative Strength Index indictor were approximately normally distributed and in line with assumptions of an ANOVA experiment.

There was no indication the selected indictors perform differently among the randomly selected securities. Furthermore, there was no indication of interaction between the selected securities and the outcome classifications among the selected indicators. The methodology used to assign the outcome classification label could be a possible explanation for these findings. Although the distributions of position returns varied among the different randomly selected securities, the relative ranking of the positions and corresponding assignment of position outcome label was performed within each security rather than among all securities.

As the number of positions for a given security were defined by the 21-day simple moving average trading system, it was not possible to guarantee the sample sizes were equal. For each security, the total number of positions was divided into even quartile classification groupings which ensured an equal number positions allocated to each outcome classification (+/- 1 observation), but not necessarily the same number of positions identified by the trading system among the randomly selected securities. If the sample sizes were equal, the assumption of normally distributed sample groups could be relaxed. Unfortunately, the variances of the observed indicator values (the response variable) were not consistent among each experiment groupings which made it difficult to draw definitive conclusions.

6 FUTURE RESEARCH

It would be worthwhile to investigate clustering position outcomes rather than simply dividing the samples positions into four equally weighted classifications based on percentile. Given the distribution properties highlighted in Table 4, a clustering approach would likely result in a small number of extreme positions being assigned "Excellent" and "Terrible" classifications, and the majority of the position outcomes being assigned to the "Favorable" and "Unfavorable" classifications. Correspondingly, the research hypotheses could be reformed to investigate if technical indicators have the ability to discover outlier market positions, namely those in "Excellent" and "Terrible" classifications.

Using all 318 positions from the four selected securities defined by the Simple Moving Average system in this experiment, the following table contains the top 10 positions with the greatest z-score, where the z-score is defined as $z = \frac{x_i - \mu}{\sigma}$. The z-score for each of the corresponding technical momentum indicator observations is also calculated and presented. It is interesting to observe that extreme position outcomes frequently have a corresponding extreme indictor observational value as defined by the z-score.

Table 13: Top Ten Position Outcomes by Z-Scores and Corresponding Indictor Observations

Position Return	**Position Return z-Score**	*RSI z-Score*	*AD Osc z-Score*	*Will %R z-Score*	Sym
26.38%	**2.17**	*-0.57*	*0.54*	*-0.06*	NCI
142.0%	**11.77**	*-0.46*	*0.74*	*1.25*	NOG
27.0%	**2.22**	*0.82*	*0.89*	*1.40*	NOG
35.4%	**2.92**	*-0.37*	*-0.25*	*0.43*	NOG
26.9%	**2.22**	*2.09*	*0.94*	*1.23*	NOG
40.32%	**3.33**	*0.45*	*-0.78*	*-1.15*	PKT
27.91%	**2.30**	*-0.92*	*-0.21*	*-1.96*	PKT
38.46%	**3.18**	*0.16*	*1.50*	*3.07*	PKT
80.57%	**6.67**	*1.59*	*0.65*	*2.09*	PKT
31.69%	**2.61**	*-1.50*	*-1.35*	*-0.87*	SWS

In addition to refining how positions are group into outcome classifications, it may be interesting to vary the targeted trends (number of n-observations) for the selected technical indicators as well as the parameters of the Simple Moving Average trading system. This research set the n- observation parameter consistently to 21 days for the Simple Moving Average, Relative Strength Index, and Williams %R indicator calculations. By varying the n-observation parameter the technical indicators will become more or less sensitive to the market fluctuation depending on if n-observation is decreased or increased, respectively.

Lastly, it is suggested to explore combining complimentary indicators to further investigate the possibility of developing a classifier that could be used to predict position outcome. At the time of an entry signal, multiple technical indicators can

be used to measure various aspects of market sentiment in addition to momentum which was the focus of this research. Other market sentiment aspects may include the strength of the trend, volatility of the security pricing, and trading volume. There are various types of indictors that could be used in combination as a feature set in a more complex model to estimate position outcome. The concept of complimentary indicators was explored by Galloppo who suggested the simultaneous use of Moving Averages and Oscillator indicators leads to improved forecast power as a result of their ability to catch complimentary information in past prices more effectively [6].

7 Conclusions

This paper highlighted the concept of using technical momentum indicators as predictors of position outcome defined by a technical trading system. This paper indirectly investigated and assessed the value of three momentum based indicators. The A/D Oscillator and the Williams' %R indicators offer some potential of predictive power to classify the outcome of a position defined by a 21-day SMA trading system, although no conclusions were able to be drawn as the assumptions of the ANOVA experiment could not be validated; nor were the results fully convincing. Results of the Relative Strength Index (RSI) suggest no predictive power to classify the outcome of a position defined by a 21-day SMA trading system.

8 References

[1] Achelis, S. B. (2001). Technical analysis from A to Z (2nd ed). New York: McGraw Hill.

[2] Bodie, Kane, Marcus (2003). Investments, 5th Edition. McGraw−Hill Primis. USA. p178

[3] CFA Institute (2008+). CFA Program Curriculum. Level 1, Vol. 5. p.95-109

[4] Dowgett Investments. S&P SmallCap 600 Index Components. www.bowgett.com Accessed Dec. 10, 2014.

[5] Fang Y., Xu, D. (2003). The predictability of asset returns: an approach combining technical analysis and time series forecasts. International Journal of Forecasting, Volume 19, Issue 3, July–September 2003, Pages 369-385. ISSN 0169-2070.

[6] Galloppo, G. (2009). Dynamic Asset Allocation Using a Combined Criteria Decision System. Accounting & Taxation, 1(1), 29-44.

[7] Gold, S. C. (1999). Computerized stock screening rules for portfolio selection. Financial Services Review, 8(2), 61.

[8] Kaufman, Perry J. (2013). Trading Systems and Methods (5th Edition). Hoboken, New Jersey: John Wiley & Sons Inc. p.1, 287, 397 & 401

[9] Leung, C., MacKinnon, R., & Wang, Y. (2014). A machine learning approach for stock price prediction. ACM International Conference Proceeding Series, (Proceedings of the 18th International Database Engineering and Applications Symposium, IDEAS 2014), 274-277.

[10] Mangram, M. E. (2013). A Simplified Perspective of the Markowitz Portfolio Theory. Global Journal of Business Research (GJBR), 7(1), 59-70.

[11] Preethi, G. & Santhi, B. (2012). Stock Market Forecasting Techniques: A Survey. Journal of Theoretical and Applied Information Technology. Vol. 46 No. 1.

[12] Investopedia. Definition of a Trend. URL: http://www.investopedia.com/terms/t/trend.asp. Accessed: December 15, 2014.

[13] Sharpe, W., Alexander, G., Bailey, J. (1999), Investments 6th Edition. Prentice Hall, Upper Saddle River. New Jersey. P.146

[14] Tsai, C.-F., & Wang, S.-P. (2009). Stock Price Forecasting by Hybrid Machine Learning Techniques. International Multiconference Of Engineers & Computer Scientists 2009, 755-760.

[15] Weckman, G. R., & Agarwala, R. (2003). Identifying relative contribution of selected technical indicators in stock market prediction. IIE Annual Conference.Proceedings, 1-6.

[16] Wilder, J.W. Jr. (1978) New Concepts in Technical Trading Systems. Hunter Publishing Company, NC, p.63-70

[17] Yoo, P.D., Kim, M.H., Jan, T. (2005). Machine Learning Techniques and Use of Event Information for Stock Market Prediction: A Survey and Evaluation. IEE: International Conference on Computational Intelligence for Modelling, Control and Automation, and International Conference of Intelligent Agents, Web Technologies and Internet Commerce.

A WEB APPLICATION USING MVC FRAMEWORK

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Abstract - *With the rapid development of the web, the facets of software have been changing rapidly. The web software is no longer static and should be able to cope with constant interactions with the users who are communicating with the system by clicking the mouse. This generates huge amount of data. The web-based software should be able to update the persistent data accordingly. In this paper, we will demonstrate the need for the MVC framework for the design of the web-based software to address these issues and present a web-based application software using CakePhp framework.*

Keywords: MVC, Three-Tier Architecture, CakePHP Framework

1 Introduction

Unlike a static website, a web application requires user interaction and persistent data storage capabilities. This introduces complexities to the software that can be alleviated with the help of a framework. Without a framework, a significant part of a programmer's time is spent on coding standard services such as caching, persistence and security. Since these are most likely application specific, there is no interoperability between different applications. This result is a lot of duplicate effort for each new project. A framework is a foundation of code that provides functionality that is common to a specific type of application. The programmer can build upon this foundation which can be used in multiple projects. Having lower-level functions, such as database connection, already created will cut down on development time and allow the programmer to focus on the main requirements or business logic; which is the project's objective. Some features of a web framework are the ability to easily store, access and update the application's persistent data; data integrity; session management; user authentication; security; and caching. The framework typically controls the flow of execution and can assist in programming to design patterns such as Model-View-Controller (MVC).

2 MVC and Three-Tier Architecture

In the MVC approach the application is divided in three components: model that represents the application data, view that present the user interface, and control that handles user input [2]. The MVC architecture is ideal for building websites that require user interaction. It makes applications easier to code, maintain and expand. This is due to the separation of the program components into different areas of logic; presentation (view), business or logic (control) and data access (model). Using the traditional description of MVC, the components are described as follows:

Model – Represents persistent application data and notifies views and controllers of changes to its state or data.
View – Presents model data to the user and observes the model for updates.

Controller – Handles any type of input and sends commands to update the model based on that input if necessary.

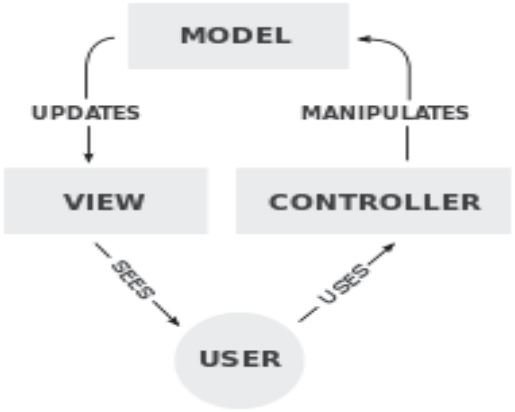


Fig. 1 The traditional MVC model

Three-tier architecture is based on the same principles of separation; with the idea that the components can be physically separated to reside on different machines. In addition to the advantages of code separation already discussed, three-tier architecture offers the advantage of being able to upgrade or replace any of the tiers without affecting the others.

2.1 CakePHP Framework

CakePHP is a rapid development framework for PHP that provides an extensible architecture for developing, maintaining, and deploying applications. Using commonly known design patterns like **MVC** and ORM, within the convention over configuration paradigm, CakePHP reduces development costs and helps developers write less code [7]. This is just one of many frameworks available for developing PHP applications. Some other popular frameworks are Laravel, Phalcon, Zend, Symfony and Code Igniter. Some of the reasons for choosing CakePHP are that it is open source, has a lot of built-in security tools, has built-in ORM and has a

large community of active developers. In CakePHP, the MVC pattern is slightly modified to fully separate the view from the model. The view only receives information from the controller and has no direct communication with the model. The framework is laid out as follows:

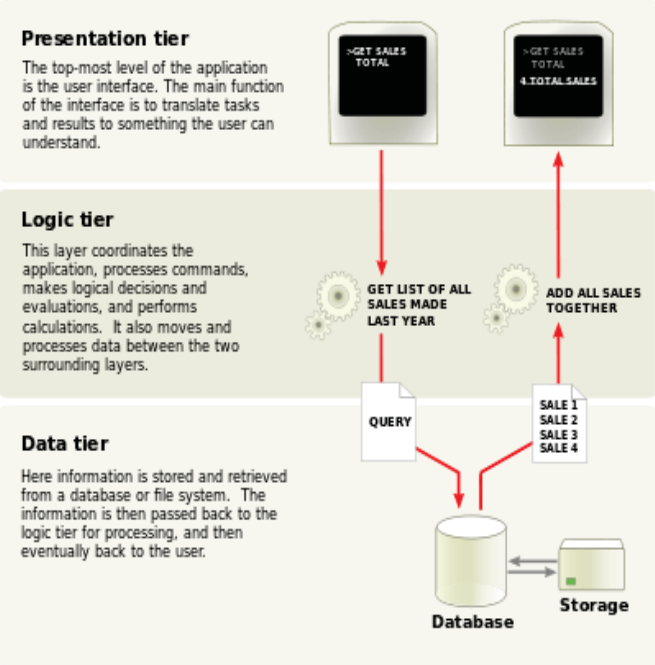


Fig.2 Three-Tier Architecture

Model - Fulfills requests sent by the user through the controller to view or manipulate the application data. This is where the persistent data for the application is stored. The model also defines relationships between objects and performs data integrity checks. Once the model is set up, the relationships are available to the rest of the application. Changes made to the model are automatically reflected throughout the application.
View - Displays the requested data or appropriate message to the user. The view never modifies application data but is updated with any changes made to it. An application can have more than one view that represents the same data. The view that is displayed depends on the type of user and what that user is trying to accomplish. Each view is associated with a unique controller but one controller can control multiple views. Based on the type of user and requested action, the controller decides which of those views to call.
Controller - Receives requests from the user and calls the appropriate method in the model to retrieve or modify data. The requested data is then sent to the appropriate view. The controller also performs data validation on input received from the user.

Keeping each component separate makes it possible to assign the programming for each part of the application to different teams. Changes made to one part of the application do not affect the other parts. With this configuration, it is easy to integrate a new model or view into the application. Since the components are separate, they can be used in other applications as well.

2.2 Object-Relational Mapping

CakePHP also provides object relational mapping. Once you define what type of database you want to connect to, the appropriate syntax is automatically used. Since Cakephp employs the convention over configuration paradigm, if you follow the naming conventions provided in the CakePHP documentation, relationships between models are easy to create and are recognized throughout the application. For example, a simple call to get data from a table with related tables; will retrieve all related data as well.

A relationship is defined between the User and Comment objects.

```
class User extends AppModel {
   public $hasMany = 'Comment';
}
```

A simple call to retrieve users, results in the users' comments being retrieved as well; without any extra programming effort.

```
//Sample results from a $this->User->find() call.
Array
(
   [User] => Array
      (
         [id] => 121
         [name] => Gwoo the Kungwoo
         [created] => 2007-05-01 10:31:01
      )
   [Comment] => Array
      (
         [0] => Array
            (
               [id] => 123
               [user_id] => 121
               [title] => On Gwoo the Kungwoo
               [body] => The Kungwooness is not so Gwooish
               [created] => 2006-05-01 10:31:01
            )
         [1] => Array
            (
               [id] => 124
               [user_id] => 121
               [title] => More on Gwoo
               [body] => But what of the Nut?
               [created] => 2006-05-01 10:41:01
            )
      )
)
```

Both of the above arrays are made available to the corresponding view. The framework is flexible as well and this scenario is easily overwritten for an instance when you do not want to retrieve the related data.

```
$this->User->unbindModel(
   array(hasMany => array('Comment'))
);
```

This only affects the very next find function; subsequent calls revert back to the standard call unless they are also overwritten. Updating a model does not require any updating to the methods that manipulate and retrieve data from that model. The basic CRUD (Create Read Update Delete) logic remains the same. Therefore, the controller logic does not need to be changed.

2.3 CakePHP Web Application

This section presents an example of the CakePHP MVC framework in implementing an event sign up application. This can be a stand-alone application or just a part of a larger website. The objective of this application is to allow users to sign up for events online instead of filling out a form by hand and mailing it. This not only provides value for those signing up, but for the event organizers as well. Unlike with the current situation of having a static website, the organizers will not have to manually keep track of attendees from hand-written, sometimes illegible, forms; they will have a way to quickly retrieve past event attendees; and can easily add a new event or update existing events. Users can view all events; sign up for those whose registration deadline has not yet passed and get a quick view of what they have already signed up for and how much they still owe. Since the application was implemented using the MVC design pattern, it can easily be expanded and can also be adapted for use in other similar projects.

The flow of the application from a user's perspective:

1. A user clicks on the events page of a website which sends a request to the controller.
2. The controller reads the request and sends the appropriate call to the model for a list of events.
3. The model connects to the database and performs the necessary logic to retrieve the requested data.
4. The data is then available to the view called by the controller and the list of events is displayed to the user. The event hyperlinks are disabled.
5. The page displays a message to log in to sign up for an event.
6. The user either logs in or creates an account and is routed back to the events page where the event hyperlinks are now enabled.
7. The user clicks on an event, signs up and is routed back to the event page where he can view a list of events for which he has signed up and how much he owes. If he has not already paid for an event, he can delete it from his list.

The flow of the application from an admin's perspective:

1. The admin log in page is presented since no admin pages are available to non-admin users.
2. Once logged in, the controller routes the admin user to the admin events page where a different controller makes a call to the model and the model makes the list of events available to view.
3. The admin can edit an event or delete one if there are no paid attendees.
4. The admin clicks on an event to view the attendee list and can mark them as paid.
5. Once back at the events page, the admin can create a new event.

2.4 High-Level System Diagram

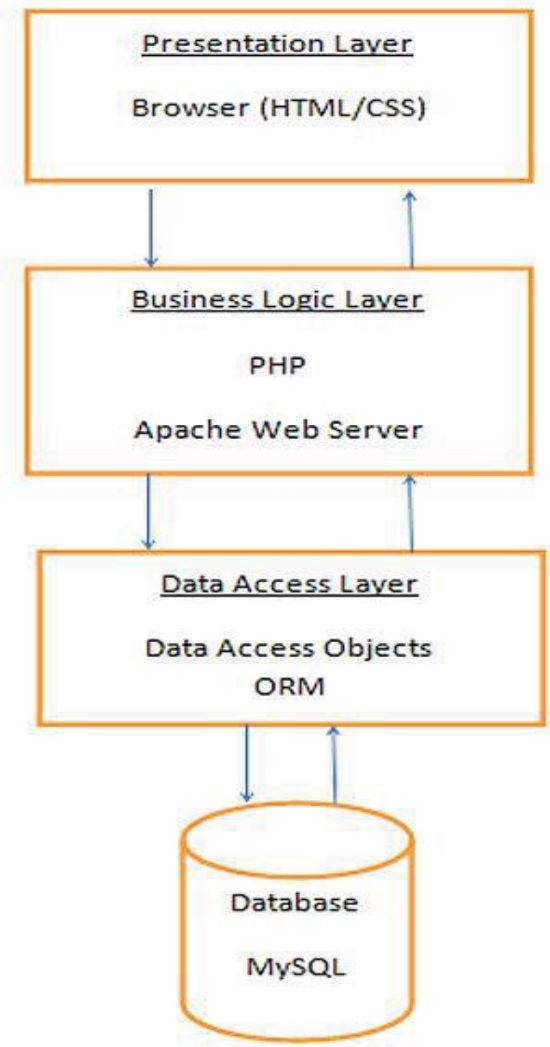
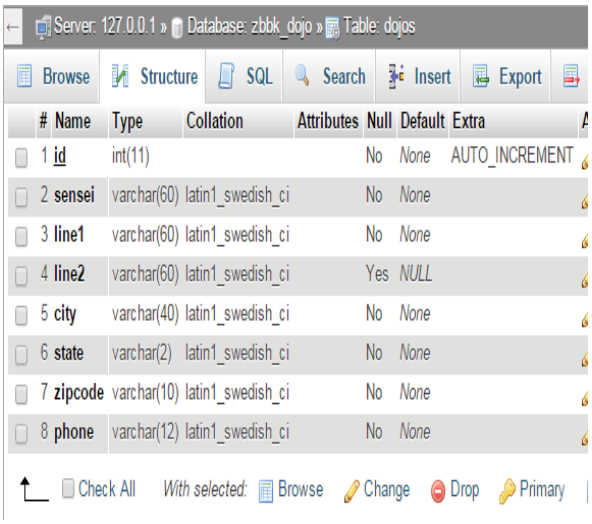


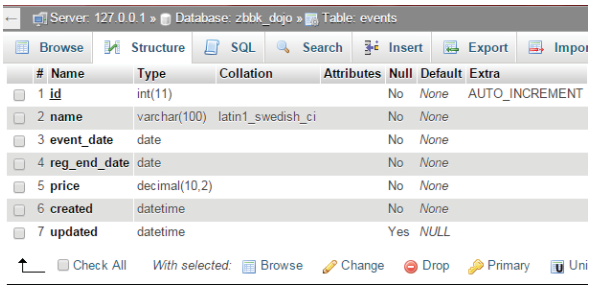
Fig. 3 High-level system diagram

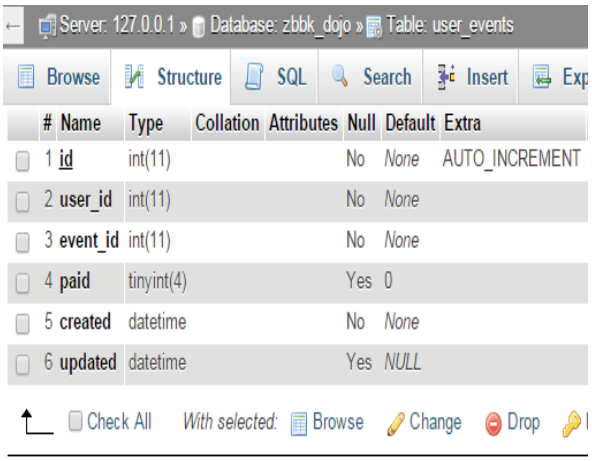
2.5 Table Names

dojos



events





For more screen shots, the readers are referred to the appendix at the end of the paper.

3 Conclusion

The benefits of using the MVC design method when programming a web application are abundantly clear. The fact that there are many existing frameworks available to help with the process is very encouraging. Taking the time to research, choose, and learn a framework is definitely worth the up-front effort. Even though it might take a lot of time away from the project in the beginning, the end result is that it makes the coding faster and less error prone. Since errors are a great source of frustration, this alone makes the effort worth it. Since many of the frameworks are open source, new components frequently become available. These plugins contain content that is common to many applications; such as shopping carts. This all contributes to the goal of making a programmer's job less tedious.

4 References

[1] The Architectural Design of Globe: A Wide-Area Distributed System http://www.nlnet.nl/projects/sirs/200202-final-sirs/papers/ieeeconc.99.pdf

[2] Abhishek Arora, "Distributed Software Using MVC and Hybernate in Business Applications," MS Project, CIS Department, University of Michigan – Dearborn, 2014

[3] A Database and Web Application Based on MVC Architecture http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=1604744&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D1604744

[4] Model-view-controller http://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93controller

[5] Web Application Framework http://docforge.com/wiki/web_application_framework

[6] Multitier Architecture http://en.wikipedia.org/wiki/Multitier_architecture

[7] Design Pattern: MVC By Vincenzo Stefanini in PHP, PHP Frameworks, Web Development 11/10/2013;http://www.vincenzostefanini.it/category/php/

[8] CakePHP MVC Documentation http://book.cakephp.org/2.0/en/cakephp-overview/understanding-model-view-controller.html

[9] CakePHP Documentation http://book.cakephp.org/2.0/en/index.html

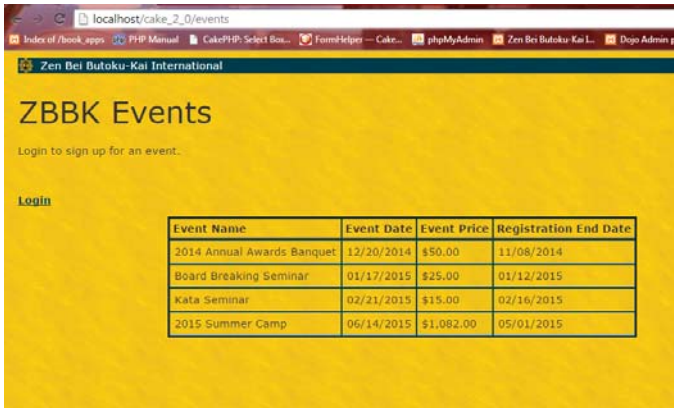
[10] Murach, Joel and Harris, Ray. PHP and MySQL. Fresno: Mike Murach & Associates, Inc. 2010

[11] Model View Controller Architecture http://www.mindtelligent.com/pdf/mvc.pdf

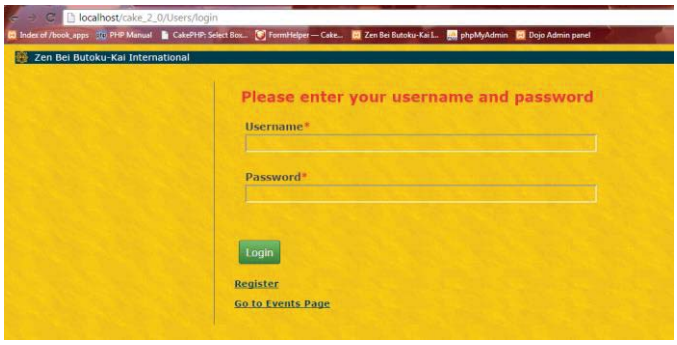
APPENDIX

Application Screenshots

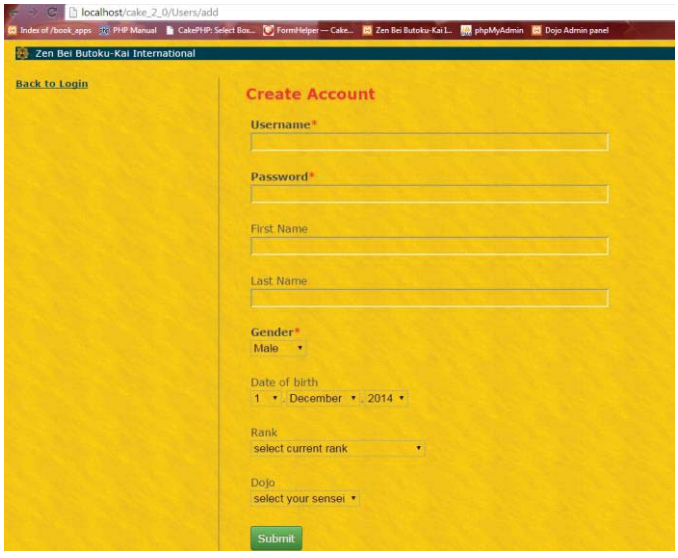
The user can look at events before logging in, but cannot sign up. Event hyperlinks are disabled.



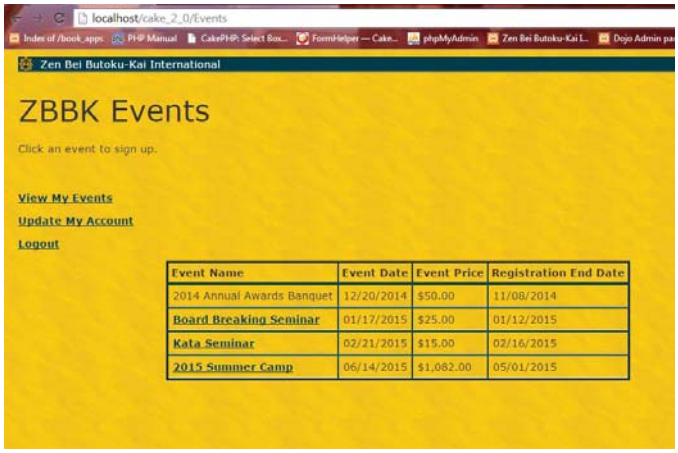
The user can log in or create an account.



The account creation page.

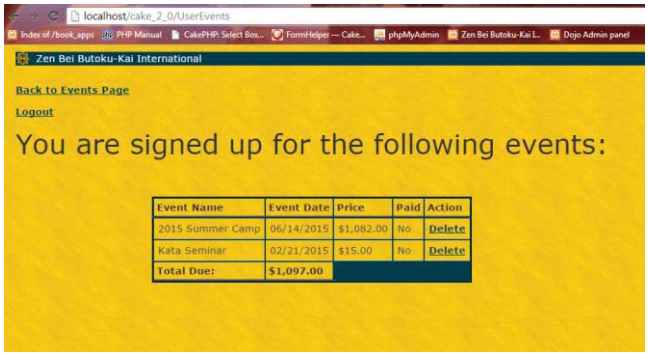


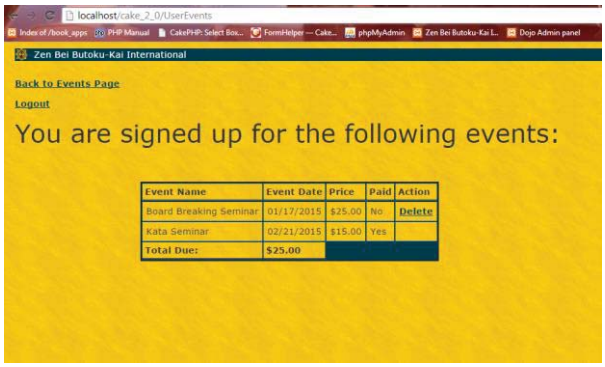
After logging in, the user can sign up for events if registration is still open, see a list of events they have already signed up for, and edit their user information. Event hyperlinks are now enabled.



The events sign up page.

User can view events and delete from their list if they have not yet paid.



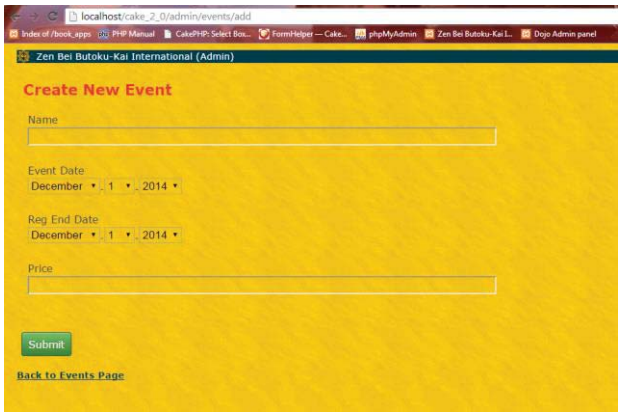


Admin view of events page. Events can be deleted only if there are no paid attendees.

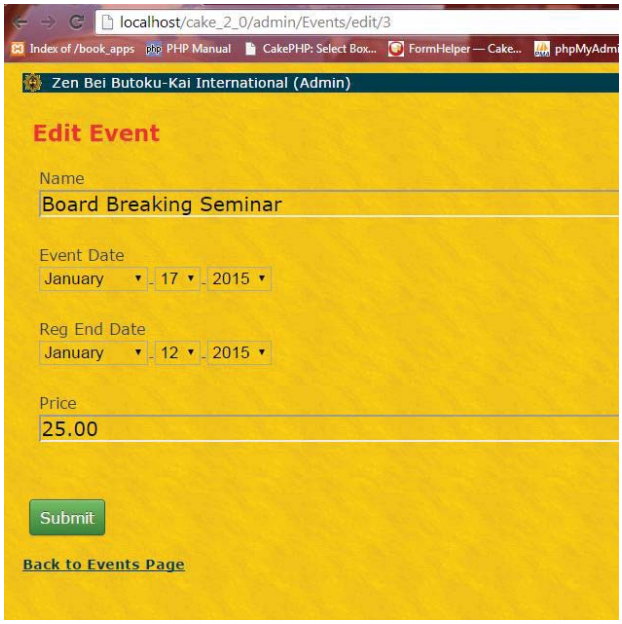
Try to delete an event with paid attendees.

Admin can view attendee list and mark them as paid.

Admin can create a new event.



Or edit an existing event.



Adopting Change

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Abstract – *Frequent change is common in the internet environment. The best of products, applications, ideas, methods, and/or procedures are worthless unless adopted. This paper explores modern change theory from the context of implementation. The author proposes a theory based on utility and cost benefit analysis.*

Keywords: Change, Management

1 Introduction

Change is often the overlooked part of process. Better theories, products, or methods are of not useful if they are not adopted. This paper explores various adoption models, proposes a simplified model, then explores change strategies.

2 Change

There are many reasons that people are justifiably wary of change. These reasons include memory of imposed changes that did not work, were less effective, created more work, and/or had no purpose. Particularly when there is constant change, folks may hesitate to adapt because they know something new will be coming soon.[1]

Managers and leaders should consider why they want change and the likelihood the probable popularity of proposed changes. There needs to be a balance between and administrator's understanding of needed change and the degree to which followers are likely to accept the change. [1, 2]

Singly and collectively, follower opinions and decisions make change happen or prevent change. Thus, it is very important to build follower opinions.

Ideally, everyone is involved in change decisions and thus "buys in". Some managers try to disguise a sales pitch for change as involvement. In example, committees are formed then guided to make the already made decision. This process is both old and obvious. Many find fake involvement insulting and a waste of time. [3] To improve the possibility for future change, leaders should be open to the possibility that followers will prove that the change is not needed.

Common factors in successful change include [4-8]:

- A clear, complete, and easily accessed plan for change,
- Constant and current communication about need, process, and current status,
- Build trust that everyone's opinion is respected and responded to.
- Concern for all involved in the change and buy-in from at least key persons,
- Addressing and overcoming resistance to change (unfreeze culture - change - refreeze culture).

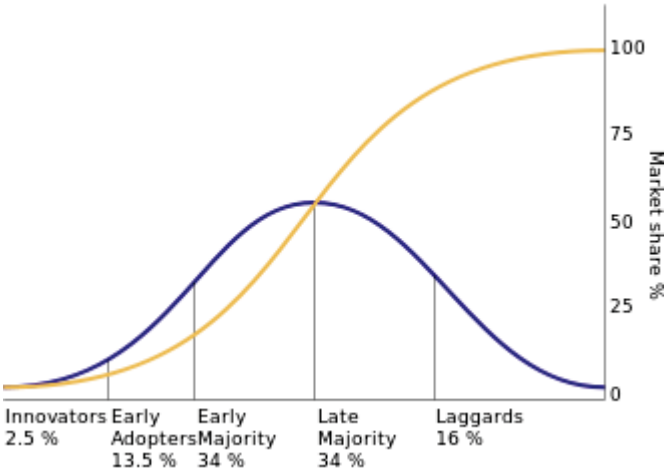
3 Rogers' Theories of Diffusion of Innovation

Roger's theories [9] focus on the social aspects of changes and thus his classification focuses on who adopts change and when. Rogers defined five categories of persons who adopt change and placed them on both a bell and S curve:

1. **Innovators** are the first to adopt something new but the things they adopt often fail in the sense that they do not reach common use and/or do not prove useful. These persons might be described as persons who try anything and everything. Innovators are estimated at about 2.5% of the population.

2. **Early Adopters** are the second fastest to adopt. As opinion leaders, early adopters are watched closely by the other adopter categories and are often influential in later category decision making. I believe the major difference between innovators and early adopters is that early adopters tend to adopt innovations that are later more widely used. Perhaps early adopters are more careful in their selection, influential, or lucky. Early adopters often keep track of what Innovators are exploring but do not make decisions as quickly. Early adopters are about 13.5% of the population.
3. **Early Majority** take longer to adopt, tend to have less effect on other persons' decisions to adopt, and their opinions are often the result of the opinions of early adopters. Rogers estimated Early Majority users at about 34% of the population. Between
4. **Late Majority** tends to be skeptical of change and only adopt after they perceive a majority have already adopted and/or are required to make the change. Late majority users are also about 34% of the population.
5. **Laggards** tend to be very set in their ways and thus resistant to change. Laggards are unlikely to change and represent about 16% of the population. These are the people who probably still have landline phones at home.

Figure 1 [10] supplies a bell curve representation of how successive groups adopt innovation. The yellow S curve shows saturation of the population.



The take-away for administrators (or marketing folks) who want to create change is they need to generally classify or discover members of the Early Adopters and Early Majority groups. Energy focused on convincing Early Adopters facilitates change as other adopter are likely to follow their lead..

Rogers also identified five factors that that influence the choice to adopt:

1. **Relative Advantage**: How much better is the innovation that what is currently used. Users are more likely to adopt innovations that improve their environment and that make drastic improvements. For instance, a power screwdriver is a major improvement over a hand driven screwdriver if you have to drive many screws.
2. **Compatibility**: How is easy is it to assimilate the innovation within the current structure. Users are more likely to adopt innovation that is easy to learn and that does not require substantial change to their environment. Power screwdrivers are another good example. The bulk of the power screwdriver may prove a problem.
3. **Complexity**: How easy is it to learn to use the innovation. Users are less likely to adopt innovation that takes a long time to learn. The US resistance to using the metric system is an example.
4. **Trialability**: How large are the barriers to trying the innovation. Users are more likely to adopt innovation that they can try at little expense.
5. **Observability**: How visible is the innovation and its change. Users are more likely to adopt when they are seeing the innovation used elsewhere.

4 Bass Diffusion Model

Bass [11] followed up on Roger's "observability" and defined adopters as either innovators or imitators. According to Bass, the speed and timing for a population or a subset of a population to adopt a new product depends on the population's innovativeness and imitation. [6, 12] The Bass model is particularly useful when analyzing technology adoption and social networks.

Figure 2 the Bass model of adoption.

$$\frac{f(t)}{1-F(t)} = p + qF(t)$$

Where:

- $f(t)$ is the change of the installed base fraction
- $F(t)$ is the installed base fraction
- p is the coefficient of innovation
- q is the coefficient of imitation

Criticisms of the model include questions of where values of the coefficients are discover and the accuracy of the values placed in the equation. [13]

5 Dubrin's Suggestion for Implementing

Dubrin [14] suggested a few techniques to gather support for innovation including:

- **Provide clear communication**: people are unlikely to change unless they understand the change, the need for change, and the change process.
- **Encourage participation in the change process**: people are more likely to accept change when they feel they were part of the decision making process.
- **Establish importance/urgency:** people are more likely to participate in change when they feel there is a need for change.
- **Allow gradual change**: people are more likely to adopt change with time to move at their own pace.

6 Proposed Change Theory

I suggest a simplification of the above theories based on a demand curve and substituting utility and cost. People elect to adopt new innovation based on utility and cost. Thus, something that costs very little that is perceived as very useful receives high adoption. While something perceived as high cost with low utility receives very low adoption.

Cost is defined by the user but relates to available resources which include:

- **Opportunity cost:** what is the value of items that my might be purchased?
- **Consequences of not adopting:** What are the possible consequences of not adopting?
- **Space:** What other items of value must be given up if the item is purchased. This is equivalent to kitchen counter appliances where only so many will fit.
- **Training:** How does it take to learn to effectively use the new item?
- **Availability:** How is easy is it to find a place to acquire the item.

Utility is also defined by the user.

- How **effective** the item in performing user desired tasks as compared to **time** and **effort** required by other options.
- Does the item require more or less time to accomplish tasks including setup, work, and cleanup.

Figure 3: Shows the relationship between cost and utility.

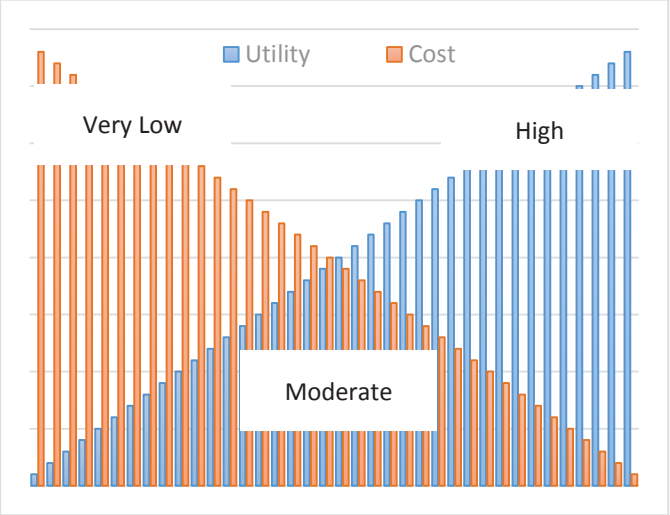


Figure 3 shows that adoption increases with decreasing cost and increased utility. The upper left area shows that, while there will be some adoption regardless of utility and cost the greatest adoption occurs in the area marked "High" with low cost and high utility..

Moderate adoption of change occurs in the area marked moderate with lower utility and higher cost.

The intersection of Utility and Cost represents a consumer decision point.

7 Discovering a Need for Change

Change results from a perceived need to change. It is very hard to get people to change if they do not perceive the need for change. Many models suggest a periodic or constant review of process to explore and discover opportunities.

The need for change for greater utility often manifests from a variety of sources including.

- Need to address organizational problems. Considerations in organization change include[15]:
    - Let the employee(s) know there is a problem
    - Do not move employees around the organizational chart or to other areas to remove the problem from your area.
    - Involve as many persons as appropriate and legal in the process.
- Effective organizations occasionally bring all layers of management and line employees temporarily together to review their processes and make changes to improve outcomes. [3]
- Communication is essential. [14]
- The goals of the organization and organizational units should occasionally be reviewed by all. Many managers would be surprised at the extent of difference between their understanding and what people they supervise consider their job duties and priorities. [16, 17]

Marketing is also a very import concern. The best idea/device/method in the world for a particular task is not adopted if nobody hears about it in a convincing way.

The take away is that administrators who wish to introduce something new should stress the utility of what they want to introduce and make the new whatever easily accessible.

Organizational discovery of needed change may come from a variety sources. SWOT (Strengths, Weaknesses, Opportunities, and threats) was discussed as source for understanding need for change in some posts. You should have been (over) exposed to SWOT by now. If you are not familiar with the SWOT analysis method, I strongly urge you review it.

You may not be as familiar with Porter's Five Forces. Porter's Five Forces are a nice compliment to SWOT that also deserves review when reviewing the company's environment:

1. The power of customers to affect pricing and reduce profit margins.
2. The power of suppliers to influence the company’s pricing.
3. The threat of similar or substitute products to limit market freedom and reduce prices and thus profits.
4. The level of existing competition that affects investment in marketing and research and thus erodes profits.
5. The threat of new market entrants to intensify competition and further affect pricing and profitability.

Another approach towards approaching a project is to consider the balance between cost, scope/quality, and time.

8 Who Makes Decisions

The higher you are in the administrative chain of command the bigger your picture should be. However, change decisions should involve input from all levels. [18-21]

1. Top level administrators make **strategic** decisions [22, 23] about the direction of the organization and major changes in what the organization does. This requires much review of the external environment. Organizational strategic plans are typically plans are typically for three to ten years and will typically have much higher cost.
2. Middle level administrators make **tactical** decisions which fill out in broad strokes the needed actions to accomplish tactical direction to complete strategic decisions. Organizational tactical plans are typically for a few months to a couple years.
3. Lower level administrators and line employees make **operational** decisions about what will actually be done. Their focus is mostly internal to the organization and direction of line employees.

9 Planning and Implementation

Regardless of your administrative level or the type of decision, it is wise to involve and receive input from all levels for a few reasons: [4, 24, 25]

- Plans at all levels must coordinate. Strategic plans that ignore tactical and operational realities will fail. Operational plans that are

at odds with tactical and strategic plans are bad for the organization. This increases cost and decreases utility.
- Plans that are developed at all levels tend to receive improved **buy-in**. Plans do not happen when stakeholders do not participant. [20, 26]
- **Sanity check**. What makes sense at one level may not possible at other levels.
- People at all levels have good ideas and are often aware of possibilities for improved decisions and reasons to avoid some decisions.

9.1 Linear Models

The classic linear model [19] suggests that development should occur one stage at a time while chaotic models combine the stages to occur simultaneously. Linear models are generally applied to very large projects with resultant high cost and utility that have very critical outcomes
As Figure 2 of my model shows, high cost and utility tend to have moderate adoption.
Small to medium sized organizations or organizational units tend to use methods that are more chaotic where design, implementation, and verification are combined.
I find the greatest weakness in linear models is that end-users, systems analysts, and administrators cannot fully articulate their needs until they begin to use a system. Even advocates of linear models acknowledge than some change must occur in the maintenance phase.
Linear planning methods take the essential parts of development one at a time.

1. Identify a need for change.
2. Identify requirements (analysis)
3. Design the system changes/create a new system.
4. Implement the changes
5. Verify, test
6. Maintain with small modifications

Outcomes generally take much longer with linear models and the product may be obsolete by the time it is implemented. In example, the IRS is reported to have twice spent billions to create new systems that were never used because the product was obsolete by the time it was finished.
The last stage, maintenance, demonstrates that all planning models agree change to the final product must happen.

9.2 Chaotic Models

This chaotic model is not new but modern computer application design tools are making chaotic design much easier.
The linear sequence is iterative as need for further change is perceived or the current system is reviewed.

9.3 Comparison of Linear and Chaotic Models

Chaotic models combine stages. Linear models, such as the classic Waterfall complete each stage before the next stage begins. (The Waterfall model is so named because the concept is a series of pools; each pool must be filled before the flow reaches the next.)
Even a classic linear project will have some chaos at the team level.
In practice, I find all development has aspects of chaotic and linear models to some degree. Typically, the smaller the unit of organizations the greater the chance they are using chaotic development methods.

10 Conclusion

Organizations cannot survive without effective change decisions. Evaluation of the utility and cost is an effective approach towards deciding when organizational or personal change should occur.
Reasons for change and the implementation process are also explored.

11 References

[1] G. Jones, *Organizational Theory, Design, and Change.* Edinburgh Gate, England: Pearson Education, 2013.

[2] J. Kotter, *Kotter, J. (2012). Leading Change. Boston, MA: Harvard Business Review Press.* Boston, MA: Harvard Business Review Press, 2012.

[3] (November 2012). *3 Leadership Tips for Creating Organic Change*. Available: http://www.forbes.com/sites/johnkotter/2012/11/19/3-leadership-tips-for-creating-organic-change.

[4] (9/4/2014). *Sponsorship of Change* . Available: http://changingminds.org/disciplines/change_management/planning_change/sponsorship_change.htm.

[5] Anonymous "Leadership," pp. 409168680, -01-21, 2011.

[6] B. Bass, *Transformational Leadership.* New York, NY: Lawrence Erlbaum Associates Inc., 1998.

[7] Cameron, K. & Quinn, R., *Diagnosing and Changing Organizational Culture: Based on the Competing Values Framework.* . Reading, MA: Addison-Wesley, 1999.

[8] Fernandez, S. & Rainey, H.G., "Managing Successful Organizational Change in the Public Sector: An Agenda for Research and Practice." *Public Administration Review,* pp. 168-176, 2006.

[9] E. Rogers, *Diffusion of Innovation.* Simon and Schuster, 2003.

[10] (March 2015). *Diffusion of innovations.* Available: http://en.wikipedia.org/w/index.php?title=Diffusion_of_innovations&oldid=654244053.

[11] F. M. Bass, "Comments on "A New Product Growth for Model Consumer Durables The Bass Model"," *Management Science,* pp. 1833--1844, 2004.

[12] F. Bass, "A new product growth for model consumer durables," *Management Science,* vol. 15, pp. 215--227, 1969.

[13] F. Bass, T. Krishnan and D. Jain, "Why the Bass Model Fits without Decision Variables," *Marketing Science,* vol. 13, pp. 203--223, 1994.

[14] A. DuBrin, *Essentials of Management.* Mason, OH: South-Western, 2012.

[15] (June 2014). *3 Mistakes to Avoid When Strategizing*. Available: http://www.thegoldhillgroup.com/3-mistakes-to-avoid-when-strategizing/.

[16] P. Hersey, K. H. Blanchard and D. E. Johnson, *Management of Organizational Behavior: Leading Human Resources.* Upper Saddle River, NJ: Prentice Hall, 2001.

[17] Hersey, P. & Blanchard, K., *Situational Leadership: A Summary.* Englewood Cliffs, NJ: Prentice-Hall, 1988.

[18] (June 2014). *A project management primer: Basic principles - scope triangle. Project Smart, U.K.* Available: http://cdn.projectsmart.co.uk/pdf/project-management-scope-triangle.pdf.

[19] J. Hiatt, "ADKAR: A model for change in business, government and our community. prosci learning center publications." Prosci, Loveland, CO, 2006.

[20] (August 2011). *How to Tap Employee Ideas*. Available: http://www.inc.com/guides/201108/how-to-tap-employee-ideas.html.

[21] (March 2014). *Are You Asking For Feedback From Your Employees?*. Available: http://www.forbes.com/sites/drewhendricks/2014/03/31/are-you-asking-for-feedback-from-your-employees/.

[22] J. Bryson, *Strategic Planning for Public and Nonprofit Organizations: A Guide to Strengthening and Sustaining Organizational Achievement.* . John Wiley & Sons., 2011.

[23] H. Mintzberg, "The fall and rise of strategic planning." *Harvard Business Review,* vol. 72, pp. 107--114, 1994.

[24] W. Seibel, "Beyond Bureaucracy—Public Administration as Political Integrator and Non-Weberian Thought in Germany," *Public Adm. Rev.,* vol. 70, pp. 719-730, Sep, 2010.

[25] (June 2013). *Planning in Management: Strategic, Tactical, and Operational Plans.* Available: http://www.udemy.com/blog/planning-in-management/.

[26] F. Siddiqui, "Impact of Employees Willingness on Organizational Change " *Journal of Economics and Sustainable Development,* vol. 2, 2011.

SESSION

E-BUSINESS, E-COMMERCE, ENTERPRISE INFORMATION SYSTEMS, TELEWORK, AND RELATED ISSUES

Chair(s)

TBA

THE IMPACT OF MOBILE USAGE AND SOCIAL MEDIA ON E-COMMERCE ACCEPTANCE AND IMPLEMENTATION IN SAUDI ARABIA

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Abstract - *Despite the fast growing economy, the rapid increasing internet usage and the strong purchasing power in Saudi Arabia, the evolution of E-Commerce remains slow in the country. The growth rate of E-Commerce in Saudi Arabia is inconsistent with the growth rate of its economy, mobile usage, social media activity and internet penetration. Previous studies have shown what factors motivate or inhabit the evolution of E-Commerce in Saudi Arabia. This paper is conducted to investigate impacts of mobile usage and social media on the acceptance and implementation of E-Commerce in the country. A comprehensive web survey was designed and used to gather an in-depth understanding of the motivators and inhibitors of E-Commerce in Saudi Arabia, and have received more than a thousand valid responses from Saudi individuals. In this paper, we examined the impact of mobile usage and social media resulted from our data analysis.*

Keywords: E-Commerce, Saudi Arabia, Social Media, Awareness, M-Commerce

1. INTRODUCTION

E-Commerce adoption and implementation in developed and developing countries have been carefully studied with focuses on consumer behavior and/or business issues. However, very little is known about the evolution of E-Commerce in Saudi Arabia. Recent studies [1]–[3] have reported factors that motivate or inhabit the evolution of E-Commerce in Saudi Arabia focusing on either businesses or consumers. This paper will review and examine the impact of mobile usage and social media on the acceptance and implementation of E-Commerce in Saudi Arabia.

As an important economic growth factor, E-Commerce becomes vital for many businesses to remain in competitive markets. Therefore, having an online option for sales is dramatically increasing in developing countries. However, this expected increase is not applied to the E-Commerce in Saudi Arabia despite the fast growing economy, the rapid increasing internet usage and the strong purchasing power in the country. Several studies have indicated the slow evolution of E-Commerce in Saudi Arabia [1], [4]–[6].

Khalidi et al (2014) have recently reported that internet growth in the Arab World have increased significantly in the past decade to 400%. According to another report published by Sacha Orloff Consulting Group, computer and internet access for Saudis reached 65.8% of population [7]. The usage of mobiles among Saudi population has also outstandingly grown to 1.8, meaning for every 10 individuals there are 18 mobiles, to reach 95% of residents [8]. The universality of mobile devices opens the door for companies to consider mobile commerce (M-Commerce) for online purchasing or at least for advertising their products. Similarly, there is also remarkable growth in social media usage in Saudi Arabia. Statistical reports and information graphics about social media usage in Saudi Arabia puts it in top of other countries in the region and the world [9].

The inadequate volume of research focusing on current issues conducted to study E-Commerce in Saudi Arabia and the lack of large assortment statistical reports create a chance for further research [10]. Some common factors reported previously by other research may be diminishing nowadays. Other factors, such as social media and M-Commerce usage, could be considered for further studies. More research related to mobile and social media could result in more reliable findings [7].

In this paper we study the impact of mobile usage and social media on E-Commerce acceptance and implementation in Saudi Arabia. A comprehensive online survey was developed for our qualitative approach to gather Saudi consumer's perspective on E-Commerce and the survey was distributed by utilizing the social media.

2. LITERATURE REVIEW

E-Commerce acceptance in developing countries has been broadly studied. Those studies varied from focusing on general perspectives like social issues

[11]–[16] to particular perspectives like online payment methods, trust, government role and/or delivery systems [1]–[3], [17]–[20]. Some studies focus on large regions [6], [21]–[27], and some focus on specific countries like Saudi Arabia [1], [3], [10], [17]–[19], [28]–[30].

E-Commerce adoption factors, implementation pitfalls, and demographics of internet users in Saudi Arabia have been reported [3], [10], [29]. In this section, we provide a brief overview on those studies. We then state the objective of our study and the questions to be answered for consumers in this developing country.

2.1 E-Commerce in Saudi Arabia

The evolution of E-Commerce practice begins in most developing countries in early 90's. The rapid progression on the number of E-Commerce transactions in developed countries have been noticed in the past decade [18]. Such practice is commonly acknowledged to be a factor of economic progression in developing countries [28]. It was reported that the global spending growth resulting from E-Commerce transactions reached around 0.27 trillion USD in 2002 significantly jumped to 10 trillion after a decade [18].

Some research and statistical reports illustrate significant growth of internet, mobile and social media usage in Saudi Arabia [25]. Additional works studied the business perspective only regarding the acceptance of E-Commerce in Saudi Arabia [4], [17], [28], [29], [31]. For examples, Al-Hudaif & Alkubeyyer studied internal and external aspects of E-Commerce acceptance [28]. Brdesee, Corbitt, and Pittayachawan studied E-Commerce adoption in Saudi Arabia from a cultural perspective [29]. Almousa, Khan and Alshehri conducted research to profile online shoppers in Saudi Arabia [3], [19], [31]. An interesting report by de Kerros Boudkov Orloff discussed different factors related to business, consumers, government and banks [7].

According to The Social Clinic report in early 2013 titled "*The State of Social Media in Saudi Arabia 2012"*, Saudi Arabia ranked number one in the world for the number of daily viewed videos, 90 million, on YouTube. Similar number can be found in its next year's report "*The State of Social Media in Saudi Arabia 2013*" showing 90 million videos are viewed daily on an average of 7 videos per day for each Saudi internet user. Saudi Arabia also ranked number one in the world in Twitter with a growth rate of 3,000% from 2011 to 2012, and is still growing. This growing rate is 10 times more compared to the average global rate. Statistics also showed that there was an average of 50 million tweets per month in 2012 and 150 million tweets in 2013 in the country. Moreover, 2 million out of 6 million of Facebook users in Saudi Arabia only use their mobiles to access Facebook in 2012 and this number has increased to 5 million in 2013 [32], [33]. Some research results stated that internet and technology negatively inhibit E-Commerce acceptance and implementation in the country, which might not be accurate [5], [18].

2.2 The Objective of the Study

The objective of this paper is to answer the following questions in order to determine the impact of mobile usage and social media on E-Commerce in Saudi Arabia and to what extent:

- Are there any new factors affecting E-Commerce in Saudi Arabia?
- Do mobile usage and social media play any role in E-Commerce in Saudi Arabia? And in what aspects?

3. METHODOLOGY

3.1 Survey instrument

A qualitative approach is used in this study aiming to gather an in-depth understanding of the motivators and inhibitors of E-Commerce in Saudi Arabia. To accomplish this goal, we have developed an extensive online survey. Given the popularity of social media in the country, the survey was distributed to local Saudi Arabians using various social media channels. The total number of replies from local Saudis is 1021. For the purpose of this paper we will focus on mobile usage and social media impact results.

3.2 Study population demographics

Demographic information complies with other research indicating most Saudi respondents, 75.7%, are young aged 18-35, shown in Table 1, and the majority, about 62%, are males [3], [19], [25], [34]. However, the level of education, Table 2, and occupation, Table 3, answers do not comply with mentioned research. Previous research indicated that the majority of consumers have high school degree or less and are unemployed [19], [34]. Our survey results, on the other hand, show that 55.6% of respondents have a Bachelor degree and 55.8% are working (3.6% of them merchants) compared to 39.9% unemployed, which is similar to a recent research [3]. Perhaps the reason behind such diversity in results is time. Recent research like ours and Khan's indicate obvious change in consumer behavior, which will also reflect on other aspects discussed later in the next section.

Table 1: Age distribution of respondents

Age	Responses	Percent
Less than 18 years old	36	3.5%
18-25	323	31.6%
26-30	270	26.4%
31-35	181	17.7%
36-40	101	9.9%
41-45	59	5.8%
46-50	38	3.7%
51-55	5	0.5%
56-60	4	0.4%
Greater than 60 years old	4	0.4%
Valid Responses	1021	

Table 2: Education level distribution of respondents

Occupation	Responses	Percent
Less than High School	45	4.4%
High School	179	17.5%
High Diploma	81	7.9%
Bachelor	568	55.6%
Master	124	12.1%
Doctorate	24	2.4%
Valid Responses	1021	

Table 3: Occupation distribution of respondents

Answer Options	Responses	Percent
Unemployed or a student	271	26.9%
University graduates not working	131	13.0%
Government employee	345	34.2%
A non-governmental employee	182	18.0%
Merchant	36	3.6%
Other	44	4.4%
Valid Responses	1009	

4. Results and Discussion

Internet access and usage result, as shown in Table 4, illustrates significant change in user's behavior compared to previous research. The average-hour people spent online using each device is calculated by the following formula:

$$AverageHour = \frac{(col1*2) + (col2*4) + (col3*8) + (col4*13) + (col5*15)}{(col1 + col2 + col3 + col4 + col5)}$$

Mobile use to access the internet significantly exceeds our expectation by an average of 5.98 hours per day compared to 3.61 hours using personal computers and 3.16 hours using tablets. It was also pointed out in an online article that the majority of Saudi Arabia and Indonesia users access the internet using their smart phones instead of personal computers [9]. This implies that potential customers prefer to visit websites using mobile and tablets. Therefore, merchant websites should be mobile ready (responsive) and should not rely only on traditional web otherwise merchants could lose many potential buyers. The result also encourages merchants to have their own native mobile apps to reach out additional customers and to offer a more convenient way to shop online. This result coincides with several recent reports showing high increase in internet access from mobile devices [6], [27], [33]. This result, however, is different compared to another recent research indicating a low usage of portable devices in Saudi Arabia [3]. Perhaps this is because Khan counted the number of times internet is used and from where (i.e., home, office or smart phone) per day while we counted daily hours from distinct devices.

The result of social media and online communication impact on making the decision to purchase online shows interesting findings, see Table 5. We define and compute an average rate to estimate the impacts of various social media affecting the decision. The average rate for individual social media is calculated by the following formula:

$$AverageRate = \frac{(col1 * 1) + (col2 * 2) + (col3 * 3) + (col4 * 4) + (col5 * 5)}{Valid\ Responses\ from\ each\ social\ media}$$

The most influence comes from Instagram, an image sharing service, with average of 3.16 out of 5. Other types of social media and communication services also have good impacts on online shopping decision making. Surprisingly, E-mail and Short Message Service (SMS), the most popular ways companies use in the country, have lower impact than expected on Saudi consumers. Saudi consumers get plenty of advertising emails and SMS messages from many companies due to the weak privacy laws in the country. Yet, the impact of such emails and short messages is low. Consumers were not encouraged to go to their websites and to buy from them. Not only companies were wasting time and money on such ineffective mass messages, they may also hurt their reputation when consumers get the notion that they have been spammed. It is recommended that retailers should focus more on social media and word of mouth rather than randomly distribute massive SMS and emails. This finding is coherent with the *Web 2.0, Social Networks and E-Commerce as Marketing Tools* report [35] that suggests using social media for Electronic Marketing (E-Marketing). In addition to E-

Marketing and awareness, we recommend using social media for E-Commerce itself as well, based on our result. Due to the significant increasing growth of social media usage in Saudi Arabia, it could play a key role in increasing the growth of E-Commerce in the country.

Table 4: Average time spent on internet per day

What is the average time spent on the Internet per day using various handheld devices?							
Device used for access	**Less than 3 hours**	**3-5**	**6-10**	**11-15**	**More than 15 hours**	**Answer Count**	**Average Hours**
Using cellphone	265	265	208	78	68	884	5.98
Using PC	454	185	78	20	11	748	3.61
Using tablet	374	75	27	10	12	498	3.16
Using other devices e.g. Smart TV	388	21	12	2	3	426	2.41

Table 5: The average rate of various social media impacting online purchasing decisions

In your opinion, to what extent the impact of social networks and electronic communication of the following in making a decision to purchase from the Internet?						
Answer Options	**Does not affect the decision**	**Somewhat influential**	**Influential**	**Very influential**	**Main reason to buy**	**Aver Rating**
Instagram	109	104	171	199	115	3.16
Internet sites and forums	93	144	183	194	84	2.97
Twitter	139	129	212	150	68	2.84
YouTube	183	144	169	137	65	2.71
What's App	226	162	158	115	37	2.48
Facebook	257	155	156	84	46	2.44
E-mail	257	197	140	77	27	2.26
BB Messenger	346	146	126	56	24	2.23
SMS	315	195	110	57	21	2.13
Other	388	123	106	45	36	2.26

5. CONCLUSIONS

This paper studies the impact of mobile usage and social media on the acceptance and implementation of E-Commerce in Saudi Arabia. A comprehensive web survey was designed to gather an in-depth understanding of those factors and data was collected from Saudi individuals.

The major implication of the study is that the use of mobile and social media results indicates that there is a good chance they can be helpful. Mobile usage in Saudi Arabia is very high, especially when used to access the internet. This factor should be considered by companies when building their websites assuring that all visitors from various devices have no issues related to screen size. M-Commerce also has great potentials according to the high mobile usage in the country. Consumers are more likely to shop online using a mobile. Social media has more impact on consumers' decision making than emails and SMS. Social media, especially Instagram, can also be very effective in increasing product E-Marketing promotion and selling online. Furthermore, social media can significantly assist in the increase of E-Commerce awareness. We recommend further studies to be conducted on the impact of mobile usage, social media and M-Commerce on E-Commerce in Saudi Arabia.

6. REFERENCES

[1] M. Almousa, "Barriers to E-Commerce Adoption: Consumers' Perspectives from a Developing Country," *iBusiness*, vol. 5, no. 2, pp. 65–71, 2013.

[2] R. Alghamdi, A. Nguyen, and V. Jones, "A Study of Influential Factors in the Adoption and Diffusion of B2C E-Commerce," *Int. J. Adv. Comput. Sci. Appl.*, vol. 4, no. 1, pp. 89–94, 2013.

[3] A. A. Khan, "Investigating of Online-Shopping from Customers Perspective : A Case Study from Saudi Arabia Riyadh," *J. Am. Acad. Business, Cambridge*, vol. 20, no. September, pp. 120–128, 2014.

[4] R. AlGhamdi, S. Drew, and W. Al-Ghaith, "Factors Influencing E-Commerce Adoption By Retailers In Saudi Arabia: A Qualitative Analysis," *Electron. J. Inf. Syst. Dev. Ctries.*, vol. 47, no. 11, pp. 1–23, 2011.

[5] R. AlGhamdi, A. Nguyen, J. Nguyen, and S. Drew, "Factors Influencing E-Commerce Adoption By Retailers In Saudi Arabia : A Quantitative," *Int. Conf. Internet Stud.*, vol. 8, no. 10, pp. 83–100, 2012.

[6] "Telecommunications Predictions 2014 Middle East," 2014.

[7] A. de Kerros Boudkov Orloff, "E-Commerce in Saudi Arabia : Driving the evolution , adaption and growth of e-commerce in the retail industry," London, 2012.

[8] A. M. Alsenaidy and A. Tauseef, "A REVIEW OF CURRENT STATE M GOVERNMENT IN SAUDI," *Glob. Eng. &Technologists Rev.*, vol. 2, no. 5, pp. 5–8, 2010.

[9] N. Schoonderwoerd, "4 Ways How Twitter Can Keep Growing - PeerReach Blog," 2013. Internet: : http://blog.peerreach.com/2013/11/4-ways-how-twitter-can-keep-growing/. [Accessed: Jan. 20, 2015].

[10] I. Ahmad and A. M. Agrawal, "An Empirical Study of Problems in Implementation of Electronic Commerce in Kingdom of Saudi Arabia," *Int. J. Bus. Manag.*, vol. 7, no. 15, pp. 70–80, Jul. 2012.

[11] F. P. Karimov and M. Brengman, "Adoption of Social Media by Online Retailers," *Int. J. E-entrepreneursh. Innov.*, vol. 2, no. 1, pp. 26–45, 2011.

[12] S. A. Al-Somali, R. Gholami, and B. Clegg, "An investigation into the acceptance of online banking in Saudi Arabia," *Technovation*, vol. 29, no. 2, pp. 130–141, Feb. 2009.

[13] Y. Baghdadi, "From E-commerce to Social Commerce: A Framework to Guide Enabling Cloud Computing," *J. Theor. Appl. Electron. Commer. Res.*, vol. 8, no. 3, pp. 5–6, 2013.

[14] T. Al-Maghrabi and C. Dennis, "What drives consumers' continuance intention to e-shopping?: Conceptual framework and managerial implications in the case of Saudi Arabia," *Int. J. Retail Distrib. Manag.*, vol. 39, no. 12, pp. 899–926, 2011.

[15] T. Al-maghrabi, C. Dennis, and S. V. Halliday, "Antecedents of continuance intentions towards e-shopping: the case of Saudi Arabia," *J. Enterp. Inf. Manag.*, vol. 24, no. 1, pp. 85–111, 2011.

[16] T. Al-maghrabi and C. Dennis, "Driving online shopping : Spending and behavioral differences among women in Saudi Arabia," vol. 5, no. 1, 2010.

[17] S. M. Sait, K. M. Al-tawil, and S. A. Hussain, "E-Commerce In Saudi Arabia: Adoption And Perspectives," *A*, vol. 12, no. 1, pp. 54–74, 2004.

[18] R. AlGhamdi, S. Drew, and T. Alhussain, "A Conceptual Framework for the Promotion of Trusted Online Retailing Environment in Saudi Arabia," *Int. J. Bus. Manag.*, vol. 7, no. 5, pp. 140–150, Feb. 2012.

[19] M. Almosa, "Profiling E-buyers in Saudi Arabia : Saudi Arabia as A Promising Developing Country," *CROSS-CULTURAL Commun.*, vol. 7, no. 2, pp. 92–100, 2011.

[20] E. Aleid, "Delivery Issues in E-Commerce : The Case of Saudi Arabia" Ph.D. dissertation, University of Waikato, 2012.

[21] A. M. Aladwani, "Key Internet characteristics and e-commerce issues in Arab countries," *Inf. Technol. People*, vol. 16, no. 1, pp. 9–20, 2003.

[22] "MENA B2C E-Commerce report 2014," 2014. Internet: : http://www.ystats.com/uploads/report_abstracts/1060.pdf. [Accessed: Oct. 10, 2014].

[23] N. Kassim and N. A. Abdullah, "The effect of perceived service quality dimensions on customer satisfaction, trust, and loyalty in e-commerce settings: A cross cultural analysis," *Asia Pacific J. Mark. Logist.*, vol. 22, no. 3, pp. 351–371, 2010.

[24] "Middle East & Africa Telecommunications Insight - January 2014," London, 2014.

[25] F. Al Khalidi, O. Soudodi, S. Syed, and N. Abdalla, "THE STATE OF PAYMENTS IN THE ARAB WORLD 2014," 2014.

[26] G. Bus, "Smarter Commerce : Moments matter," Dubai, 2014.

[27] E. Ghanem, E. Aoun, F. Barel, D. Moayedpour, and H. Al Anbari, "PayPal Insights e-commerce in the Middle East 2012-2015," 2013.

[28] S. a Al-Hudhaif and A. Alkubeyyer, "E-Commerce Adoption Factors in Saudi Arabia," *Int. J. Bus. Manag.*, vol. 6, no. 9, pp. 122–133, Sep. 2011.

[29] H. Brdesee, B. Corbitt, and S. Pittayachawan, "Lessons to Be Learnt: Cultural Means Impeding e-Commerce Adoption in a Saudi Industry," *Int. J. e-Education, e-Business, e-Management e-Learning*, vol. 2, no. 6, pp. 488–492, 2012.

[30] E. Makki and L.-C. Chang, "E - Commerce in Saudi Arabia : Acceptance and Implementation Difficulties," in *The 2014 International Conference on e-Learning, e-Business, Enterprise Information Systems, and e-Government (EEE'14)*, 2014, pp. 114–120.

[31] M. Alshehri, H. Aldabbas, J. Sawle, and M. A. Baqar, "A DOPTING E-C OMMERCE TO U SER ' S N EEDS," *Int. J. Comput. Sci. Eng. Surv.*, vol. 3, no. 1, pp. 1–12, 2012.

[32] "The State of Social Media in Saudi Arabia 2012 | The Social Clinic," *The Social Clinic*, 2013. Internet: : http://www.thesocialclinic.com/the-state-of-social-media-in-saudi-arabia-2012-2/. [Accessed: Jun. 10, 2013].

[33] "The State of Social Media in Saudi Arabia 2013 | The Social Clinic," *The Social Clinic*, 2014. Internet: : http://www.thesocialclinic.com/the-state-of-social-media-in-saudi-arabia-2013/. [Accessed: Jul. 06, 2014].

[34] M. T. Simsim, "Internet usage and user preferences in Saudi Arabia," *J. King Saud Univ. - Eng. Sci.*, vol. 23, no. 2, pp. 101–107, Jun. 2011.

[35] F. J. Mata and A. Quesada, "Web 2.0, Social Networks and E-commerce as Marketing Tools," *J. Theor. Appl. Electron. Commer. Res.*, vol. 9, no. 1, pp. 11–12, 2014.

Integration of the Real-time Simulation Systems with the Automated Control System of an Enterprise

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Abstract - *The paper discusses the integration method of simulation models used within the enterprise information system. The integration problem is presented on one sample class of models – the real-time models that are used in control, diagnostics and decision making processes. The suggested method is based on multi-agent approach with distributed knowledgeable agents. The dynamic model consists in the multi-agent resource conversion process model that supports multi-approach modeling, including discrete-event, agent-based, queuing systems. To substantiate suggested technical decision of the integration module existing message brokers were analyzed. The subject area ontology is presented. It is used for semantic data integration that is required for simulation modeling of technological processes, business processes and logistical processes. In order to achieve a cross-platform system, the Java language is used for development.*

Keywords: Model integration, resource conversion process

1 Introduction

Currently, multi-agent approach is among the perspective directions of enterprise management systems [1][2]. The paper deals with the representation of distributed corporate information systems of a metallurgical enterprise in form of a multi-agent system. Such systems consist of multiple interacting agents that solve the goals, set by analysts [3].

Development of state-of-the-art technologies allows large industrial enterprises to obtain and store vast data volumes that define technological, logistical and commercial problems of an enterprise. These data may be used for simulation modeling of various aspects of its activity. Simulation results may be used for quality control of manufactured products, defect prevention, optimization of logistical and commercial schemes. Integration of these models into the enterprise control circuit by interaction with the corporate information system and development of unified software is a pressing task.

After the introduction in section 2 we start from the state of the art overview for the area of simulation modeling tools with real-time capabilities. We identify the richest systems from the functionality point of view. In part 3 we present the architecture of suggested system, describing role of the agents. We move on to application of the system to metallurgical production. Here we present and discuss the ontology of the metallurgical enterprise. We get to the role of each agent within the system and discuss their interaction. In part 4 we present our research on how the developed models interact with each other. In part 5 we describe the integrating data model. Part 6 presents the mechanisms for semantic integration of data sources. In part 7 we compare our approach to similar implementations in other simulation systems in terms of performance. Finally in part 8 we present the conclusions from our research.

2 Current State of Tools

The development trend of enterprise information systems focuses on wide application of Internet technologies. Currently the commercial simulation systems available on the market, including AnyLogic [4], ARIS [5], G2 [6], are all desktop applications. Additional requirements for simulation modeling tools for team development of comprehensive simulation models include support for multi-user environment, availability of model access on the Internet and running simulation experiments on the Internet.

A comparison of systems [7] showed that the most part of the functionality is included in AnyLogic [4] and BPsim [8] products. Only G2 is developed focusing on the direction of service oriented architecture [7]. At the moment the SaaS (software-as-a-service) technology [9] is the most convenient in use, optimal in performance and client software requirements. The end user in this case is the analyst or decision making person. Thus, the pressing problem is development of the model integration software for simulation modeling servers, using service oriented approach.

3 System Architecture

A multi-agent system architecture will further be discussed based on a sample integration system of automated system models of metallurgical production. It contains the following software agents:

- Data exchange agent. It is used for actualization of model parameters and data transfer (including experiment results) into corporate information system,

- Modeling agent. It is used to solve process control tasks in real-time on the basis of real-time models,

- Message exchange agents. It provides interaction between data exchange and modeling agents. This agent decides when to activate real-time model, based on occurring events and activation rules, and also transfers messages into the corporate information system, e.g., into a MES-system or to a corresponding analyst's (specialist, technologist) workstation.

The method of design, development and operation of real-time models is based on the methodology of business process analysis and development of information systems. It includes integration of structural and object-oriented approaches, simulation and multi-agent modeling [10] and consists of the following stages:

- Design of simulation model in the model definition module,

- Running experiments for model verification and adequacy checks in simulation module. BPsim.MAS system is used for this task at the stage of schematic design [10]-[11],

- Design of real-time model for its further use in model integration module and interaction with other sub-systems of the corporate information system. BPsim.SD tool [12] is used for this task at the stage of schematic design. It implements the following design stages:

  - Design of architecture for the model integration modules by dataflow diagrams, use-case diagrams and sequence diagrams of unified modeling language,

  - Subject area ontology representation in form of class diagram,

  - User interface modeling,

  - Testing and debugging the real-time model in corporate information system,

  - Operation.

Use of real-time models means that modeling time must be less or equal to a set value, and modeling must be completed before the next portion of data is received from the corporate information system. Thus, the following features need to be considered during the models integration:

- Performance. Architecture of automated system for metallurgical production must be oriented towards maximum use of server resources,

- Scalability. Models must be able to run simultaneously on multiple computers, as well as effectively use multi-core and multi-CPU computers.

To provide these features each model needs to be executed as a standalone process. Special mechanisms, included with the integration module should be used for the interaction of processes.

Integration is suggested to be performed at the data level. Each model performs analysis of data, received from the data storage. Modeling results are transferred either into the data storage or immediately into the corporate information system.

In general case, the following data integration levels may be distinguished [13]: physical, logical and semantic. A single ontology of subject area needs to be developed for consideration of semantic properties.

Ontologies are defined as a result on subject area analysis. In our case, the approach suggested by Girardi et al. [14] has been used. It is based on the Chen's model "entity-relation", since all data is suggested to be stored in relational database. The model has been extended in a way to be able to store other "entity-relation" models and related data.

The method has been extended with such features as availability to process cause-and-effect relations and knowledge of decision making people. Semantic model of the multi-agent resource conversion processes [11] was used for this. It was further extended with the elements of logistical projects ontology, presented by Kowalski et al. [15], and adapted to specific features of logistical problems, related to metallurgical production. Also, the ontology included elements of technological and business process. The designed ontology is presented on Figure 1.

Model integration method focuses on several problems [13]. They are briefly discussed further.

The automated system for monitoring, control, modeling, analysis, and optimization of the full production cycle of metallurgical production, due to specific requirements of the automation object, consists of a large number of various modules, each of which performs a specific task. Together they monitor state of the industrial objects, check parameter validity, model consistency, analyze and prepare recommendations for optimization of the full production cycle of metallurgical production. These recommendations are based on integration of mathematical models of technological, logistical, and business processes of an enterprise. Thus, the automated system for metallurgical production may be considered a distributed multi-agent system. Separate modules are represented with software agents with complex behavior and communicative capabilities.

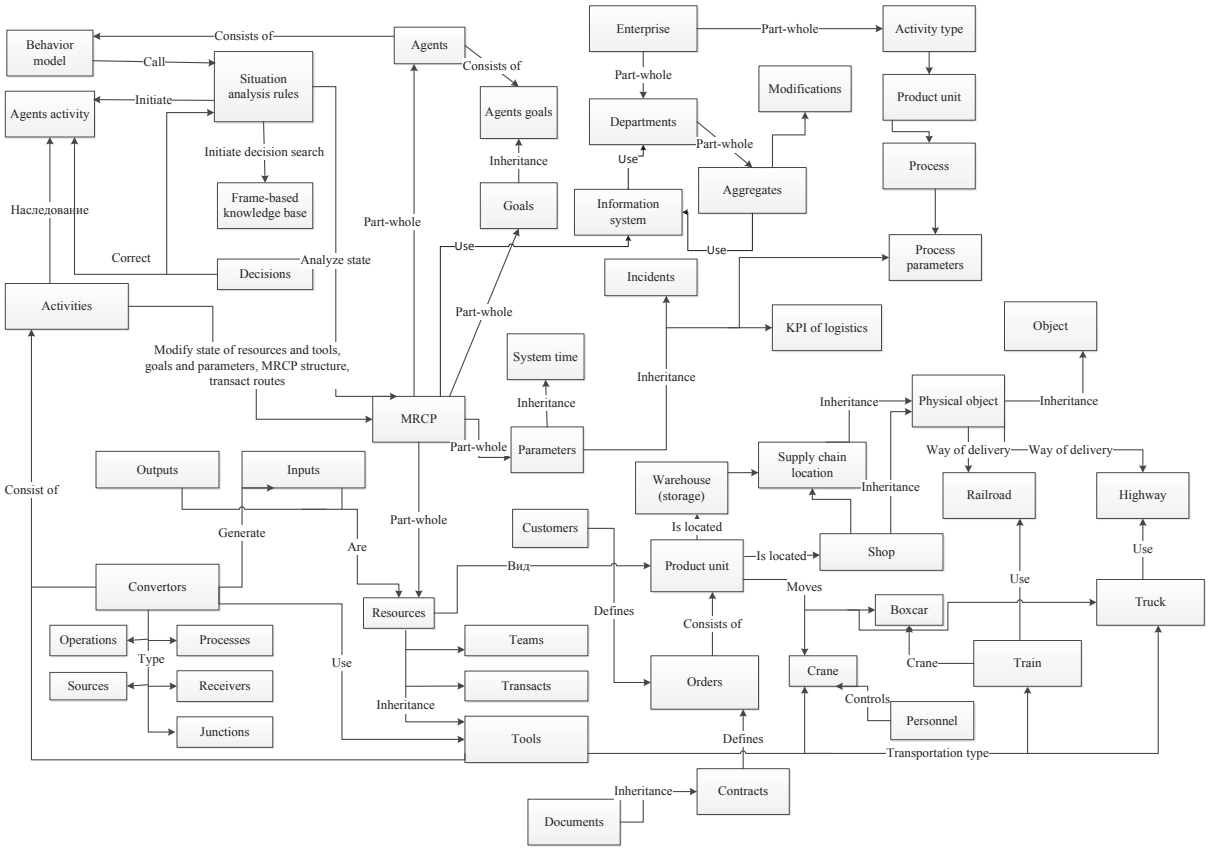

Figure 1. Subject area ontology

Automated system for metallurgical production is an open multi-agent system. This consists in bi-directional interaction with multiple information systems of a metallurgical enterprise, related to such classes of information systems as ERP (Enterprise Resource Planning) [16], MES (Manufacturing Execution System) [17], automated technological process control systems, technologists' automated workstations.

An automated system for metallurgical production consists of the following modules (or main agent types):

- Enterprise automated systems data exchange. Technically this corresponds to the enterprise services bus
- Data preparation
- Enterprise processes optimization
- Models integration – allows use of models in decision making tasks in real-time.

Certain problems make use of data storage, query constructor, and model design modules that are also included in the automated system of metallurgical production.

Architecture of the automated system is implemented in the way that load ration of specific agents may result in copying of these agents in order to distribute and balance load.

One of the applied directions of multi-agent technologies is planning. The concept of an agent corresponds to hardware or software implemented entity, which is capable of acting for the benefit of goal achievement set by the owner or user. Agents possess certain intelligent capabilities [18][19].

A sample application of the multi-agent system for planning operation of a flexible production system is discussed in [18]. We may name the following advantages of the multi-agent system:

- Formalization of decision making points in form of the agents. The points include specific situation processing scenarios. Technically this process is a part of knowledge formalization stage.
- Planner is dynamically embedded by means of interaction of specific element of the multi-agent system and thus is ready to modify the plan in case of delays or unexpected (unintended) situations. The planner works in real-time.

•Agent network, interconnected with relations, self-coordinates its activity.

An additional benefit of multi-agent planning is the capability of automated information sharing between process individuals about changes of controlled object, which introduces control transparency. Subject area knowledge is being formalized during development and deployment of the planning multi-agent system, the decision making process is automated. Thus we ease activity, related to decision making.

Agents may be separated into three following types: reactive, intelligent and hybrid [18][19]. Reactive agents make decisions on the basis of "Situation-Response" rules. Intelligent agents solve the set tasks according to its goals, using common limited resources and knowledge of external world. Hybrid agents have features of both classes.

Agents of the automated system for metallurgical production, that are immediately operating in control and decision making tasks, may have goals presented on Figure 2. Intersection of their goals may be present. Thus, agents have to co-operate. In order to achieve a common goal, agents use messaging.

Interaction of agents of the metallurgical enterprise corporate system introduces problems, related to identifiers of the very same objects and parameters in different data storages. In addition, there is a dis-synchronization of single object-related processes in time.

In order to fix such problems, the data exchange agent is capable of transforming its internal identifiers into identifiers of other agents and vice-versa. Apart from this, the messages are dispatched, which help other agents to fix the problems, related to process arrangement in time.

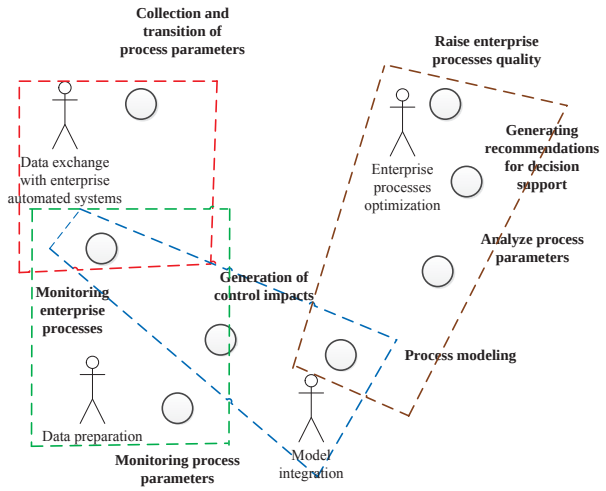

Figure 2. Agent goals

The development of the automated system for metallurgical production is based on decision support method for information system development. This method, in turn, is based on multi-agent approach. The method is supported by the products of BPsim family [11][12], which allows definition of hybrid agents on production and frame-based knowledge bases.

4 Design of Integrating Data Model

Integrating data model represents the basis of the common user interface in the integration system. Since the web-interface is suggested for model integration system, a decision, based on JSON (JavaScript Object Notation) [20] and XML (eXtensible Markup Language) standards for the integration model seems reasonable.

The MVC (Model-View-Controller) [21] concept is suggested as the main concept of the model integration system development. The concept utilizes several design templates, which allows the application data model, user interface and user interaction are distributed between three specific components, when modification of just one component has minimum impact on other ones. Model integration system includes common classes that implement typical procedures for data obtaining from the automated information system, as well as presentation of modeling results (parameter values, graphs, etc.).

Since the integration module has the multi-agent structure, the agent elements need to correspond to certain elements of MVC. To make things easier, consider a reactive agent with a single rule: "if a>b, then a=a-b". Figure 3 shows the dataflow diagram that presents operation of such agent. Data storages correspond to work memory, which is required to store the variable. Operations on the diagram are all If-Then rules. The agent formulae in software implementation that are stored in "If" and "Then" rules of an agent, are transferred into method definition of the corresponding class.

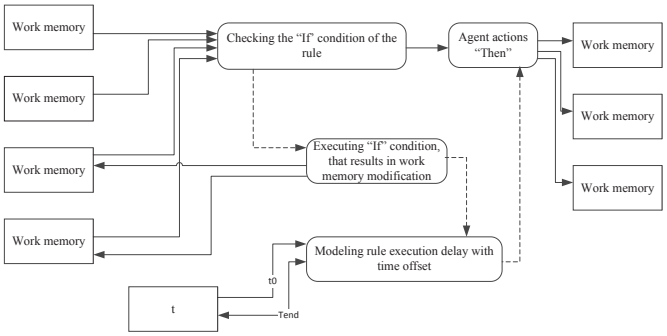

Figure 3. Sample DFD diagram for the reactive agent with one rule

Thus, from the MVC point of view, work memory represents the Model, while the logical output machine together with agent rules form the Controller. When

visualization of modeling results is required by the user, corresponding classes would represent the *View*.

5 Development of Mechanisms for Semantic Integration of Data Sources

Object-relational mapping is used as a means of data sources semantic integration. This is a programming technology, which allows conversion of incompatible model types between relational data storage and programming objects. Such technology is implemented in ORM (Object-Relational Mapping) systems [22]. After analysis, two systems have been selected for further development, namely, Morphia [23] and Cayenne [24] due to the following factors:

- Their features fully satisfy the requirements of model integration system,
- Cayenne has a convenient feature of visual development of connection of software classes and entities in the database. This reduces the time required for development and debugging.

The prototype of model integration module for automated information system of metallurgical production has been developed after analysis. Since at this stage, some models of the system are yet to be implemented, testing and running the experiments used the emulated parameter inflow from the technological process. Data required for the simulation model integration module were forwarded to corresponding models for analysis and result output. Model results transfer into the corporate information system for further processing has also been emulated.

6 Performance Comparison

An enterprise uses its own quality assurance software, which includes the enterprise process definition module for design of simulation models of processes under research, and process optimization module for experimenting with the models and searching for management decisions. These two modules are based on multi-agent modeling and the concept of big data. Authors compare the metallurgical manufacturing process model definition with the enterprise software and the popular simulation tools Plant Simulation [25], Simio [26], and AnyLogic [4]. The description of the model itself goes beyond the scope of this work, and only the comparison results are presented.

We assume that models are equivalent and produce averagely the same output. As an effectiveness criterion we use the duration of experiment on the same hardware with animation set to off (Figure 4).

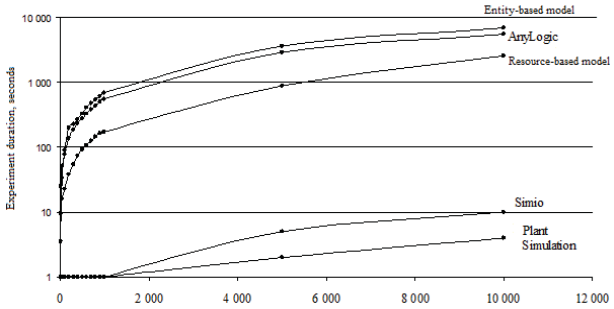

Figure 4. Experiment duration and number of processed product units

The analyzed simulation modeling tools may be separated into fast tools (Simio, PS) and slow tools (AnyLogic and enterprise process optimization module). Optimization module speed is related to detailed journaling of log tables and statistics on model variables and entity instances. No other simulation tool provides these statistics. Resource-based model works faster in the same simulation system. This fact is related to computational resources being spent on queues processing in the process optimization module. The slowest experiment duration was 2 hours and 13 minutes, which may be applicable in case of non-real-time decision making.

After analyzing simulation results we may conclude:

- All models are adequate to logistical processes of a metallurgical enterprise,
- Simulation speed is applicable for all simulation systems for various production volumes,
- Simio and PS have an advantage in simulation speed for simulation of logistical processes of an enterprise,
- CPU and RAM load are applicable for a short (under 10 minutes) simulation experiment without animation in all systems,
- CPU and RAM load are applicable for a long non-animation experiment (over 1 hour) for all systems, except PS (due to hang up) and Simio (due to high RAM load),
- Advantage of the enterprise optimization module from the RAM load point of view for “short” and “long” non-animated experiments.

7 Conclusion

Use of simulation modeling for analysis of technological, logistical and business problems of an enterprise is a perspective direction. The discussed method of simulation models integration has been implemented in practice and has successfully passed the tests.

The automated system for metallurgical production may assist in the following areas:

- Collection and storage of information about enterprise products and processes,
- Analysis of quality of products, diagnosis of production stages with most faulting operations, with full information of production cycle,
- Application of models in decision making and control tasks. In case a model used in control process diagnoses a significant deviation from quality indicators for a product unit, it generates a signal and forwards in to a MES system, in order to reassign routes for further processing.

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9 References

[1] L. Cao, V. Gorodetsky, and P. A. Mitkas, Guest Editors' Introduction: Agents and Data Mining, *IEEE Intelligent Systems*, vol. 24, no. 3, pp. 14-15, May/June, 2009

[2] P. Sridhar, S. Sheikh-Bahaei, S. Xia, and M. Jamshidi, Multi-agent simulation using discrete event and soft-computing methodologies, *Proceeding of: Systems, Man and Cybernetics, 2003. IEEE International Conference on*, Volume: 2

[3] V. Gorodetsky, O. Karsaev, V. Konushy, W. E. Matzke, E. Jentzsch, V. Ermolayev, Multi-agent Software Tool for Management of Design Process in Microelectronics, *Agent Technology, IEEE / WIC / ACM International Conference on*, pp. 773-776, 2006 IEEE/WIC/ACM International Conference on Intelligent Agent Technology (IAT'06), 2006

[4] http://www.anylogic.com

[5] http://www.softwareag.com/corporate/products/new_releases/aris9/overview/default.asp

[6] http://www.gensym.com/en/product/G2

[7] O. P. Aksyonov a, K. A. Aksyonov, V. D. Kamelsky, and A. L. Nevolina, Analysis of organization of distributed multi-user work in business processes simulation modeling systems // *Modern problems of science and education*. – 2012. – № 5; URL: http://www.science-education.ru/105-6936 [retrieved: 05, 2014]

[8] http://www.bpsim.ru

[9] http://en.wikipedia.org/wiki/Software_as_a_service

[10] K. A. Aksyonov, A. S. Antonova, and I. A. Spitsina, Analysis and synthesis of resource conversion processes based on simulation modeling and intelligent agents. // *Science and technology news*, St. Petersburg State Technical University, № 1 (115) 2011. Informatics. Telecommunication. Control. St. Petersburg, pp.13-20.

[11] K. A. Aksyonov, *Theory and practice of decision support tools*. Germany, Saarbrucken: LAP LAMBERT Academic Publishing GmbH & Co. KG, 2011.

[12] K. Aksyonov, I. Spitsina, E. Bykov, E. Smoliy, and O. Aksyonova, Computer-supported software development with BPsim products family – integration of multiple approaches // *Proceedings of the 2009 IEEE International Conference on Information and Automation (ICIA).* (22-25 June 2009). - Zhuhai/Macau, China, 2009, pp. 1532-1536.

[13] M. R. Kogalovsky, *Methods of data integration in information systems*. Moscow, 2010. http://www.cemi.rssi.ru/mei/articles/ kogalov10-05.pdf [retrieved: 05, 2014]

[14] D. Girardi, J. Dirnberger, and J. Trenkler, A Meta Model-Based Web Framework for Domain Independent Data Acquisition // ICCGI 2013: *The Eighth International Multi-Conference on Computing in the Global Information Technology*. Nice, France, 2013, pp. 133-138.

[15] M. Kowalski, S. Zelewski, D. Bergenrodt, and H. Klupfel, Application of new techniques of artificial intelligence in logistics: an ontology-driven case-based reasoning approach // *Proceedings of European Simulation and Modelling Conference* 2012 (October 22-24, 2012, FOM University of Applied Sciences). — Essen, Germany, 2012, pp. 323-328.

[16] http://en.wikipedia.org/wiki/Enterprise_resource_planning

[17] http://en.wikipedia.org/wiki/Manufacturing_Execution_Systems

[18] N. R. Jennings, On agent-based software engineering // *Artificial Intelligence*. — 2000, vol. 117, — P. 277-296. - URL: http://www.agentfactory.com/~rem/day4/Papers/AOSE-Jennings.pdf [retrieved: 05, 2014].

[19] M. Wooldridge, Agent-based software engineering // *IEEE Proc. Software Engineering*, no. 144 (1), 1997, pp. 26–37.

[20] http://www.json.org/

[21] http://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93controller

[22] http://en.wikipedia.org/wiki/Object-relational_mapping

[23] https://github.com/mongodb/morphia

[24] http://en.wikipedia.org/wiki/Cayenne_(programming_language)

[25] http://www.plm.automation.siemens.com

[26] http://www.simio.com

Investigating the moderating effect of social identity on group buying purchase intention

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Abstract

This research studied the user behavior on online group buying services. In the research model, users' behavior is represented by three dimensions, satisfactory, trust, and group buying intention. Satisfaction is hypothesized to have positive relationship with trust that will have positive impact on the purchase intention. Each of the three dimensions is divided into two constructs, one for product and the other one for the web site. Satisfaction is divided into two dimensions, satisfaction toward the products and satisfaction toward the web service. Similarly, trust toward the product and trust toward the web site are the two constructs for trust. Lastly, the intention to purchase the product traded in any web site and the intention to purchase any product on the web site are the two constructs for purchase intentions. In addition, the moderating effect of social identity on the relationship between trust and purchase intention was tested. A marketing firm was hired to conduct the survey and 300 effective samples were collected. The results show that all of the causal relationships were all significant while the moderating effects of social identity were significant on two of the three relationships. Furthermore, managerial implications and suggestions for future research are discussed.

Keywords: Group buying, social identity, satisfaction, trust, purchase intention

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1. Introduction

The theory and practice of e-service is still in its infancy (Santos, 2003), but it indeed brings a dramatic revolution to the internet world. An investigation regarding the B2C E-Commerce of USA revealed double digit growth within the B2C e-commerce segment and reported that about 42% of internet users purchased goods online (yStats.com, 2011). The data showed that the differential types of e-commerce has infiltrated into people's daily life. It is no doubt that online group buying will continue to be an important business model on Internet, and several issues remain unresolved requiring further studies. One of the issues is the role of virtual community on the group buying sites. Two well-known group buying web sites in Taiwan, Groupon.com and Babyhome.com employed two opposite strategies. Groupon provides a larger variety of products/services to all of the customers interested in discounted prices, while Babyhome targets on a certain type of customers, the parents, and offers a relatively less various products/services. The virtual community formed by parents on Babyhome is critical to its group buying model. Feedback and discussion topics on its virtual community provide the guidance for the management to identify the proper products and services that were sold successfully on Babyhome. However, Groupon of Taiwan closed its social network service and its group buying model relies on providing the most well-known and efficient mean for sellers and buyers to transact. The existence of virtual community that could be theoretically represented by sense of belonging becomes the key factor differing Groupon from Babyhome. This study is intended to provide solutions to the following questions:

- Test the causal effects from satisfaction to trust that leads to the repurchase intention.
- How strong are the relationships between the trust toward the products or the sites and the repurchase intention of any product traded on the site or the products traded in any online service? How are these two concepts, with or without virtual community, differ on the relationships, trust toward the products to purchase intention of any product traded on the site, trust toward the products to purchase intention of the products traded on any site, and trust toward the sites to purchase intention of any product traded on the site.

2. Theoretical background and hypotheses

Literature review will cover two topics, online paying behavior and group buying.

Online Paying Behavior

As the Internet has become increasingly popular and accepted as a facet of life for most people, electronic channels provide an important avenue for companies to reach their customers and generate sales (Moe and

Fader, 2004). Many firms make their products or services available online expecting to attract more customers. Understanding the purchasing behavior of online users is an important topic for web service operators in managing their sites. Several papers focused on this issue and provided useful information. Heijden et al. (2003) investigated two types of online purchase intentions in shopping for CDs: technology-oriented and trust-oriented. Using students as the samples, perceived risk and perceived ease of use were found directly to have influenced user attitude toward purchasing intentions. Venkatesh and Agarwal (2006) studied how visitors become customers in four different industries: airlines, online bookstores, automobile manufacturers, and rental agencies. They collected longitudinal data and the results showed that the following factors had a significant effect on purchase behavior: time spent on the site, content quality, made-for-the-medium purchase need, and previous purchase experience.

Hume and Mort (2008) surveyed past and present performing arts audience members and identified satisfaction as the antecedent of repurchase intention. The same concepts can be applied to business to business context with similar results (Whittaker et al. 2007). Wells et al. (2011) proposed a model to investigate website quality as a potential signal of product quality and consider the moderating effects of product information asymmetries and signal credibility. The results indicate that website quality influences consumers' perceptions of product quality, which subsequently affects online purchase intentions.

In addition to products and services, virtual products such as music downloads are especially suitable to be transacted online. Perceived usefulness, perceived enjoyment and perceived trust were the strongest predictors of college students' behavioral intentions to purchase online music downloads (Bounagui and Nel 2009). Online gaming is another example and prior offline purchase experience was found to be significantly related to paying for online games (Barbera et al. 2006).

Online Group Buying

The concept of group buying is to collect and leverage the consumer's bargaining power to obtain the lower price or extra service of the products which they are interested in (Van Horn et al. 2000). When a batched request is created by an internet-based platform, the Website claims that the consumers will enjoy the lower price on their interested items, and the suppliers will benefit from saving the cost of recruiting customers. It is a win-win situation between suppliers and consumers (Kauffman et al. 2010).

The study on group buying is rare and most relevant literature focused on the issue of online auction pricing mechanism (Chen et al. 2009) or comparing of externality effect, such as price drop effect and ending effect (Kauffman & Wang, 2002). According to Anand & Aron (2003), those people who are attracted to group buying sites are price sensitive.

Matsuo and Ito (2004) developed a system to support the formation of grouped buyers in order to effectively expedite the transactions. By using the analytic hierarchy process, they proposed three methods for group integrations, buyers trading in simple group buying, all buyers integrated, and some buyers integrated. The strength of their system are that it can effectively express the buyers' multiarttribute utilities in group integration and the buyers can purchase goods at a lower price. Anand and Aron (2003) studied the online group buying from the perspective of price-discovery mechanisms. Demand uncertainty was modeled as different conditions and the profits were compared under several price mechanisms.

3. Hypotheses Development

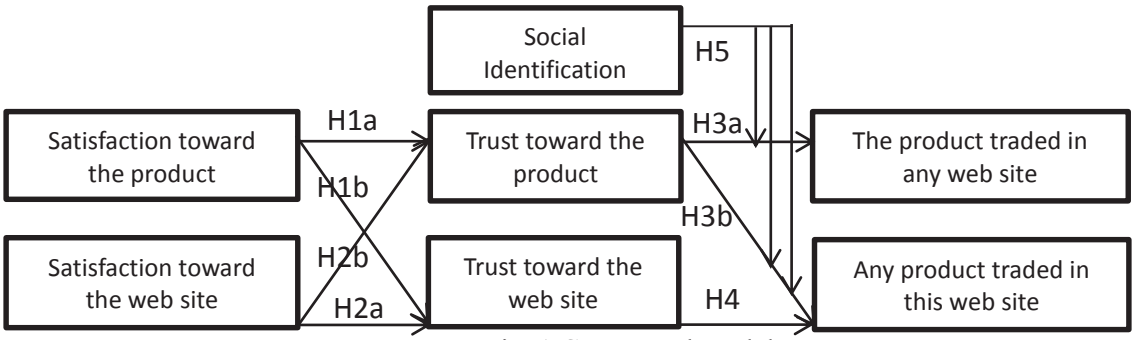

Fig. 1 Conceptual model

Fig. 1 illustrates the conceptual model of this research and the following section will describe the development of the hypotheses.

Many researches have supported the positive influence of satisfaction on trust in the online context (Ribbink et al. 2004). In the study of offline retail channels, consumer satisfaction is positively related to future attitudes and behaviors (Webster and Sundaram 1998). However, most of the work focused on the immediate

intentions of behavior and less on the attitudinal variables such as trust. Tax et al. (1998) conducted an investigation and found a significantly positive relationship between satisfaction and trust. Therefore,

H1a: Satisfaction toward the product will positively influence the trust toward the product

The overall degree of pleasure felt by consumers in previous exchanges is an important antecedent of consumer attitude. Young (2006) indicated that cognitive and experiential signals represent the satisfaction level of a consumers shopping online. The influence of these signals on buyer trust may be direct or indirect. It is reasonable to include the perception of the product as one of the cognitive signals that include service quality, warranty, security and privacy policies indicated by Martin et al. (2011). Thus,

H1b: Satisfaction toward the product will positively influence the trust toward the web site

Satisfaction and trust in online contexts are essential to maintain relationships with consumers. The concept of satisfaction implies the fulfillment of expectations as well as a positive state based on previous outcomes in the relationship with the website. Trust implies a willingness on the part of the consumer to accept vulnerability in the transaction and the belief that the firm will fulfill its promises and will not exploit that vulnerability to its own benefit (Chouk and Perrien 2004). Consumer trust in an internet purchase will have two dimensions: trust in the purchase site and in the internet as a whole (Chen and Dhillon 2003). Since internet has becomes an important channel for commodity trading, trust in the purchase site is a key factor for further study. Satisfactory experiences with a specific online retailer inspire consumer trust in the virtual medium and Santos and Fernandes (2011) provided evidence that satisfied consumers in online purchasing will have a higher level of trust toward the purchasing website. Based on the discussion,

H2a: Satisfaction toward the web site will positively influence the trust toward the web site

Signaling theory has been applied in an online context to investigate how traditional signals influence trust and perceived risk with an online retailer (Aiken and Boush 2006). Wells et al. (2011) applied signaling theory and proposed a hypothesis stating that the perceptions of website quality positively correlated with a consumer's perception of product quality. Many studies applied theory of reasoned action (Ajzen and Fishbein 1980) to predict the online users' behavior and satisfaction toward the website usually represents the attitude in which website quality is an important antecedent. The buyer's overall satisfaction with the buying experience is proposed to have a positive impact on the trust of the manufacturer. Hence,

H2b: Satisfaction toward the web site will positively influence the trust toward the product

The relationship between trust and purchase intention has been studied widely. Trust affects the purchase intention through perceived risk and satisfaction in the study of Green and Pearson (2011). The empirical finding of Ha et al. (2010) indicated that trust has directly affected the repurchase intention. Perceived risk, an antecedent of trust was found significantly affect the intention to shop online. Although the context of these researches is online shopping, the same concept can be logically applied to product traded online. Therefore,

H3a: Trust toward the product will positively influence the purchase intention for the product traded in any web site

The theory of reasoned action includes attitude as a key determinant of behavioral intention. Gefen et al. (2003) indicated trust as a determinant of online purchase intention. The study by Wells et al. (2011) indicated that the perceived quality of a product significantly affect a consumer's intention to use a website to purchase the product. Thus,

H3b: Trust toward the product will positively influence the purchase intention for any product traded in this web site

Horng (2012) identified ten variables influencing the users' online paying behavior and clustered them into three factors. Of the most influential factor, the variable of security concerns has the highest loading. In the context of online transaction, security concerns were often considered equivalent to trust toward the website. The study by Ha et al. (2010) concluded the same relationship between trust toward the website and the repurchase intention on the site. Hence,

H4: Trust toward the web site will positively influence the purchase intention for any product traded in this web site

The Web 2.0 research platform and social-network approach offers marketing research new tools to meet the challenges of the future (Cook and Buckley 2008). Social applications are also appropriate in several areas for companies such as R&D, marketing, sales, customer support, and operations (Bernoff and Li 2008). Although it is not clearly defined, SNS can be considered equivalent to a virtual community in a broader sense (Hagel and Armstrong 1997).

The importance of SNS can be signified by their ever increasing usage. These services enable users to communicate and connect with each other, to build up a personal network with common interests, allowing them to interact regularly in an organized way over the Internet. From this perspective, social identity theory,

proposing that the functionality of groups shapes their members' social identity with these groups (Dholakia et al. 2004), prescribes and instigates group-oriented behavior. Pentina et al. (2008) suggested that stronger motivations to join virtual communities for social interaction would lead to higher degrees of member identify with the group. Bergami and Bagozzi (2000) found that social identification led to performance of organizational member behavior by firm employees. In the study of Dholakia et al. (2004), a stronger social identification led to higher levels of we-intentions, defined as the intentions to participate together as a group, to participate in the virtual community. Venkatesh et al. (2012) tested the relationship behavior intention and use behavior, and found that experience will moderate the effect of behavioral intention on use, such that the effect will be stronger for consumers with less experience. Experience level is a strong antecedent of social belonging, hence,

H5: User with lower social Identification will be stronger for the following three relationships: trust toward the product and purchase intention for the product traded in any web site; trust toward the product and purchase intention for any product traded in the web site; trust toward the web site and the purchase intention for any product traded in this web site.

3. Data collection

To collect the online users' behavior with experience of group buying, a marketing firm, Eastern Online, was hired to conduct the survey. A report by Ministry of Economic (2011) ranked the top 10 group buying web sites in Taiwan. However, the group buying market is very competitive and few of the web sites on this list were no longer available during the survey. With the help from Eastern Online, a new list, after removing 3 from the original list and adding 4 new sites, comprising the most popular 11 group buying web sites was used in the survey. The survey was conducted in March, 2015 and 300 effective samples were collected. The survey was administrated so that only effective samples with some pre-defined criteria were reported. Each of the 11 web sites had at least 5 samples. Since the topic of this study is group buying, only the users with group purchase experience were surveyed. In summary, most of the samples are married (55.7%), mid-aged (46.7% are older than 45), and experienced (more than 2 years of group buying experience 60.3%). Male samples account for 50.7 percent, and most of them, 60.3 percent, use desktop computers to conduct group buying.

4. Results and analysis

Table 1 provides the sources of the constructs in the present study. Where available, these constructs were measured using questions adapted and revised from prior studies to enhance validity (Stone, 1978). All items were measured using seven-point Likert scales anchored from "strongly disagree" to "strongly agree". Prior to distributing the survey, a focus group interview was conducted, and the comments from the participants provided a basis for questionnaire revisions. A pre-test conducted by the same marketing firm collected 300 samples and the results were also used to revise the questions.

Table 1. Research constructs and their references

Construct	References
Satisfaction toward the Website (WSat)	Cheng et al. (2011); Martin et al. (2011)
Satisfaction toward the Product (PSat)	Hume and Mort (2008)
Trust toward the Website (WTrust)	Greem and Pearson (2011); Martin et al. (2011)
Trust toward the Product (PTrust)	van der Heiden et al. (2003)
Purchase intention for any Product at the Website (WInt)	Choi et al. (2010)
Purchase intention for the Product at any Website (PInt)	Wen et al. (2011)
Social Identification (SOCI)	Dholakia et al. (2004)

The reliability and validity of the data were tested and shown in Table 2. The items have standardized loadings ranging from 0.658 to 0.879. According to the suggested guideline (Comrey 1973), all of the loadings are larger than 0.63 and are considered very good or excellent (larger than 0.7). Average variance extracted (AVE) estimates the amount of variance captured by a construct's measure relative to random measurement error. Estimates of Cronbach alpha above 0.7 and AVE above 0.5 are considered supportive of internal consistency (Bagozzi and Yi 1988; Fornell and Larcker 1981). The square root of the AVE for each construct is also compared and greater than the correlation shared between the construct and other constructs in the model. Thus the discriminant validity is verified.

Table 2. Summary of measure scales including factor loadings, average, and standard deviation of items, and Cronbach's alpha, AVE of constructs

Item	Factor loadings							Item average	Item stand. deviation	Cronbach's alpha/AVE
WSat1	.212	.237	.192	**.755**	.329	.168	.161	5.10	1.02	.895/.742
WSat2	.235	.272	.208	**.745**	.273	.196	.217	4.99	1.06	
WSat3	.265	.279	.207	**.698**	.271	.314	.171	5.19	1.08	
WSat4	.215	.313	.252	**.730**	.250	.272	.177	5.17	1.02	
PSat1	.234	.252	.192	.373	**.722**	.200	.280	5.11	1.09	.915/.794
PSat2	.303	.228	.168	.419	**.681**	.229	.272	5.12	1.13	
PSat3	.311	.215	.185	.383	**.676**	.237	.318	5.10	1.17	
PSat4	.324	.256	.186	.372	**.677**	.213	.298	5.07	1.11	
WTrust1	.178	**.816**	.212	.248	.168	.192	.206	5.21	1.12	.905/.786
WTrust2	.179	**.826**	.213	.255	.143	.205	.174	5.20	1.15	
WTrust3	.173	**.770**	.249	.211	.197	.282	.205	5.23	1.17	
WTrust4	.184	**.766**	.240	.226	.204	.320	.237	5.26	1.12	
PTrust1	.289	.330	.248	.223	.299	.228	**.680**	5.22	1.13	.911/.792
PTrust2	.316	.294	.238	.246	.301	.245	**.680**	5.18	1.10	
PTrust3	.323	.313	.253	.245	.338	.269	**.642**	5.16	1.16	
PTrust4	.321	.329	.248	.248	.330	.251	**.657**	5.16	1.16	
WInt1	.216	.359	.276	.297	.195	**.702**	.252	5.52	1.14	.916/.817
WInt2	.234	.359	.294	.280	.210	**.717**	.238	5.53	1.14	
WInt3	.259	.339	.321	.266	.242	**.668**	.206	5.48	1.22	
WInt4	.223	.383	.294	.280	.221	**.704**	.214	5.64	1.12	
PInt1	**.879**	.165	.209	.187	.144	.159	.151	4.98	1.39	.916/.806
PInt2	**.870**	.179	.223	.181	.179	.134	.194	4.87	1.40	
PInt3	**.881**	.138	.223	.178	.165	.124	.165	4.84	1.49	
PInt4	**.816**	.161	.214	.181	.229	.199	.195	5.06	1.44	
SocI1	.183	.216	**.841**	.173	.138	.223	.142	5.00	1.32	.902/.773
SocI2	.195	.207	**.834**	.164	.109	.211	.166	4.98	1.24	
SocI3	.211	.163	**.872**	.122	.140	.148	.149	4.81	1.31	
SocI4	.238	.183	**.868**	.184	.100	.121	.113	4.61	1.37	

All of the loadings are significant at $p < 0.01$.

Table 3 Results of the research model

Relationship	Coeff.	*t*-value	*p*	Relationship	Coeff.	*t*-value	*p*
H1a: PSat -> PTrust	.738	12.09***	.000	H3a: PTrust -> Pint	.697	12.626***	.000
H1b: PSat -> WTrust	.242	3.318***	.000	H3b: PTrust -> WInt	.418	7.937***	.000
H2a: WSat -> WTrust	.551	7.537***	.000	H4: WTrust -> Wint	.478	9.081***	.000
H2b: WSat -> PTrust	.122	2.006**					

*** : α=0.01 ; ** : α=0.05 ; * : α=0.1

The study used Partial Least Squares (PLS) to test the causal effects of the research model, and this study applied SmartPLS 2.0 to analyze the structure model. Results in Table 3 indicate that all of the hypotheses are tested significantly. Except H2b, the relationship between satisfaction toward websites and trust toward products is significant at 95 percent confidence level, all of the other hypotheses are significant at 99 percent confident level. Both of the satisfaction toward websites and products will have positive impact on trust of websites and products. The two cross relationships, product satisfaction to website trust and website satisfaction to product trust, had lower coefficients (.242 and .122) than those of two direct relationships, product satisfaction to product trust and website satisfaction to website trust (.738 and .551). For the hypotheses regarding purchase intention, trust toward the products shows the strongest relationship with purchase intention of the products.

To test the moderating effects of social identity on the relationship between trust and purchase intention, a multi-group analytical procedure (Keil, 2000) was used to compare the corresponding path coefficients in the structural models. To generate two groups for social identity, 40 observations equal to the median value (5 in this case) were removed and the remaining observations, 134 samples with measures smaller than 5 and 126 samples with measures larger than 5, were used to generate groups (Hair et al. 2010). According to the numbers shown in Table 4, the t-values are 2.550, 1.345, and -0.369 for the moderating effects of social identity on the relationships of trust toward products and purchase intention on products, trust toward product and purchase intention on the websites, and trust toward websites and purchase intention on the websites, respectively. Only the two relationships regarding purchase intention on the websites are significantly moderated by social identity. These two relationships are stronger for low social identity.

Table 4 Results for the moderating effect of social identity on purchase intention

Moderating effect of social identity on relationships	Coefficient (*t*-value)		Coefficient difference (*t*-value)	Results
PTrust -> PInt	Low	.701 (13.374***)	.256 (2.550***)	Stronger for low social identity
	High	.445 (5.029***)		
PTrust -> WInt	Low	.426 (4.131***)	.169 (1.345*)	Stronger for low social identity
	High	.257 (3.722***)		
WTrust -> WInt	Low	.441 (4.493***)	-.046 (-0.369)	Insignificant
	High	.487 (5.681***)		

*** : α=0.01 ; ** : α=0.05 ; * : α=0.1

5. Conclusions, Managerial Implications, and Future Work

Causal effects between satisfaction and trust are significant for all four relationships as expected. Cross relationships, web site satisfaction to product trust and product satisfaction to web site trust, are weaker than the relationships of satisfaction and trust on the same targets, products or web sites. It is interesting to note that the coefficients for H1a and H1b are larger than H2a and H2b, respectively. It implies that the satisfaction toward product has higher effect on the users than the satisfaction toward the web site. The similar results are observed on the relationship between trust and purchase intention. Group buying operator should select the items to be sold in their web sites carefully, because the effect on the users is higher for products than for the web site. A user dissatisfied on the products might prevent him conducting any purchase on the web site.

For the moderating effects, social identity only moderates the relationships between trust toward the product and purchase intention on the web site; and between trust toward the product and purchase intention on the web site. Social identity is measured based on users' interaction with their network members, and the moderating effect only applies on trust toward products and the two purchase intentions. Weaker social identity has stronger relationship between trust toward product and purchase intentions. These results support the strategy of Groupon.com in Taiwan, as mentioned previously, to close its online social network. However, does this mean all of the group buying sites should not have its own online social network? Perhaps some factors, not considered in this study, could play an important role needing further study. For example, types of product traded for the group buying might be important. Babyhome.com, the group buying web site relying on its social network, sold most of the products without expectation of re-purchase within a certain period of time. For example, a user purchased a complete set of children books for ages 2 to 6 would not have the same purchase for a long time. On the other hand, the majority of the products traded on Groupon.com are re-purchasable such as meals for restaurant or tickets for theme parks. Further study is needed to clarify this issue.

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References

Aiken, D. J., and Boush, D. M. (2006). Trustmarks, objective-source ratings, and implied investments in advertising: Investigating online trust and the context-specific nature of internet signals, Academic of Marketing Science Journal 34(3), 308-323.

Ajzen, I., and Fishbein, M. (1980). Understanding Attitudes and Predicting Social Behavior, Englewood Cliffs, NJ: Prentice-Hall.

Anand, K. S., and Aron, R. (2003). Group-buying on the web: a comparison of price-discovery mechanisms, Management Science, 49(11), 1546-1562.

Bagozzi, R.P., and Yi, Y. (1988). On the evaluation of structural equation models, Journal of the Academy of Marketing Science 16(1), 74-94.

Bergami, M., and Bagozzi, R. P. (2000). Self-categorization, affective commitment, and group self-esteem as distinct aspects of social identity in an organization. British Journal of Social Psychology, 39(4), 555-577.

Bernoff, J., and Li, C. (2008). Harnessing the power of the oh-so-social web, MIT Sloan Management Review, 49(3), 35-42.Bounagui, M., & Nel, J. (2009). Towards understanding intention to purchase online music downloads, Management Dynamics, 18(1), 15-26.

Chen, J., Chen, X., Kauffman, R. J., & Song, X. (2009). Should we collude? Analyzing the benefits of bidder cooperation in online group-buying auctions. Electronic Commerce Research and Applications, 8(4), 191-202.

Chen S., and Dhillon, G. (2003). Interpreting dimensions of consumer trust in e-commerce, Information Technology and Management, 4(2), 303-318.

Cheng, H., Yang, M., & Chen, K. (2011). Elucidating the ethical sales behavior in electronic commerce. Journal of Computer Information Systems, 52(1), 87-95.

Choi, J., Sohn, C., and Lee, H. J. (2010). The Impact of multi-dimensional trust for customer satisfaction. International Journal of Management Science, 16(2), 81-97.

Chouk, I., and Perrien, J. (2004). Consumer trust towards an unfamiliar web merchant, Proceedings of the 33rd RMAC Conference.

Comrey, A.L. (1973). A First Course in Factor Analysis, Academic Press, New York.

Cooke, M., and Buckley, N. (2008). Web 2.0, social networks and the future of market research, International Journal of Market Research, 50(2), 267-292.

Dholakia, U. M., Bagozzi, R. P., & Pearo, L.K. (2004). A social influence model of consumer participation in network- and small-Group-based virtual communities. International Journal of Research in Marketing, 21(3), 241-263.

Fornell, C., and Larcker, D.F. (1981). Evaluating structural equation models with unobservable variables and measurement errors, Journal of Marketing Research 18(1), 39-50.

Green, D. T., and Pearson, J. M. (2011). Integrating website usability with the electronic commerce acceptance model, Behavior & Information technology, 30(2), 181-199.

Ha, H-Y, Janda, S., and Muthaly, S. K. (2010). A new understanding of satisfaction model in e-re-purchase situation, European Journal of Marketing, 44(7/8), 997-1016.

Hagel III, J., and Armstrong, A. (1997). Net Gain: Expanding Markets through Virtual Communities, Boston, MA: Harvard Business School Press.

Hair, J. R., Anderson, R. E., Tatham R. L., & Black, W. C. (2010). Multivariate Data Analysis, New Jersey: Prentice Hall.

Heijden, H. V. D., Verhagen, T., & Creemers, M. (2003). Understanding online purchase intentions: Contributions from technology and trust perspectives, European Journal of Information Systems, 12(1), 41-48.

Horng, S. M. (2012). A study of the factors influencing users' decisions to pay for web 2.0 subscription services, Total Quality Management & Business Excellence, 23(7/8), 891-912

Hume M., and Mort, G. S. (2008). Understanding the role of involvement in customer repurchase of the performing arts, Journal of Nonprofit & Public Sector Marketing, 20(2), 297-328.

Kauffman, R. J., Lai, H., & Ho, C. T. (2010). Incentive mechanisms, fairness and participation in online group-buying auctions. Electronic Commerce Research and Applications, 9(3), 249-262.

Kauffman, R. J., & Wang, B. (2001). New buyers' arrival under dynamic pricing market microstructure: The case of group-buying discounts on the Internet.

Keil, M., Tan, B., Wei, K-K, Saarinen, T., Tuunainen, V., and Wassenaar, A. (2000). ‘’a cross-culultural study on escalation of commitment behavior in software projects, MIS Quarterly, 24(2), 299-325.

Martin, S. S., Camarero, C., and Jose, R. S. (2011). Does involvement matter in online shopping satisfaction and trust? Psychology & Marketing, 28(2), 145-167.

Matsuo, T., and Ito, T. (2004). A group formation support system based on substitute goods in group buying, Systems and Computers in Japan, 35(10), 23-31.

Ministry of Economic, (2011), retrieved on 2015/1/3 http://ciis.cdri.org.tw/files/attachment/0B350362603789551975/%E5%8F%B0%E7%81%A3%E5%9C%98%E8%B3%BC%E7%B6%B2%E7%AB%99%E7%9A%84%E7%8F%BE%E6%B3%81%E8%88%87%E8%B6%A8%E5%8B%A2%E7%99%BC%E5%B1%95.pdf.

Pentina, I., Prybutok, V. R., and Zhang, X. (2008). The role of virtual communities as shopping reference groups, Journal of Electronic Commerce Research, 9(2), 114-136.

Ribbink, D., Van Reil, A. C. R., Liljander, V., and Streukens, S. (2004). Comfort your online customer: Quality, trust, loyalty on the Internet, Managing Service Quality, 14, 446-456.

Santos, C. P., and Fernandes, D.V. (2011). Perceptions of justice after recovery efforts in internet purchasing: The impact on consumer trust and loyalty toward retailing sites and online shopping in general, BAR, Curitiba, 8(3), 225-246.

Stone, E. F. (1978). Research Methods in Organizational Behaviour. Glenview, IL: Scott Foresman.

Tax, S., Brown, S., and Chandrashekaran, M. (1998). Customer evaluations of service complaint experiences: Implications for relationship marketing, Journal of Marketing, 62(2), 60-76.

van der Heijden, H., Verhagen, T., & Creemers, M. (2003). Understanding online purchase intentions: contributions from technology and trust perspectives. European Journal of Information Systems, 12, 41-48.

Venkatesh, V., and Agarwal, R. (2006). Turing visitors into customers: A usability-centric perspective on purchase behavior in electronic channels, Management Science, 52(3), 367-382.

Venkatesh, V., Thong, J., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. MIS Quarterly, 36(1), 157-178.

Webster, C., and Sundaram, D. S. (1998). Service consumption criticality in failure recovery, Journal of Business Research, 41(2), 153-159.

Wells, J. D., Valacich, J. S., and Hess, T. J. (2011). What signal are you sending? How website quality influences perceptions of product quality and purchase intentions, 35(2), 373-396.

Whittaker, G., Ledden, L., and Palafatis, S. P. (2007). A re-examination of the relationship between value, satisfaction and intention in business services, Journal of Services Marketing, 21(5), 345-357.

Young, L. (2006). Trust: looking forward and back, Journal of Business and Industrial Marketing, 21, 439–445.

yStats.com. (2011). USA B2C E-Commerce Report 2011 (pp. 62). Retrieved from http://www.ystats.com/uploads/report_abstracts/805.pdf

Influential factors for online impulse buying in China: a model and its empirical analysis

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Abstract - *This study provides insights into online impulse buying behavior by exploring clear endogenesis relationships among factors that influence such a behavior. Drawing upon cognitive emotion theory and the existing literature, we develop a theoretical model that shows how personal impulse character, stimuli, psychosocial factors, and perceived risks are related to internal emotion and online impulse buying behavior. The influential path model is tested and modified on the basis of survey data obtained from 246 valid questionnaires. Data are analyzed with exploratory and confirmatory factor analyses to determine and confirm the identified factors. Structural equation modeling indicates the significant effects of the factors, as well as their indirect effects. Results aim to enhance our understanding of impulse online buying and improve online store operations from a management perspective.*

Keywords: online impulse buying; cognitive emotion theory; non-rational decision-making model; influential factor.

1 Introduction

With the popularity of the Internet, online shopping has become pervasive in the day-to-day lives of the Chinese. Online impulse buying is further triggered by easy access to products, fast purchase process, lack of social pressure, and absence of the need to hand-carry products on the part of the consumer [1]. An understanding of the consumer buying behavior is vital for e-commerce practitioners, so the nature of such an online buying behavior should be explored [2]. The online context is highly susceptible to non-rational purchases, such as impulse buying, unplanned purchases, compulsory purchases, and the herd phenomenon. All of these can be largely attributed to physiological limits, the deterministic environment, personal preferences, and background effects. While plenty of research indulged in traditional consumer purchase model that involves ideal buying conditions does not always occur in online stores. Surprisingly, research on the factors that influence impulse buying in an online context remains limited.

The goal of our research consists in analyzing the relationship among the influential factors, internal states and buying behavior in the online context. After a survey of relevant research involved in impulse buying and influential factors to impulsive buying, this study summarizes the factors that influence online impulse purchases in relation to real-world online shopping processes. Based on the Cognition Emotion Theory, an online impulse buying model is constructed, and then research hypotheses are developed. Through empirical analysis, the study verifies and modifies the structural model, which shows the relationship among the identified factors, internal states and online impulse buying behavior.

2 Theoretical background

2.1 Impulse buying

Traditional theories on consumer purchase decisions purport that consumers possess sufficient information to select and implement the best option. However, such a concept is limited in consideration of actual conditions. Prior to 1982, the definitions of impulse buying focused on the product rather than the consumer as the motivator of impulse purchases. [3] regards impulse buying as an unplanned action that occurs after consumers have entered a shopping center. By contrast, [4] regards impulse buying as a rational action because it is confirmed after consumers have entered a shopping center. [5] provides a basic definition of impulse buying behavior, which classifies the act as planned, unplanned, or based on impulse. According to this categorization, planned buying behavior involves a time-consuming search for information, followed by rational decision making [8, 9]. Unplanned buying refers to all purchases made without planning and includes impulse buying, which is characterized by the relative speed with which buying "decisions" occur. After 1982, when researchers began to re-focus their attention on impulse buying behavior, they started to investigate the behavioral dimensions of impulse buying. Researchers then agreed that impulse buying involves a hedonic or affective component [10-13]. A definite concept of impulse buying remains lacking because it involves complex mental processes and emotional states. However, relevant studies imply that impulse buying involves two principles. First, it lacks a clear, detailed purchase target, so it is an unplanned action. Second, it is a complex emotional reaction to an external stimulus. Therefore, online impulse buying is

defined as an action without consideration or purchase intention and is a result of a mental reaction to an external stimulus from the online environment.

2.2 Factors that influence online impulse buying

Compared with traditional purchasing, online shopping involves the following four advantages. First, shopping through a network is not limited in terms of time and space. Second, the prices of online commodities are not significantly different from those in physical shops. Third, shopping online can save consumers' time and effort in determining the commodity they want. Fourth, online products are diverse and rich in information, characteristics that significantly reduce information irregularities. In addition to these advantages, sophisticated online payment systems largely address the security issues of online payment; as a result, online buying generates a positive consumer demand [14].

Research on online impulse buying has mainly focused on promotions. [10] examines how promotions influence consumers' impulse buying behavior. [12] explores low price and advertising as a means of promotion that affects impulse buying. In recent years, researchers have recognized that certain factors are more influential than others in affecting online impulse buying. Using the actual purchasing behavior in a high school reunion web store, [1] examines the factors that lead to the increased willingness of online consumers to impulsively purchase items. [2] develops a model and shows how beliefs on functional convenience (product attractiveness in the online store) and representation (enjoyment and website communication style) are related to online impulse buying. However, existing research lacks insights into consumer reaction on the factors that influence online impulse buying. In this study, we attempt to investigate such factors, which are summarized into the following four types.

(1) Personal factors: 1) Impulse character refers to the tendency to engage in impulsive behavior. In real life, people respond to external stimuli in varying degrees[2]; 2) People who are easygoing and prefer to be highly similar to others, so that they are likely to engage in impulse buying [8]; 3) Demographic factors, such as age, gender, and race, are related to impulse buying [9]; 4) Self-control ability, highly self-controlled consumers are less inclined to engage in impulse buying than those who are not [10];

(2) External stimuli: External stimuli, including price promotions, advertising, product attributes, website design, and online reputation, are direct and obvious elements evident in online stores [11] [12];

(3) Indirect stimuli: 1) Online comment. [15] has found that buyers are very sensitive to negative comments. Similarly, [16] indicates that the role of comments on products decreases as the sales is extended; 2) Online service. The quality of online services affects consumers' emotion; poor service may lead to consumers cancelling a transaction [17]; 3) Recommendation from others in the network. Someone knowledgeable in online shopping shares his or her shopping experience and recommends a commodity [18];

(4) Restrained factors: 1) Income. Online buying is directly influenced by income because it is hindered by the lack of disposable income [12]; 2) Perceived risks. Consumer uncertainty on a commodity can cause negative consequences after buying [19]. [20] proposes perceived risk: economic, functional, physical, psychological, and social dimensions. [21] adds the "time risk" as the sixth dimension. These dimensions can explain most of the perceived risk.

How do the aforementioned factors affect online impulse buying? The next section constructs an online impulse buying behavior model based on cognition emotion theory (CET) and develops the relevant hypotheses.

3 Model and hypothesis

3.1 Theoretical model

This study discusses the superiority of the cognitive approach to emotionss over the behavioral and physiological approaches. CET indicates that observing a stimulus and the consequent formation of evaluative perceptions causes emotions [20]. Therefore, the factors that influence online shoppingt that a stimulus leads to impulse action tendencies adjusted under restrained factors. The outcome of the emotion, therefore, is to impulsively buy or not. Fig. 1 shows our theoretical model, which is anchored on the literature on impulse buying and derives its theoretical structure from CET.

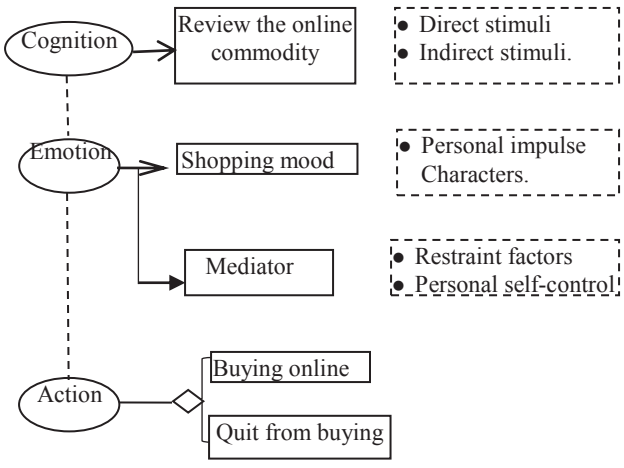

Figure1. Cognition-Emotion-Action link: the theoretical model for measure the effects of influential factors on online impulse buying.

This structure has been shown to be robust in many consumer emotion studies and is empirically favored over other views. In the online context, shopping emotion has two

internal states: online shopping mood which is revolved by (direct and indirect) stimuli, personal impulse character; the shopping mood is mediated by self-control which is determined by restraint factors, such as perceived risk and personal self-control traits. Final action is decided by personal emotion state. The effect between outside stimuli and internal state on online impulse buying behavior will be analyzed, as well as examining the influence of mediator variable between constructs. Related hypotheses are proposed as following sub-section.

3.2 Hypotheses

3.2.1 Online shopping moods and online impulse buying emotion

[22] presented unplanned browsing brings direct and indirect stimuli, which can increase the will of impulse buying. The issue in planned online buying is not involved in this study. The online shopping atmosphere working as external stimulus influences consumer mood, which in turn affects the buying behavior through the shopping emotion. Therefore, the following hypothesis is suggested:

H1. Online shopping pleasure moods and impulse buying emotion have a positive relationship.

3.2.2 Stimulus and online impulse shopping emotion

In Section 2, we discussed the online shopping stimulus. The direct stimulus comes from the commodity and the online store. Indirect stimulus includes online comments, quality of service, and recommendations. The hypotheses are proposed as following:

H2. Commodity promotion and online impulse buying emotion have a positive relationship.

H3. The detailed information of a commodity and impulse buying emotion have a positive relationship.

H4. The commodity recommended in online stores and impulse buying emotion have a positive relationship.

H5. The number of online comments and impulse buying emotion has a positive relationship.

H6. The quality of comments and impulse buying emotion has a positive relationship.

H7. The quality of service and impulse buying emotion has a positive relationship.

H8. Others' recommendations and impulse buying emotion have a positive relationship.

3.2.3 Personal impulse character and online impulse buying emotion

A person with an impulsive character makes decisions without consideration. High-impulse characters tend to have an optimistic mood, are pleasure oriented, and neglect prior cognition and evaluation [6, 8], which all leads to impulse shopping emotion. The following hypotheses are suggested:

H9. A high-impulse character has greater online impulse buying emotions than a low-impulse character.

H10. A high-impulse character and impulse buying emotion have a positive relationship.

H11. A low-impulse character and impulse buying emotion have a negative relationship.

3.2.4 Perceived risk and impulse buying emotion

Perceived risk is defined as the uncertainty and potential negative effects when a buying decision is made. [23] believed the perceived risk reduces the probability of buying. Jacoby and Kaplan categorize perceived risk into financial, functional, physical, psychological, and social risks. This paper involves time, financial, social, and psychological risks. Therefore, the hypotheses are suggested as following:

H12. A perceived high risk and impulse buying emotion have a negative relationship.

H13. A perceived low risk and impulse buying emotion have a positive relationship.

H14: A perceived low risk leads to greater impulse buying emotions than a perceived high risk.

Look back at the theoretic model shown in figure1, the relationship among the hypotheses is shown as following figure 2:

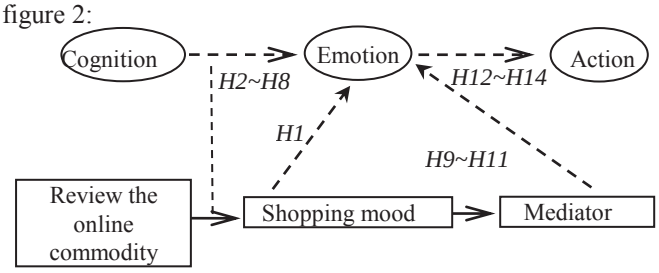

Figure 2. The initial structure for the research hypotheses

The hypotheses are involved the latent variables, such as shopping mood, stimulus, personal impulse characters etc. According to related scale, the observable variables are built to analyze empirically.

4 Research method

4.1 Questionnaire measurement

As the main purpose of our research is to empirically test the path between the cognition and mood on the impulse buying behavior in online context. A self-administered questionnaire with eight parts is designed: the first part is the introduction and reminder to reduce the respondents' awareness deviation; the second part obtains the basic personal information and online shopping experiences of the respondents; the third to sixth parts involve online shopping moods, perceived risk, personal impulse character, and stimuli and impulse emotions respectively. We measured the constructs by using multi-item scales. To empirically analyze the path model among initial latent factors, the corresponding observed variables are built. Cronbach's alpha represents the reliability of latent variables, as shown in the following table.

Table 1. Questionnaire Measurement

Initial latent factor	Initial number of observed variables	Alpha value
Shopping moods	5	0.797
Perceived risk	9	0.797
Impulse character	6	0.853
Online comments	6	0.721
Direct stimuli	9	0.739
Others' recommendations	5	0.787

Table 1. shows that each alpha value is greater than 0.7, so the reliability of the questionnaire is confirmed.

4.2 Empirical data collection

A questionnaire survey was utilized to collect empirical data through the Internet and instantaneous random sampling. The online invitation included a link to our web-based survey, which elicited data on the purchase and user demographics. As an incentive, the respondents were asked to provide their e-mail respective addresses, so that they can join a raffle contest for a token worth 200 RMB. A pretest was conducted among three graduate students. They were asked to evaluate the clarity and interpretability of the questionnaire, and they met with the research team to discuss and suggest improvements.

4.3 Sample

The questionnaires were administered on May 1, 2013, and the deadline of submission was May 10, 2013. A total of 246 complete and valid questionnaires were used. [24] suggests that the sample size of a study should be at least five times more than the number of measurements when structural equation modeling (SEM) is used. The questionnaire comprises 40 attitude measurements, which met the requirement for sample size. Table 2 shows the demographic data of the sample.

Table 2. Sample demographics (n = 246)

Demographic	Category	Count	Percentage
Gender	Male	125	50.8
	Female	121	49.2
Age	< 20	3	1.2
	20–24	217	88.2
	25–30	24	9.8
	31–40	2	.8
History of online shopping	Below 1 year	49	19.9
	1–2 years	72	29.3
	2–3 years	57	23.2
	3–4 years	46	18.7
	More than 4 years	22	8.9
Frequency of online shopping	More than 3 times a week	4	1.6
	2–3 times a week	12	4.9
	Once a week	33	13.4
	Once in 2 weeks	67	27.2
	Once in 4 weeks	60	24.4
	Once in 8 weeks	48	19.5

The demographic profile shows that in terms of gender, the proportion of the respondents is almost equal. Slightly more males than females participated, and the majority of the respondents are in the 20- to 30-year old age group. The survey data similar with statistical characters presented in the 2013 Statistical Report on Internet Development in China, which was taken from the China Internet Network Information Center [24] .

5 Data analysis and results

5.1 Exploratory factor analysis

Barblett sphericity and Kaiser-Meyer-Olkin (KMO) value tests were employed to confirm whether the sample is fit for factor analysis. The value of KMO is 0.783, and the Sig. is 0.000, which correspond with the required significance and thus guarantee the following factor analysis. Factor analysis showed that the variables initially lacked aggregation, so the observed variables were adjusted and deleted, with the final rotation matrix. Both direct stimuli 1 and 2 are from the commodity, whereas direct stimuli 3, 5, 6, 7, and 9 are from the online store. Perceived risks 1, 2, 3, and 9 are psychological risks, whereas perceived risks 4, 5, and 6 are financial risks. With further testing, the value of KMO is 0.783, and the Sig. is 0.000, which meet the required significance and alpha value, as shown in Table 3.

Table 3. Reliability analysis for the modified factors

Modified Factor	Number of observed variables	Alpha

Impulse purchase will (*WILL*)	2	0.696
Shopping mood (*MOOD)*	3	0.827
Psychological perceived risk (*PRISK)*	4	0.787
Financial perceived risk (*FRISK)*	3	0.694
Impulse character (*CHAR*)	5	0.845
Online comments (*REVI)*	4	0.729
Commodity stimuli (*GSTIM)*	2	0.754
Online store stimuli (*SSTIM)*	5	0.764
Others' recommendations (*RECO)*	5	0.787

Exploratory factor analysis (EFA) determines the potential factors among the observed items and is different from our classification in Section 2. Table 4 defines the observed variables.

Table 4. Definitions of the observed variables

WILL	*WILL 1*	I am willing to shopping online.
	WILL 2	Online shopping brings me joy.
MOOD	*MOOD 1*	Browsing online stores brings me pleasure.
	MOOD 2	I experience unplanned online shopping.
	MOOD 3	I have the desire to buy commodities that attract me even if doing so is unplanned.
PRISK	*RISK 1*	Online buying may be inefficient because too much time is spent on searching.
	RISK 2	I am afraid of purchasing online without product quality being guaranteed.
	RISK 3	I am afraid that the commodity I will purchase is inappropriate because I cannot physically check the product.
	RISK 9	I am afraid that I will regret the purchase if the online commodity turns out to be below my expectations.
FRISK	*RISK 4*	I am afraid that Internet sellers over-charge.
	RISK 5	I am afraid that my credit card will be compromised when I buy online because the transaction is processed through the Internet.
	RISK 6	I am afraid that a mistake can occur in charging my account when I buy online.
CHAR	*CHAR 2*	I am not easily tempted when I browse my favorite commodity.
	CHAR 3	I have a desire for online buying.
	CHAR 4	I will be distressed if I do not buy my favorite commodity.
	CHAR 5	I want to get my favorite commodity.
	CHAR 6	I will purchase according to my desire.
REVI	*REVI 3*	Many online comments are worthy and reliable.
	REVI 4	Many comments strongly recommend buying.
	REVI 5	I am willing to purchase if product comments are detailed.
	REVI 6	I am willing to purchase if product comments are easy to understand.
GSTIM	*STIM 1*	I am attracted by beautiful pictures of the commodity.
	STIM 2	I would like the detailed product description to be presented to prove the merit of the commodity.
SSTIM	*STIM 3*	I am always attracted by online store promotions.
	STIM 5	I would like to buy according to the recommended commodity list in online stores.
	STIM 6	I am affected by the technique of an online store in recommending products.
	STIM 7	I would like to purchase in a store that has a detailed description of its commodities.
	STIM 9	I will cancel my purchase if the quality of service (e.g., attitude of the online BA) is poor.
RECO	*RECO 1*	I believe the suggestions and recommendations of my friends.
	RECO 2	I am willing to refer to the purchase experiences provided by others in the internet.
	RECO3	I am willing to refer to the reviews made by previous buyers.
	RECO4	My shopping mood is affected by others' recommendations.
	RECO5	I buy a commodity on the basis of others' recommendations through the Internet.

5.2 Confirmatory factor analysis

Confirmatory factor analysis (CFA) was applied to test the adequacy of the measurement model with linear structural relations (LISREL) 8.70. All loading coefficients of the factors are found to be greater than 0.5, except for the loading coefficient of *risk 1* to *prisk*, which is below 0.5. The consequences of the fitting indicators, $\chi 2/df = 1.485$, $GFI = 0.86$, $AGFI = 0.83$, $NFI = 0.87$, $IFI = 0.95$, $CFI = 0.95$, $RMR = 0.049$ $RMSEA = 0.045$, $P = 0.000$, which all meets the requirement. The analysis in this section verified that the identified factors from the observed variables are reliable and valid. Further analysis is conducted with the use of SEM with LISREL 8.70 to explore the relationships among the factors. The hypotheses presented in Section 3 are then tested.

5.3 Structural analysis

The theoretical model that established the initial structural model indicates that the identified factors are the latent variables, and the original variables are the observed variables. *T*-test was employed to verify the validity of the relationship among the latent variables. However, some *t*-values are less than 1.96, which discounted the significant influence of the latent factors. The structural model is modified by removal of the minimum *t*-value until each value is beyond 1.96. The maximum value of *MI* was then obtained, and the connection between the latent variables was established. The fitting indicators for SEM after modification are $\chi 2/df = 1.486$, $GFI = 0.86$, $AGFI = 0.82$, $NFI = 0.87$, $IFI = 0.95$, $CFI = 0.95$, $RMR = 0.054$, $RMSEA = 0.045$, $P = 0.000$, which all meets the requirement. Therefore, the structural equation model fits well. Further *t*-test was conducted on the model, with the results shown in Figure 5. The *t*-value of each path is greater than 1.96, which indicates the significant influence of the latent variables.

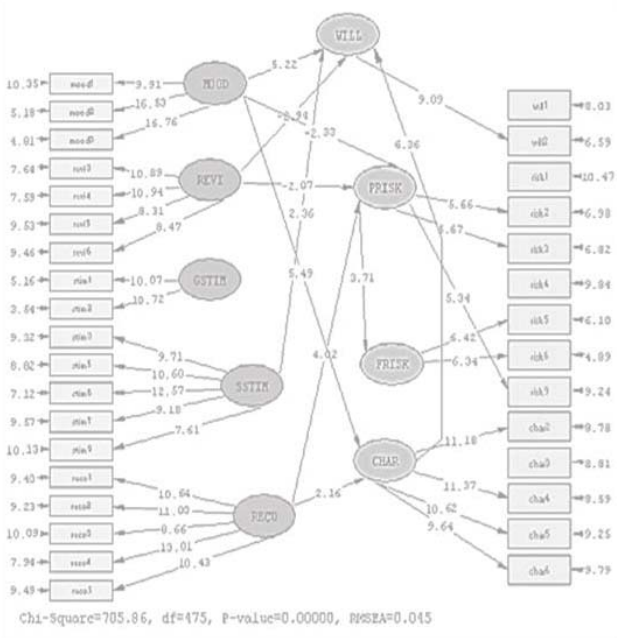

Figure 5. *t*-test for the modified structural equation model.

MOOD indicates the significant influence on *WILL, PRISK,* and *CHAR*; *REVI* on *WILL* and *PRISK; RECO* on *CHAR* and *PRISK*; and *SSTIM* on *WILL*. A significant influence was similarly found among the emotional factors: *CHAR* on WILL and *PRISK* on *FRISK*. The coefficient of each standard path shows the degree of influence (Figure 5). The analysis indicates that the hypotheses presented in Section 3 are confirmed, the hypothesizes *H1, H4, H7-H11* are accepted while the *H2, H3, H12-H14* are rejected.

5.4 Discussion

The path model in figure 5 and tested result of related hypotheses shown as table 8 indicate the following results that could be relevant for online shopper because online impulse buying is an important part of their sales. The discussion will be carried out along the theoretic model link.

1) The cognition to online impulse buying emotion.The cognition from the e-shop is reflected in direct stimuli (from goods, GSTIM) and indirect ones (from service or e-shop atmosphere, SSTIM). From the figure 4, the direct stimuli (GSTIM) are lack of influence to the internal emotion of online impulse buying while the indirect ones (SSTIM) affect the impulse buying emotion. Moreover, the *H2, H3, H5, H6* have been rejected while H7 has been accepted, which proves the conclusion again. So, e-shopper would strengthen the indirect stimuli (improve the e-shop atmosphere and service) to increase online impulse buying since stimuli from stores directly increase impulse buying emotion, whereas stimuli from commodities themselves do not significantly influence impulse buying emotion.

The cognition from other external stimuli, especially the reviews on the commodity affect the online impulse buying directly (see in figure 4, 5, REVI to WILL), and the path coefficient between online comments (REVI) and impulse buying emotion (WILL) is significantly negative (–2.94). This finding means that impulse buying emotion is sensitive to negative comments, which reduce online impulse buying obviously.

2) Internal adjustment in online impulse buying emotion. Besides the cognition, the emotion is revolved by mood and mediator. From the figure 4, 5 and table 8, shopping mood influences impulse buying emotion directly (see in MOOD to WILL and H1). Consumers who have positive impulse buying emotions therefore tend to buy if they feel enjoyment from online browsing. Moreover, personal impulsive character (CHAR) does so (see in CHAR to WILL, H9, H10, and H11). The external stimuli, recommendation affected the personal impulsive character, then make the influence to online impulse buying (WILL) indirectly (see in RECO to CHAR, CHAR to WILL, H4, and H8). The e-shop retailer would pay more attention to find out the customer with high personal impulsive character with intelligent sales analysis

[23] regardeds the perceived risk as mediator for shopping mood, which restricted the impulse buying. In the online context, the empirical analysis in the paper cannot support the conclusion since the psychological perceived risk (PRISK), financial perceived risk (FRISK) have nothing to do with the online impulse buying emotion. And then, *H12, H13* and *H14* have been rejected. From this point, the online impulse buying in China is an non-economic behavior, irrational and unplanned behavior.

6 Conclusions and future work

The findings of our study indicates that impulse buying emotion is significantly influenced by online shopping mood, online store stimuli, recommendations, and personal impulse character.

From a managerial perspective, online stores should work on improving the factors determined to have a positive relationship with impulse buying. According to our research, the improving implications should focal on the following: First, we showed that shopping mood directly influences impulse buying emotion. The presentation and attractiveness of a commodity are therefore important in impulse buying. Second, considering the influence of online store stimuli, online retailers should create a user-friendly, informative, and fun website that makes the browsing experience of customers enjoyable. Third, online retailers should adopt strategies to encourage their previous customers to recommend their store to others because recommendations have been shown to significantly influence impulse buying. Fourth, bad comments negatively affect impulse buying. Therefore, online retailers should address bad comments and avoid them altogether.

Finally, online impulse buying lacks insight into the perceived risk involved, and income puts its relevance into perspective. Each improving will demand cost, how to allocate limited resources to improve these factors can also be a meaningful topic for further research.

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References

[1]S.A. Jeffrey, R. Hodge. Factors influencing impulse buying during an online purchase. Electronic Commerce Research vol. 7 (2007): 367 – 379.

[2]Tibert Verhagen, Willemijn van Dolen. The influence of online store beliefs on consumer online impulse buying: A model and empirical application. Information & Management 48 (2011): 320 – 327.

[3]Katona, George and Eva Mueller, The Dynamics of Consumer Reactions, New York: New York University Press (1955): 30-88.

[4] Nesbitt, Saul. Today's Housewives Plan Menus as They Store. Nesbitt Associates Release (1959): 2-3.

[5] Stern, Hawkins. The Significance of Impulse Buying Today. Journal of Marketing, 26 (1962): 59-62.

[6]Weinberg, Peter and Wolfgang Gottwald. Impulse Consumer Buying as a Result of Emotions, Journal of Business Research, vol. 10 (1982): 43-57.

[7]West, John C. Results of Two Years of Study into Impulse Buying, Journal of Marketing, vol.15 (1951): 362-363.

[8]Winshie, H. The Impulse Personality, New York: Plenum Press (1977).

[9]Wolman, Benjamin .Dictionary of Behavioral Science, New York: Van Nostrand Reinhold (1973).

[10]Joann Peck, Terry L. Childers, If I touch it I have to have it: Individual and environmental influences on impulse purchasing Journal of Business Research. Volume 59, Issue 6(2006): 765 – 769

[11] Mengkuan Lai. A Qualitative Approach for Conceptualizing Consumer Decision-Making in Online Auctions. Advances in Consumer Research. Volume 35, 2008:319-323

[12]Utpal M. Dholakia. Temptation and resistance: An integrated model of consumption impulse formation and enactment Psychology & Marketing. Vol. 17 (2000): 955–982.

[13] Cai Yaqi etc. The research on impulse buying behavior. Application psychology. Vol. 10(3), 2004: 53-57

[14] Qin Wu. The research on influential mechanizes of online comments to impulse buying behavior [D]. Wuhan: Huazhong University of Science & Technology, 2009.

[15] Lisa Hankin, 2007.The effects of user reviews on online purchasing behavior across multiple product categories. Master's final project report, UC Berkeley

[16] F.J.M. Laros, J.-B.E.M. Steenkamp, Emotions in consumer behavior: a hierarchical approach, Journal of Business Research 58 (10), 2005, pp. 1437 – 1445.

[17] J.A. Lee, J.J. Kacen, Cultural influences on consumer satisfaction with impulse and planned purchase decisions, Journal of Business Research 61 (3), 2008, pp. 265 – 272.

[18] S.T. Madhavaram, D.A. Laverie, Exploring impulse purchasing on the internet, Advances in Consumer Research 31, 2004, pp. 59 – 66.

[19]J. Paul Peter and Michael J. Ryan. An Investigation of Perceived Risk at the Brand Level. Journal of Marketing Research. Vol. 13, No. 2 (May, 1976), pp. 184-188

[20] Kaplan, Leon B.; Szybillo, George J.; Jacoby, Jacob. Components of perceived risk in product purchase: A cross-validation. Journal of Applied Psychology, Vol 59(3), Jun 1974, 287-291.

[21] Julian C. Sweeney. The role of perceived risk in the quality-value relationship: A study in a retail environment. Journal of Retailing. Volume 75, Issue 1, Spring 1999, Pages 77 – 105

[22] Mohan G, Sivakumaran B, Sharma P. Impact of store environment on impulse buying behavior [J]. European Journal of Marketing, 2013, 47(10): 1711-1732.

[23] Pires G, Stanton J, Eckford A. Influences on the perceived risk of purchasing online [J]. Journal of Consumer Behaviour, 2004, 4(2): 118-131.

[24] Randall E, Schumacker. Latent Variable Interaction Modeling Structural Equation Modeling: A Multidisciplinary Journal Volume 9, Issue 1, 2002

[25] China internet network information center. Report on development of Internet in China [R]. http://www.cnnic.net.cn/hlwfzyj/hlwxzbg/hlwtjbg/201403/t20140305_46240.htm. Jan. 2014

Customer's Protection in E-commerce Transaction Through Identifying Fake Online Stores

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Abstract - *Electronic commerce is the process of doing business transactions online. Most research works on e-commerce transaction has being on ensuring security that will enhance customers' trust. Thus, a centralized merchant registration retrieval (CMRR) is introduced in e-commerce model and how fake virtual stored is distinguished from legitimate virtual stores were highlighted in this paper. Also, identifying and knowing the merchant location through the use of CMRR were discussed. Finally, questionnaire was distributed to customers who purchase goods and services online to evaluate the application of CMRR in distinguishing fakes virtual stores. Analysis of the data generated showed that CMRR can efficiently be used to distinguish fake virtual stores from authenticated and verified merchant stores*

Keywords: Fake merchants, Central Merchant Registration Retrieval System (CMRRS), online transactions, customer's trust, E-commerce

1 Introduction

Electronic Commerce is a new way of doing online business [1]. In other words, the act of buying and selling via a telecommunications networks is known as e-commerce. The Internet is an excellent medium to carry out e-commerce transaction. But, consumer confidence is thwarted by the fact that the delivery of goods and services are uncertain, merchants are not known and merchants' locations are also not known [2]. This makes consumers to be disinterested in online shopping and invariably makes e-commerce not to boom as expected [3].

2 Related works

2.1 Factors affecting trust in Online

There are various types of merchant scam that ranges from merchant using customers personal data, goods or services are not delivered, cloning of website or payment page, fake merchant sites [4, 5, 6].

According to [7], online transactions make use of important and personal information of the consumers and merchants. Securing this information is of great importance and is necessary in defining the e-commerce environment. Thus, the protection of the Internet environment is a necessary step to enhancing e-commerce transaction

[6] highlighted eight factors that affect trust in e-commerce transaction. Among these factors, merchant reputation which entails merchant integrity and merchant competence is seen as a major factor that can enhance customers trust [8].

E-commerce transactions is not expanding rapidly due to customers distrust on sellers online [9]. Hence, most countries have set bills that will restore confidence to customers [10].

[5] elicited bank security features used to protect online transactions from swindlers. Their work highlighted four steps that banks can use to lessen credit card problems.

[11] highlighted the techniques available for corporate bodies to identify counterfeit of popular Web sites such as e-commerce transaction sites and merchant- customer sites.

[12] described five external and internal factors that can influence consumers' trust. Among the listed factors was vendor's reliability and integrity.

[13] researched on four main quality factors: security, privacy, design, and content, which affect e-commerce transactions. Thus the security of the buyers and sellers is essential in enhancing trust and building confidence.

2.2 Survey of security Tools used in E-commerce

The e-commerce transaction entails different stages. The best way that fraud can be combated is to use different security layers at different stages. From the order stage to payment stage, different tools such as Online payment authorization of credit card, Address verification services/ system, Card verification codes, Negative files, Risk prediction techniques/ models, Rules Based Detection, and

MasterCard secure code are security tools used at the payment stage.

2.3 E-commerce vulnerability threats

There is need to check all built website. Hence, [13] proposed a model that is used to test the weakness, threats and quality of e-commerce sites using four main quality factors: security, privacy, design, and content. Therefore, the CMRR, a component of e-commerce model [14] is used to check the authenticity of the online stores for customers online.

3 Problem Formulation

The E-commerce web sites should not only protect credit cards, online store, and sellers' goods. Customers do not have to visit corporate affairs websites to know about the merchant to transact business with. The e-commerce website should also be able to distinguish fake online stores from legitimate stores. Hence, a CMRR is shown and demonstrated to distinguish fake virtual stored from legitimate virtual stores in e-commerce transaction through the use of rule-based deduction.

4 Research Framework

4.1 Analysis of the Existing System

The Jumia.com e-commerce components do not have CMRR component built into it. Often times, the components of the existing e-commerce web sites comprises the Retail, Shipping, Switching, Report, Merchant, List [14]. Thus, the customer blindly makes transaction with unknown merchant who may not be traced when problem arises

4.2 The CMRR Component

The CMRR component houses the Merchant information by accepting the Local merchant registration system (LMRS) broadcast. Thus, whenever the Retail Service component request for merchant goods to be showcased, the merchant information details is checked by the CMRR component before it is categorized and viewed by the customer.

The CMRR uses the following rules to distinguish fake online stores from authenticated online stores.

-Rule 1: That the product that comes from virtual stores that are not verified by CMRR should be rejected and should be showcased without an ID number

-Rule 2: That the product that is coming from merchant who has been authenticated by CMRR is accepted and should be given ID number.

4.3 Evaluating the use of CMRR to identify fake stores

Questionnaires were administered to customers who make online purchases for a period of four months. The respondents' generated data was analyzed using descriptive method in SPSS.

A five point Likert was used; Strongly Disagreed, Disagree, Neutral, Agreed, Strongly Agreed. The scaling options were scale of 1-5, where Strongly disagreed = 1, Disagree = 2, Neutral = 3, Agreed = 4, Strongly Agreed = 5

From the generated result, the CMRR component in e-commerce model was compared with the Jumia e-commerce model in having the advisory capability to identifying fake online stores. The findings are tabulated in Table 1. The findings showed that CMRR has the ability to verify that the merchant address received at the time of uploading product category conform to the address in the Country's corporate affairs. The CMRR also has the ability to advise customer on address verification system mismatch for online merchants. Thus, the CMRR aid the customers to transact business with trusted virtual stores. These major attributes of CMRR makes the component unique and necessary in e-commerce model.

Table 1: A comparative study of CMRR and Jumia e-commerce in identifying fake online stores

Features	Jumia e-commerce model	CMRR in e-commerce
Prevent immediate crediting of merchant account until delivery report is received	Yes	Yes
Customize how to handle merchants that return AVS mismatch codes	No	Yes
Ability to advise customer on AVS mismatch for online merchants	No	Yes
Verify that the merchant address received at the time of uploading product category conform to the address in the Country's corporate affairs	Customer is unaware	Yes
Uses Merchant Product ID to identify online stores that have no traceable physical location	Customer is unaware	Yes

The respondents average mean values is shown in Figure 1. These mean values were obtained by taking the average score of each of the respondents answer to each question. The higher the mean values, the better the feature of the tested tool. Thus, the third feature of the CMRR seems to be the best quality feature having average mean value of 4.571.

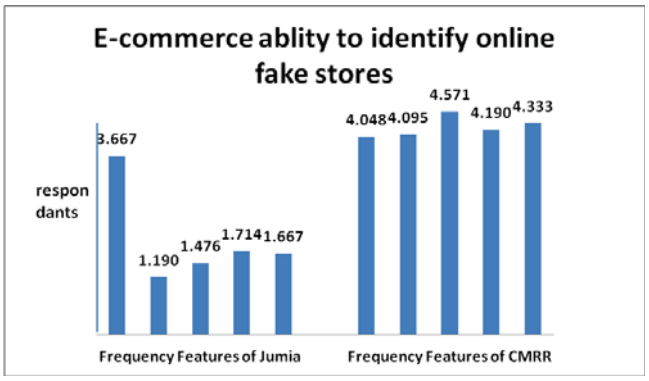

Figure1: Ability to distinguish fake from legitimate online stores

5 Discussion

In this paper, the CMRR component has the capability to distinguish fake online stores from genuine online stores. This is achieved through the use of Merchants verification filter to verify that the merchant address received at the time of uploading product at customers' request conform to the address in the CMRR database. Also, CMRR uses customized filters to handle merchants that return address verification mismatch codes, as well as advise customer on such mismatch. CMRR uses rule based deduction technique to aid customer to distinguish fake online stores and identify and prevent legitimate stores from being rejected.

6 Conclusion

In this study, the CMRR has shown to have the capability to distinguish fake online stores from genuine online stores. Thus, advising the customer on how to identify reliable merchants to buy goods and services. The findings in this paper can be used for further research work

7 References

[1] R. Kalakota and A. B. Whinston, "Frontiers Of Electronic Commerce", Pearson publishers. 1996 ISBN: 8177583921

[2] OECD/OCDE, "Report on Disclosure Issues related to the Use of Copy Control and Digital Rights Management Technologies", OECD, Paris, 2006. www.oecd.org/dataoecd/47/31/36546422.pdf.

[3] Z. Zhongwei, "Improving Efficiency and Scalability of Service Network Graph", IEEE Transactions on Image Processing 15(5), 1300-1312, 2006

[4] K. Yufeng L. Chang-Tien, and S. Sirirat, "Survey of Fraud Detection Techniques in Networking, Sensing and Control", IEEE International Conference, 2, 749 – 754, 2004. ISSN: 1810-7869

[5] D. Jithendra, "Credit Card Security and E-payment, Enquiry into credit card fraud in E-Payment. Masters project", Luleå University of Technology. http://epubl.ltu.se/1653-0187/2006/23/LTU-PB-EX-0623-SE.pdf. 2006.

[6] C. Mei-Jane and H. Yann-Haur, "Factors that affect consumer trust in online shopping in Taiwan", Journal of Global Business Management , 5 (1)14-20, 2009

[7] B. Suh and L. Han, "The Impact of Customer Trust and Perception of Security Control on the Acceptance of Electronic Commerce", International Journal of Electronic Commerce 7(3)135-161, 2003

[8] C. Dellarocas, "The Digitization of Word of Mouth: Promise and Challenges of Online Feedback Mechanisms", Management Sciences 49 (10) 1407-1424, 2003

[9] FTC (US), "Cross-Border Fraud Complaints, January – December 2008", Consumer Sentinel Network.2009 www.ftc.gov/sentinel/reports/annual-crossborder-reports/crossborder-cy2008.pdf

[10] E. B. Stephen, "The Proposed Computer Laws of Uganda: Moving Toward Secure E-Commerce Transactions and Cyber-Crime Control", Proceedings of the 10th Annual Conference ©2009 IAABD, 2009 http://www.iaabd.org/2009_iaabd_proceedings/track16b.pdf.

[11] O. Gunter, "ANTI-FRAUD IMAGE SOLUTIONS: The use of distribution tracing within web content to identify counterfeiting sources", 2009. http://www.technicalinfo.net

[12] T. Huiwen and X. Feng, "A Study of Consumer Trust Formation in Electronic-Commerce", International Symposium on Electronic Commerce and Security - ISECS, pp. 854-857, 2008

[13] M. A. Radwan, and A. K. Mumtaz, "Business-to-consumer e-commerce Web Sites: Vulnerabilities, Threats and quality evaluation model", International Conference on Electronics, Communications, and Computers – CONIELECOMP , 2010

[14] M. I. Akazue, "A Survey of Ecommerce Transaction Fraud Prevention Models" , The Proceedings of the International Conference on Digital Information Processing, Data Mining, and Wireless Communications, Dubai, UAE, 2015, ISBN: 978-1-941968-05-5 ©2015 SDIWC

Energy Saving Effects of Telework

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Abstract - *Although telework is expected as an effective tool for energy saving, the effects of telework on the energy consumption depend on the usage situation of the equipment. There are two types of equipment, equipment used by each teleworker independently and equipment shared by several persons. The energy-saving effects of telework are determined by the efficiency of the equipment and the number of persons who share the equipment. There are two opposite possibilities of the effects of telework, the energy increase case and the energy decrease case. The decrease of energy in the office is achieved by the reduction of office space. As 64% of teleworkers work alone in the room at home and use air conditioners and lights only for themselves according to the survey, the energy consumption at home may increase by 73-85% of the energy decrease attained by the office closure, that is, 15-27% of energy saving can be expected if the office is closed completely with telework. The use of the equipment with high energy efficiency and the large scale telework with office closure are keys to the energy saving by telework.*

Keywords: telework, energy consumption, equipment, energy efficiency, energy saving effects

1 Introduction

Since the Fukushima nuclear plant accident due to the Great East Japan Earthquake in 2011, attention was paid to the energy-saving and telework is thought to be one of the effective tools for energy saving in Japan. Although there are rebound effects by using car for shopping or leisure during empty time, the energy used for commuting can be saved by telework and there are many studies on the effects of saving energy for commuting by telework such as Henderson & Mokhatarian [1] and Walls & Nelson [2]. However, only a few studies focused on the use of non-commuting energy such as air-conditioning, lighting and office equipment at home and in the office during telework.

At the office, the energy is mainly used for air-conditioning, lighting and office equipment and is expected to decrease in case telework is introduced. Does the energy really decrease with telework? Even though some of employees telework and do not come to the office, the office may remain open and the space will not be reduced. In this case, we cannot expect energy saving effects by telework. It is important to know whether office space will decrease or not. Some studies conclude that the energy consumption in the office remains the same in spite of telework because the air-conditioning and lighting will not be reduced even if a few employee telework [3][4]. TIAX reports that space reductions are assumed only for the frequent (more than 3 days per week) teleworkers [5].

On the other hand, the energy consumption at home increases by telework but its amount varies according to the studies because the surveyed equipment is different by the studies and the efficiency of the equipment may be different by the year of the research (Table 1). In Japan, an air-conditioner is usually set room-by-room and it is important to know the usage situation of the telework room in order to estimate the amount of energy consumption at home.

Purpose of this paper is to verify the energy saving effects of telework and discuss the condition to realize the energy saving by telework.

In Chapter 2, the energy consumption model of telework is proposed. The model is divided into two parts by the situation of usage of equipment during telework. The first part of the model is for the equipment used by teleworkers independently (Type A). The second part of the model is for the equipment shared with teleworkers and their family members (Type B). For the Type B equipment, energy increase at home and energy decrease in the office is compared and discussed by 4 cases. In Chapter 3, the outline of the survey for the usage of Type B equipment and the results of the survey are examined. The conditions of telework to save energy are discussed in Chapter 4.

Table 1: Equipment and the increase of energy consumption at home by telework in previous studies

Previous studies	Equipment used at home	Energy increase*
Nillles et al.(1976) [6]	Computer terminal, Network, Phone line	1.1kWh
Mokhatarian et.al (1995) [3]	Air conditioning, computers, stoves, lights	5.5-20.5kWh
Mattews & Williams (2005) [7]	Heating/Cooling (in the United States) Climate control, Lighting (in Japan)	10.4kWh 4.0kWh
Sun Microsystems (2009) [8]	Home Office Equipment, Heating and Cooling	0.8-1.4kWh
Romm (1999) [9]	Air-conditioning, Lighting, Office Appliance	6.0kWh
Ministry of Internal Affairs and Communications (2011) [10]	Air-conditioning, Lighting, Office Appliance	1.1kWh
Masaki (2011) [11]	Air-conditioning, PC	0.1kWh
Röder & Nagel (2014) [4]	All home apliances	7.5kWh

* Energy increase: The increase of consumption of electric power by one day telework at home. As the amount of energy increase was expressed in different unit according to the studies, the author united the units to kWh from the data in each study.

2 Energy consumption model of telework

2.1 Structure of the model

The change of energy consumption by the introduction of telework depends on the usage situation of the equipment. There are two types of equipment, Type A and Type B. Type A equipment is used by each teleworker in the workplace independently. Personal computers and the desk lamps are categorized as Type A (Table 2). Type B equipment is shared and used by several persons including teleworkers and their family members at home. Air conditioners, ceiling lights and computer servers are the example of Type B (Table 3). As the method of estimating energy consumption for telework is different by the type of the equipment, energy consumption for Type A and Type B are estimated independently and then they are totaled. The framework of the energy impact estimation model of telework is shown in Fig 1.

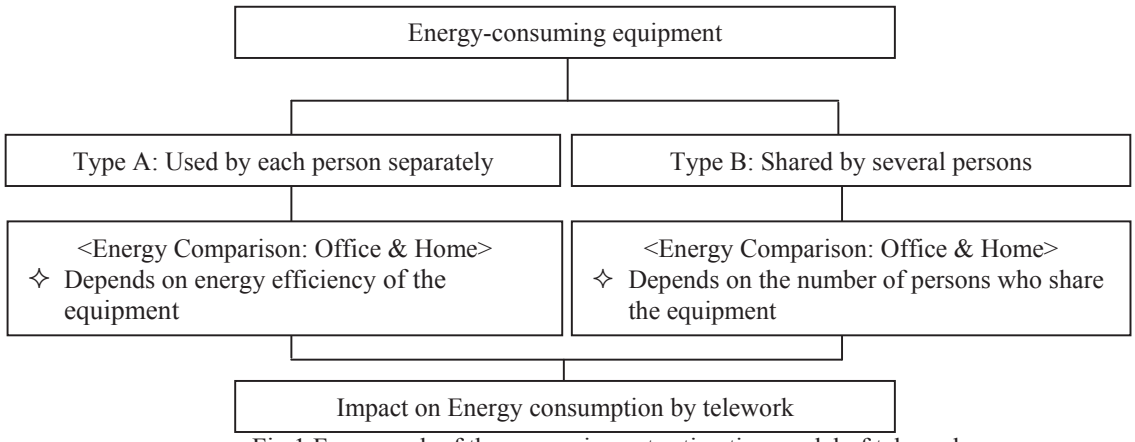

Fig.1 Framework of the energy impact estimation model of telework

Table 2 Example of energy consumption of Type A equipment

Equipment	Power Consumption	Manufacturer & Specification
Desk-top Computer	187W	NEC Valuestar G series (with TV)
Laptop	45W	NEC LaVie G Type Z
Desk lamp	27W	TWINBIRD

Table 3 Example of energy consumption of Type B equipment

Equipment	Power Consumption	Manufacturer & Specification
Air conditioner	590W (Cooling) 470W (Heating)	Panasonic CS-223CF（for 10 m^2）
Lighting	50W 72W	LED Fluorescent lamp
Ink-jet printer	16W	Canon PIXUS MG6530 (Printing)

2.2 Type A equipment

Total energy consumption of Type A equipment will increase or decrease in proportion to the number of workers who use the equipment (Fig.2). When a worker is teleworking, Type A equipment is not used in the office and the energy consumption of Type A equipment in the office decreases. On the other hand, Type A equipment is used at home and consumes the energy instead. If the working hours (duration of using the equipment) are the same between working in the office and telework at home, the difference of the energy consumption depends on the energy efficiency of the equipment in the office and at home.

Sun Microsystems reported that home office equipment used less power (65W) than Sun office equipment (124W) [8]. Considering laptops which use less power than desk top computer (Table 2) are often used at home [8], the home office equipment is thought to be energy effective than the equipment used in the office. Sun Microsystems also reported that teleworkers tend to be conscious of saving energy at home [8].

If the energy efficiency is higher at home than in the office, the energy-saving effects of telework can be realized. For Type A equipment, energy efficiency is the key to the energy saving.

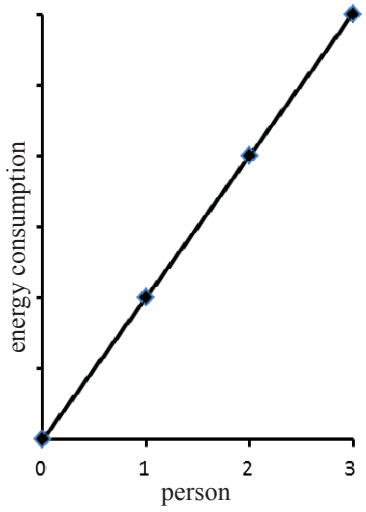

Fig.2 Change in energy consumption of Type A

2.3 Type B equipment

As Type B equipment includes an air conditioner whose energy consumption is the largest among the equipment used for telework (Table 3), it is important to consider the situation of usage of Type B equipment to estimate the energy saving effects.

The energy consumption of Type B equipment for the first person, who turns on the switch, is large, but for the second or third person, the increment of energy use is not so large as for the first person (Fig.3) because the equipment is shared by the people there. The increment of energy is quite different whether the teleworker is the first person in the room or the second person. It is therefore important to know the teleworker is alone or with somebody in the workplace.

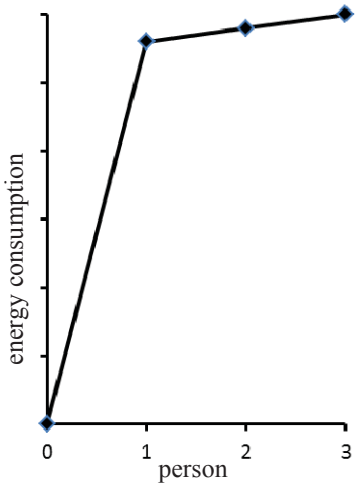

Fig.3 Change in energy consumption of Type B

In Japan, APF (Annual Performance Factor) of air conditioner for home use (Cooling capacity is 2.2kW) is 6.3 in average and 7.2 in highest [12] while APF of brand-new air conditioner for business use (DAIKIN's FIVE STAR ZEAS P112, Horse Power: 4.0) is 6.6 and the number is the highest in this class [13]. The energy performance is almost the same between the equipment for office use and the equipment for home use. Consequently, the energy consumption of Type B equipment depends on the situation of workplace.

At the office, energy consumption of Type B will not decrease if the telework program of the company is small scale and the office space is not reduced. A small number of people telework and office space is not change, then air conditioners and lights will keep operating in the office. The consumption of energy remains almost the same as before the telework. We therefore cannot expect the energy saving effects for the small scale telework. But if telework is introduced on a large scale, some of the office floor can be closed and the equipment will be shut down. Office energy can be saved on large scale telework.

At home, it is important to know whether someone else is at home or in the same room when the worker is teleworking. If a teleworker is alone in the house and the only person who use the equipment, the increase of energy consumption is large. On the contrary, if someone is already in the house, the teleworker is the second or third person who uses the equipment, the increase of energy consumption by the teleworker is small. The switch of air conditioner has already been turned on by another member of the family before the teleworker starts working!

2.4 Cases of equipment use situation and energy consumption

There are 4 cases of using Type B equipment. These cases are determined by the office space reduction and the number of people at home (Table 4).

Case 1: Office space is reduced and the teleworker is alone at home

Energy consumption in the office is reduced while energy consumption at home increases. The effects of telework are determined by the comparison of the efficiency of the equipment in the office use and that of at home.

Case 2: Office space is reduced and the teleworker is with his/her family

Energy consumption in the office is reduced and the increase of energy consumption at home is small. The energy saving effects of telework are large.

Case 3: Office space is not change and the teleworker is alone at home

Energy consumption in the office is not reduced and energy consumption at home increases. Total energy consumption will increase by the introduction of telework.

Case 4: Office space is not change and the teleworker is with his/her family

Energy consumption in the office is not reduced and the increase of energy consumption at home is small. Telework does not affect the energy use in this case.

Table 4: Office/home situation and energy consumption

<Case 1> Office Space: Reduced At Home: The worker is alone ✓ Energy consumption is determined by the efficiency of equipment	<Case 2> Office Space: Reduced At Home: The worker is with his/her family ✓ Energy consumption will decrease
<Case 3> Office Space: not change At Home: The worker is alone ✓ Energy consumption will increase	<Case 4> Office Space: not change At Home: The worker is with his/her family ✓ Energy consumption is not affected by telework

It is important to know if the teleworker is alone or with somebody at home to evaluate the energy effects of telework at home. As there is no previous study on the situation at home when telework and there is no data of the number of people at the teleworking place, the survey is conducted to obtain these data.

3 The survey of telework situation at home

In order to understand the sharing situation of the equipment, a survey was conducted from December, 2013 to January, 2014 with the questionnaire for 142 teleworkers in Japan. The teleworkers are asked to answer the questionnaire for the situation of their workplace such as the number of the room, the number of the person in the room and in the house, and the equipment which they use for teleworking.

78% of the teleworkers are female and 23% are male. 76% of the teleworkers are self-employed and 24% are employees. Majority (60%) of the teleworkers works more than 5 days a week.

During the telework, 33% of the teleworkers stay alone at home and 67% of them stay with somebody (Table 5). 42% of them are with their children and 36% of them are with their spouse. However, 64% of the teleworkers work alone in the workroom (Table 6) and only 36% of them share the equipment like air conditioner and lighting. Some

companies ask their teleworking employees to work in a secured space for the security reasons. These teleworkers may be requested by the employer to work in an independent room. As a result, nearly two thirds of the teleworkers consume additional energy for air conditioning or lighting for their own workspace.

If a teleworker is the only person at home when telework, the energy consumption can be estimated as the sum of Type A and Type B equipment. The consumption of electric power in one telework day is estimated as 6.8kWh maximum (summing up of power consumption of desk-top PC, desk lamp, air conditioner for cooling in the summer season and lighting) and 1.0kWh minimum (summing up of power consumption of laptop, desk lamp and lighting; no air conditioning) from the examples shown in Table 2 and Table 3 assuming one teleworker use the equipment for 8 hours. The number of the estimation is conformable to previous studies in Table 1. However, if Type B equipment is shared with teleworker's family members, the increase of energy use by telework is less than the estimation. If 36% of the people shared the Type B equipment as this survey shows, the consumption of electric power at home becomes 5.0kWh maximum and 0.8kWh minimum. The decrease rates by the sharing are 27% and 15%.

If the office space is reduced and energy consumption in the office decrease completely, total energy saving (the sum of decrease in the office and increase at home) by telework will be 15% to 27% of the total energy for the equipment. However, if the office space is not reduced, the situation becomes as shown in Case 3 and energy consumption may increase by the introduction of telework.

Table 5: Situation at home when telework

Situation	%
Alone	33.1
With Child/Children	42.3
With Spouse	35.9
With Parents	15.5
With Other People	2.1

Table 6: Situation of the room for teleworking

Situation	%
Alone	64.1
With Child/Children	27.5
With Spouse	19.7
With Parents	2.1
With Other People	1.4

4 Conclusion

There are two opposite possibilities in the effects of telework on energy consumption, the energy increase case and the energy decrease case. It depends on the scale of telework and the number of persons at home. For the office, the energy saving effects of telework are determined by the telework policy of the company. If telework is implemented on a large scale lead by the company and a part of the office will be closed, air conditioning and lighting can be reduced and the energy consumption of the office will decrease significantly. But if the telework is implemented on a small scale, the energy saving effects will not be realized.

For the energy use at home where the teleworker is working, energy consumption will increase by telework but the amount of the increase depends on the number of person in the workroom. As 64% of teleworkers work alone in the room and use air conditioners and lights only for themselves according to the survey, the energy consumption at home may increase 73% to 85% of the decrease in the office, that is, 15 % to 27% of energy saving can be expected if the office is closed completely with telework. But if the office is not closed, the energy consumption will increase by the introduction of telework and telework cannot be a tool for energy saving. The use of the equipment with high energy efficiency and the large scale telework with office closure are keys to the achievement of energy-saving by telework.

Brand-new air conditioners have new technologies for high energy efficiency. For example, Mitsubishi Electric's air conditioners have sensors that perceive persons in the room and heat or cool the room according to the condition of the room [14]. These air conditioners are very energy efficient, and the energy consumption will change according to the number of the people there. The category of air conditioner may shift from Type B (Table 3) to Type A (Table 2). With new technologies, the office space reduction and the high efficiency of the equipment at home become more important for the energy-saving by telework.

5 Acknowledgements

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6 References

[1] Henderson, D. and Mokhtarian, P. "Impacts of Center-Based Telecommuting on Travel and Emissions: Analysis of the Puget Sound Demonstration Project," *Transportation research Part D: Transport and Environment*, Vol.1, No.1, pp.29-45, 1996.

[2] Walls, M. and Nelson, P. "Telecommuting and Emissions Reductions: Evaluating Results from the ecommute

Program," *Discussion Paper*, 04-42, Resources for the Future, 2004.

[3] Mokhtarian, P., Handy, S. and Salomon, I. "Methodological Issues in the Estimation of the Travel, Energy, and Air Quality Impacts of Telecommuting," *Transportation research Part A: Policy and Practice*, Vol.29A, No.4, pp.283-302, 1995.

[4] Röder, D and Nagel K. "Integrated analysis of commuters energy consumption," *Procedia Computer Science* 32 (2014), pp.699-706, 2014.

[5] TIAX LLC (2007), *The Energy and Greenhouse Gas Emissions Impact of Telecommuting and e-Commerce*, July 2007, Final Report by TIAX LLC to the Consumer Electronics Association.

[6] Nilles, J. M., Carlson Jr. F. R., Cray, P. and Hanneman G. J. (1976), The Telecommunications-Transportation Tradeoff: Options for Tomorrow, Wiley Interscience.

[7] Matthews, H. S. and Williams, E, (2005), "Telework Adoption and Energy Use in Building and Transport Sectors in the United States and Japan, Journal of Infrastructure Systems, Vol.11, No.1, pp.21-30.

[8] Sun Microsystems (2009), *Suns Open Work: Energy Measurement Project*, A Study of Energy Consumption and Savings White Paper, February 2009, http://www.smart2020.org/_assets/images/Open_Work_Energy_WP_02-25-09.pdf, Viewed on 16 Dec., 2015.

[9] Romm, J. (1999), "The Internet Economy and Global Warming: A Scenario of the Impact of E-commerce on Energy and the Environment," The Center for Energy and Climate Solutions, Global Environment & Technology Foundation.
Retrieved Dec. 6, 2014, from http://infohouse.p2ric.org/ref/04/03784/0378401.pdf

[10] Ministry of Internal Affairs and Communications (2011), "*Estimation of Reduction of Electric Power and the Effect of Cost Reduction by Telework*" (in Japanese), May, 2011. http://www.soumu.go.jp/main_content/000113937.pdf, Viewed on 18 May, 2011.

[11] Masaki, A. (2011), "A commentary of the policy proposal: Reduction of the electricity demand of the office by telework", Journal of Japan Telework Society, Vol.9, No.2, pp31-35.

[12] Agency for Natural Resources and Energy (2014), "Catalog of Energy saving performance, 2014 Winter" (in Japanese), Ministry of Economy, Trade and Industry, http://www.enecho.meti.go.jp/category/saving_and_new/saving/general/more/pdf/winter2014.pdf, Viewed on 29 March, 2015.

[13] Daikin (2015), "FIVE STAR ZEAS" (in Japanese), http://www.daikinaircon.com/shopoffice/products/fivestarzeas/p1.html?ID=so_top, Viewed on 29 March, 2015.

[14] Mitsubishi Electric (2015), "TECHNOLOGY", Cooling & Heating, http://www.mitsubishicomfort.com/technology, Viewed on 31 March, 2015

User and Provider Perspectives on ES Engagement by Chinese SMEs: A Process Analysis

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Abstract - *The extant Enterprise Systems (ES) literature shows a great emphasis on Western large organisations, and the user perspective is considered prime. The survey method is dominant in this literature, focusing on what motivates an implementation and on the factors that are critical to implementation success. In the main such survey work treats ES implementation as an event with the analysis focused on input factors and outputs. In contrast, this paper examines ES adoption and implementation in Chinese SMEs by considering not only the user perspective but also the ES provider and the wider institutional setting. The use of the case study method captures the dynamics of the implementation process and the changing relationships between the stakeholders. Both actor network theory and institutional theory inform the analysis. The findings are potentially significant and challenge user-centered theories of adoption. The institutional influences are shown to be weaker than anticipated in China context.*

Keywords: Enterprise systems; SMEs; Case study; China; Institutional theory; Actor network theory.

1 Introduction

This research is designed to explore the experience of enterprise system (ES) adoption and implementation in Chinese small and medium sized enterprises (SMEs). The aim is to understand this experience from two perspectives – the user and the ES provider – both operating within a broader context of government policies, national and local. It is case based research and this paper reports the broad logic of the study and the findings from one of the four case studies.

As defined by Davenport [9], ES is a software system that imposes its own logic on a variety of aspects of an organization such as operations, culture and strategy, and which leads to a higher degree of integration and competitiveness. The research into ES is dominated by a Western oriented body of literature [12]. The situation for SMEs, both in developed and developing countries, is relatively under-researched. For example, in China, data released by Ministry of Industry and Information Technology indicates that between January to November in 2013 the ES sector software products generated revenue of CNY 911 billion (USD 148 billion) [22]. As more than 98% companies in China are SMEs a rapidly increasing proportion of this revenue is originating from this sector. Despite this importance research into the China context remains limited and is discussed later in the paper.

More generally research of ES in relation to SMEs in developing economies is problematic. Insights and assumptions from the study of large firms in developed countries are frequently applied to the research of SMEs in developing countries [5][7]. However, ES innovation is a highly complicated process, and the consequence of adoption and implementation is determined by complex interplays of involved stakeholders (e.g. user, ES vendor and government). To investigate this further in the specific context of Chinese SMEs the research set out to shed light on two questions:

- How do SMEs in China (and potentially other developing countries) adopt and implement ES?
- What roles do ES providers and governmental institutions play in the process?

Multiple-case study is employed as the research methodology. Four cases have been completed and the analysis is well advanced. For this paper one of the cases is selected to demonstrate both method and some key findings of the research. The distinctiveness of the research is potentially twofold:

- First this research employs process thinking to understand the chronology of events, rather than treating the adoption and implementation of ES as a single event. The chronology of events is graphically depicted as a flux of interactions between the main stakeholders
- Second the adoption and implementation is viewed from both the user and vendor perspectives in the context of wider institutional influences.

The paper is generally divided into 6 parts. After briefly introducing the research, literature review (2) is presented to elaborate the state of ES research and highlight relevant research gaps. Theoretical framework (3) is discussed thereafter to interpret the research concerns and guide the design of methodology (4). One example case is selected and the analysis and finding are presented (5). Discussion and some key findings form the conclusion (6).

2 Literature Review

The ES adoption and implementation literature is very large and beyond the scope of a single paper. The selected literature reviewed here is presented in two parts. First, the mainstream literature which is typically large firms in developed countries. This is important and influential research and an overview is presented here. Second, ES research in a China context, particularyy relating to Chinese SMEs.

2.1 ES Research on Large Firms in Non-China Context

In the area of ES adoption there are studies on motivators [1] and selection criteria [3] but there are many more on ES implementation. This comprises several sub-streams like implementation method, organisational fit, and implementation impact. For example, Berchet & Habchi [4] propose a five-stage model of ERP deployment; Scheer & Habermann [29] suggests business process re-engineering (BPR) to achieve a better organisational fit.

The study of critical successful factors (CSFs) remains the largest strand of research, addressing both adoption and implantation, but in virtually all cases the analytical focus is the concern of the user company [12], and embraces technological, managerial, and organisational concerns. Typical of this strand is the early work of Holland & Light [15] but there are many examples:

- A questionnaire research conducted in a group of Swedish and Finnish firms points out the critical role of IT competence, and suggests better collaborations between internal and external expertise to improve ERP system quality and information quality [16];
- Based on a comprehensive study on the critical success factors in the mass literature, "top management support", "ERP teamwork and composition", "project management", and "change management" are considered significant [27];

This rich Western based research on ES adoption and implementation is largely characterised by three perspectives introduced below.

User firm centred

Strong emphases are generally given to the perception of user Company, and user companies freqnently determine the research findings [3]. However, the user company is unlikely to be the only influential party since others such as ES vendor, ES consultants, government, etc. are also pivotal to ES adoption and implementation [6].

Dominance of survey based methods

The research into ES is heavily survey driven. Statistical data is then used as the basis for the analysis and the contribution [16]. However the statistical findings may have limited explanatory power. Surveys are especially open to challenge when based on single respondents, using factors identified as significant in prior research. Arguably, ES are complex IS and organisational systems and are context-dependent.

Event thinking

Treating ES as a 'product' that is selected and implemented as an event is commonplace e.g. the notion of organisational life 'before and after' ES implementation [1]. In reality, implementation of ES can be months and often years [28].

2.2 ES Research on Chinese SMEs

ES research in China context is heavily influenced by the dominant research phenomena created by Western literature in terms of research approach and strategy: survey-based and event-thinking [36]; firm-centred discussions [21]. Despite the similarities, Chinese firms also shown their unique experience of ES engagement [14]. ES implementation in China context is predominantly influenced by hierarchical power, and Chinese firms generally have passive attitudes towards ES innovation [33].

The ES research specifically targeting *Chinese SMEs* is scarce. Within the niche research area, most research intends to generalise findings from studies of mixed firm sizes [20]. In the China context (including Chinese SMEs) three characteristics emerge from the extant research that provide a point of comparison and reference to Western experience.

Limited resources

All SMEs are commonly recognised as resource constrained, including Chinese SMEs and possibly to a greater extent. Poor IT infrastructure, financial resources, inadequate staff competence and numbers, etc. have been identified as pivotal [18].

External influences

Unlike most Western experience the Government in China is more active in influencing ES adoption by issuing relevant policies or initiating national projects [14]. This is framed as the provision of a supportive environment (along with financial, education, training and infrastructure development, consultants etc.) to Chinese firms [34].

Cultural study oriented

The research of ES research in China context has shown a significant emphasis on cultural study. The study of Chinese culture is frequently considered as an effective way to guide the ES customization, and minimise issues of organisational fit [2]. Although understanding Chinese culture will reveal some behavioral tendencies regarding ES innovation, the cultural study arguably has limited explanatory power to the process of ES adoption and implementation.

2.3 Discussion

A clear characteristic of the extant research on ES adoption and implementation is the primacy of the firm centered user view. Other stakeholder perspectives are rare. Methodologically the survey dominates and often the variables (e.g. CSFs) are sourced from previous studies. Such

approach not only limits the exploration of CSFs, but also provides scarce explanations for the identified CSFs. Especially when the context is still under-explored.

Knowledge about the context of Chinese SMEs is even scarcer. Although the unique characteristics presented by Chinese firms (including SMEs) have been recognised, the significance of the context is inadequately explained in terms of implementation strategy and process, process of change management, interactions of stakeholders, etc [14]. A black-box effect has gradually been created. This is regrettable and limits the potential contribution to both theory and practice.

3 Theoretical Framework

Regarding the ES engagement in Chinese SMEs, the findings of literature review confirmed: the absence of contextual understandings; a dominance of survey, user focused and event based research; resource constraints; the influence of government agency; and cultural issues. Against this context the researchers identified two theoretical constructs frames that helped shape the empirical work and the subsequent interpretation of the findings.

Actor network theory (ANT) suggests that the social system is a hybrid system with various human and non-human entities, and they are equally important. Interaction and negotiation among the actants is the key of network construction, which also explains the innovation process [8]. ANT is employed as the main theory. Using the process of translation from ANT: problematisation; interresment; enrollment; mobilization [8], the interactions among the stakeholders, especially the interplay between user company and ES vendor, can be examined.

Institutional theory generally studies how the legitimacy, isomorphism, culture and all other forms of social forces would exercise the power to the organizations to change the ways they behave. Institutional theory is the second construct to capture the macro-level causalities of the ES engagement (e.g. Governmental influences and intervention) to endow organisational activities with richer meanings. With the emphasis on governmental polices, King et al. [17] in his seminal paper explores six types of institutional influence on IT innovation: knowledge building; knowledge deployment; subsidy; mobilization; standard setting; and innovation directives. The concept of institutional isomorphism proposed by DiMaggio & Powell [11] is additionally utilised to complement the institutional analysis for non-political concerns.

In our original study ANT and institutional theory are complementarily utilized as interpretive frames to explain the process of ES engagement and institutional influences. In this paper, however, the emphasis is given to institutional analysis considering the length limit. Figure 1 illustrates key elements of the proposed theoretical framework.

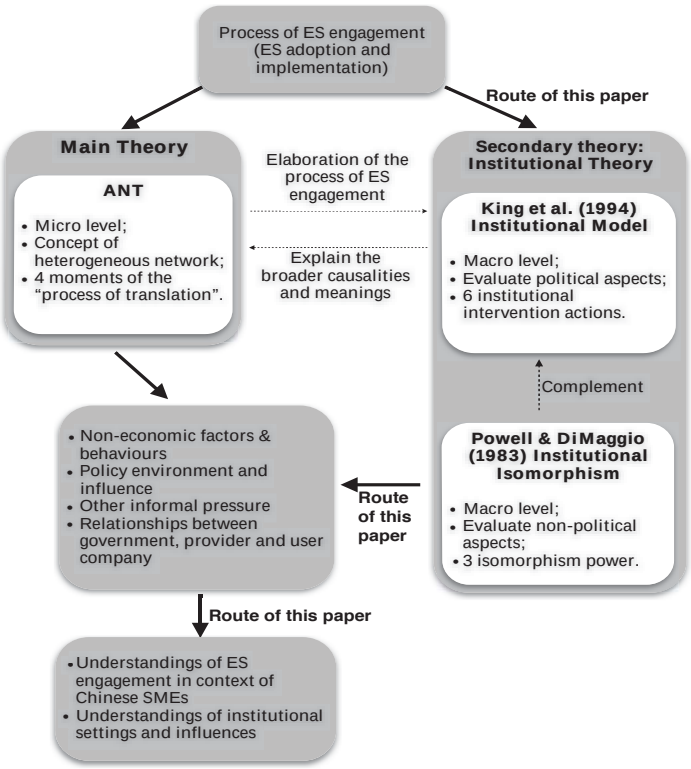

Figure 1: Theoretical Framework

4 Methodology

The discussions of literature point to the need for a research design based on a process approach, with multiple stakeholders and case-based was adopted. Thus multiple case study reserch is conducted to carry out exploratory studies where theoretical support is limited and enhance the reserach credibility [13][37].

Using the above principles, the empirical design was based on the selection of four SMEs (defined by the Chinese firm classification regulations), all in Shenzen, Guangdong Province. All firms are first time adopters, and ES providers' perspectives are included. For all the firms involved multiple semi-structured interviews were employed with interviews audio recorded where possible. Firm documentation where relevant was collected. Government personnel were included together with the collection of policy documentation.

Four company cases (A-D) are have been constructed, along with their respective software providers (X,Y). In this paper the focus is on user company A – Battery-Shell and its interactions with software provider X – GZsoft. Since the four cases are selected from the same city, the influences of local government are applicable to all of them. The overview of the four cases is shown in Table 1 with the selected example 'Battery Shell' in bold.

Table 1: Overview of the Four Cases

	(Case Example) User Company A – Battery-Shell	Other Cases: User Companies B, C & D
Turnover	**CNY 200 million (USD 32 million)**	Between CNY 12-40 million (USD 2-6.5 million)
No. of Employees	**420**	Between 15-260
Location	**ShenZhen City, GuangDong Province**	ShenZhen City, GuangDong Province
Software Provider	**ES Vendor X**	ES Vendor X or Y
Selected Modules	**1.General information; 2.Order management; 3.Production management (partially implemented); 4.Procurement management; 5.Stock management.**	Between 5-9 modules
Interviewees	**1.Vice general manager 2.IT supervisor 3.Production coordinator 4.Procurement manager 5.Software consultant (Vendor X)**	Between 3-5 interviewees (multiple interviews with each)

5 Analysis Case A: Battery-Shell

To reiterate, each case is constructed with perspectives of user company and ES vendor to offer a better view for the process of ES adoption and implementation. The approach to the analysis follows the theoretical framework in Fig 1. The section is organised into three elements: (1) profiles of company and ES vendor (2) overall timing and schema of the ES adoption and implementation process, and (3) government influence and intervention.

5.1 Profiles of Battery-Shell and GZsoft

Battery-Shell is a leading manufacturer that produces aluminum shells for lithium cellphone batteries in Shenzhen City, Guangdong Province, China. The company was established in 2002. Prior to 2008, the company had very limited knowledge of ES. But rapid growth put severe strain on the company's 'traditional' approach to management, hence the adoption of Enterprise Resource Planning (ERP) system in 2008.

The selected ES Vendor – GZsoft was established in Guangzhou city, Guangdong province in 1992, and it is one of the domestic pioneers developing and providing ES solutions. However, ES products are surprisingly not the main focus of its business, since GZsoft is also a training and employability provider in the disability sector.

5.2 Adoption and Implementation Process

Central to this process were milestone events and these are shown. The overall process can be divided into two continuous, and highly interactive, parts: adoption (up to the 12th Dec. 2008) and implementation (12th Dec. 2008 onwards).

5.2.1 ES adoption decision process

Pre-October 2008: Although Battery-Shell had prospered it had started to come under pressure from competitors (2006-2007). The company also suffered from a number of other problems related to growth, including high staff turnover, inaccurate stock management, and ineffective production plans. Based on some personal knowledge of ES acquired from a previous company, the Vice-General Manager (V-GM) recognised that the problems were linked to corporate management that cannot be easily solved by machinery upgrade, thus he decided to implement ES to standardise the company.

October 2008 to December 2008: The ES selection process was passive due to limited understanding of the ES market. Similar ES products were offered by different ES vendors, which complicated the ES selection. Although Battery-Shell had no mature selection criteria at that time, this was gradually developed as more and more vendors visited. It began to learn about both the local ES market and its own system needs. The vendor visits were a key educational process.

An in-house developed 'production co-ordination table'was the core criteria for the ES selection but no ES vendor was willing to fulfill this requirement due to the complexity of the customisation needed. Thus, the V-GM had to compromise the selection decision on selected areas, such as: order management and stock management.

GZsoft emerged and presented a pre-designed 'basic module pack' to the company, with extensions promised once Battery-Shell had reached a more advanced level of implementation. Although other ES vendors provided similar ES solutions, the V-GM trusted GZsoft due to its involvement in welfare-oriented projects and GZsoft was selected. A budget of CNY100k was fixed.

5.2.2 ES implementation process

December 2008 to January 2009: After the contract signing, GZsoft gained a better control of the project, and the code rule needed to be determined for the basic information (e.g. customer information, Bill of Material). GZsoft introduced code rule templates but these did not fit Battery-Shell very well; for example, the maximum length of data fields had to be amended. Customisation was eventually made.

This is followed by trainings that was divided into three parts: general training, training on information coding, and departmental training. All personnel received training courses and undertook practical exercises as requested by GZsoft. The V-GM had to maintain hierarchical pressure to obtain a good level of commitment of employees. In January 2009, the vendor finished the training of information coding, and specific personnel from each department, chosen by Battery-Shell, learned how to conduct information coding.

January 2009 to 20th April 2009: GZsoft started to train individual departments in particular modules following the order processing cycle: from sales & marketing, to

procurement, production, stock, and back to sales & marketing. In March 2009, GZsoft finished the training and the implementation of the selected six order cycle modules began.

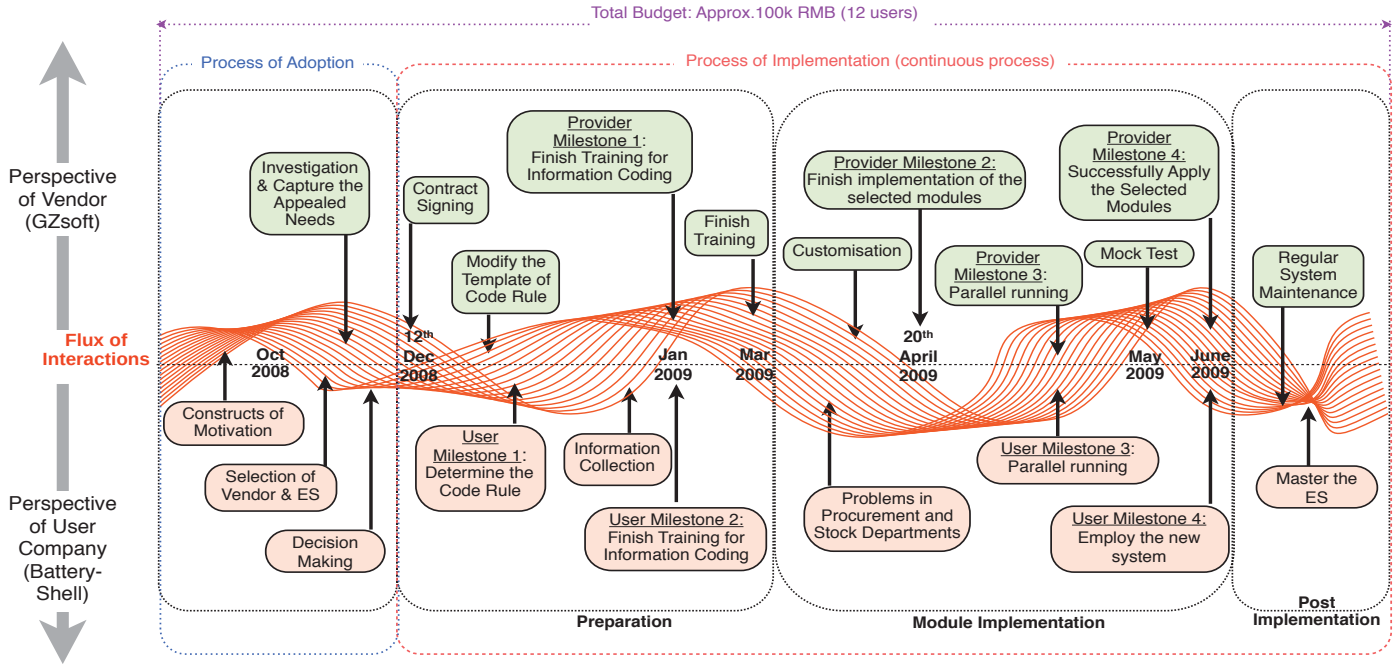

Figure 2: Overall Process Schema

Implementation issues soon emerged during this process. For instance, Battery-Shell managed the aluminum by maintaining a safety stock instead of producing procurement plans, however generating a procurement plan was compulsory when using the ES. The vendor therefore had to re-design the procurement management module to meet the company's requirements. By the 20th of April 2009, module implementations were complete, and Battery-Shell started to use the new system. Most issues had been resolved, and employees became more familiar with the system. At this point both the electronic and manual systems were running in parallel.

20th April 2009 to May 2009: ES accuracy was developed through parallel running and by the end of May most of the order cycle had been transferred.

May 2009 to June 2009: The parallel running was followed by a major mock test of outcomes to further improve accuracy and improve collaboration between departments. GZsoft was still providing much assistance to ensure the accuracy of documents. GZsoft made further adjustments to parameters based on the outcomes of the mock test. In May 2009, the mock test was complete and Battery-Shell completed the transition to ES in June 2009.

Post June 2009: No further modules or customizations were added due to financial difficulties of Battery-Shell. GZsoft therefore limited post implementation service to distance support. Implementation of the basic modules brought Battery-Shell many benefits including clear roles and responsibilities, more accurate stock and order management.

5.3 Governmental and Non-governmental Influence

The process of adoption and implementation described above took place within the wider context of Government policy. Table 2 uses the six institutional actions from King et al. [17] to examine the influence of these governmental policies on the ES initiative taken by Battery-Shell. It summarises key policies aimed at incentivising companies to adopt information systems, how these policies have been interpreted at the local governmental level, and the influence, if any, that these policies have had at the company level, at least in the case of Battery-Shell.

The concept of institutional isomorphism proposed by DiMaggio & Powell [11] can be utilised to complement the King et al. [17] institutional model to focus on non-governmental influences. With poor influence of coercive power, mimetic power was shown to be a critical influence in the case of Battery-Shell, especially during the process of ES adoption. For instance, The V-GM considers his former company as the exemplar of success considering the scale of the business, which consequently motivates the ES adoption in Battery-Shell. Normative isomorphism is another critical power influences the experience of ES engagement in Battery-Shell, and this can be illustrated since similar ES products are offered from different vendors on the market.

Table 2. Governmental Influence and Intervention

Institutional Actions	Central Governmental Policies	Local Governmental Policies	Direct applicability to Battery-Shell
Knowledge Building	The construction of industrial parks is urged by law to encourage hi-tech research [25].	'Blue tunnel project' was initiated to establish an administrative service platform to provide ICT training [30].	No evidence for substantial influences
Knowledge Deployment	Government at all levels must integrate ICT knowledge into student curriculum [26].		No evidence for substantial influences
Subsidy	Government at different levels must provide funding support for ICT dissemination [26].	The approved SMEs can receive funds to carry out ICT-related projects [32].	Receive funding from Local government as the qualified hi-tech enterprises, which also motivates the pursuit of legitimacy.
Standard Setting	Torch program set clear requirements for obtaining national hi-tech company certificate(e.g. annual investment in R&D is greater than 5% of annual turnover, etc) [24].	Employ 'Blue tunnel project' to intensify the application of information systems, and enhance ICT competence in SMEs. It intended to register 20% of SMEs in the project by 2006, 50% by 2007 and 100% by 2008 [30].	Qualified as a hi-tech enterprise of ShenZhen city. However, no requirements relating to ES usage are specified in the policy.
Innovation Directive	Torch program have specific requirements to construct hi-tech industrial parks to boost ICT development [24]	Local tax bureau has particular pieces authorized taxation software for the company to use to governance on tax reports, validation of tax receipts, etc.	No evidence for substantial influences
Mobilization	The 863 program release particular national project contracts for public bidding to encouraged ICT adoption and innovation [23].	'Peacock scheme' released to attract overseas high-tech persons. The city council invests 300-500 million RMB to support innovation and entrepreneurship [31]	The encouraging ES environment offered legitimate explanations for ES innovation in the company.

6 Discussion and Conclusions

Much of the available ES literature is set in the context of large Western organizations, with an emphasis on the user perspective. The survey method is dominant, with a focus on what motivates a firm to implement ES and on the factors that are critical to implementation success. In contrast, this paper has examined in depth the implementation of ES in one selected Chinese SMEs using the case study method, but utilising the findings from the other three cases. It does this in the context of the ES provider and the Chinese and provincial government ICT policy. We are unaware of any other equivalent study. There are six research insights that have implications for the adoption of IT related innovations in a developing country context:

1)The western focus on a user perspective is problematic in the context of Chinese SMEs. The institutional setting is different which impacts on incentivisation and the decision to adopt. This suggests that user focused theories such as Technology Adoption Models (TAM) [10], and derivatives [35] are not comprehensive enough. The institutional context needs to be taken into account and this extends beyond policy to regulation and sector norms.

2)The role of the ES vendor in both the adoption decision and implementation for SMEs is particularly important and generally ignored. Unlike large companies with informed ICT resources SMEs are vulnerable and even choosing a provider is difficult. The lack of expertise puts SMEs in a weak position in the initial selection and contract stages. This is manifested in the scope of the pre-designed ES package offered by the ES vendors. They limit customisation and control the terms of the debate with the SME. This accords with work on Western SMEs [6][19]. The theoretical implication is that the power dynamic between user and provider needs to be addressed in models of SME engagement in ES.

3)ES is a complex application and the implementation is confirmed in this case to be an interactive process, often unpredictable, between the user and the provider. For the user the process of adoption and implementation is a learning journey. As the user company gains more understanding about ES, it may become more aware of its organisational concerns and requirements. Unexpected changes and modifications can be identified during the process of implementation. What the user sets out to achieve, and what is ultimately implemented, may be significantly different. The evidence in this case is strong that the final ES is emergent. This is further confirmation of the advantage of taking a process view rather than the common 'pre-post' event perspective.

4)Chinese government generally has shown its intention to drive ICT innovation through supply-push [17] policies. In China most issued policies are influential, rather than regulatory. This can be evident in the polices in regard of construction of Hi-Tech industrial park, demand of education reform, provision of ICT trainings, provision of funding supports, open the bidding for national ICT projects, etc.

The supply-push forces generated from the policies indicate the strong will of Chinese government to stimulate the ICT innovation, including initiatives such as ES, by all means. However, policy intent and implementation are different things. The interventionist role played by the government is modest, as seen from Table 2. The evidence from Battery-Shell suggests that while governmental influence is reasonably effective at the pre-implementation stage – to motivate and stimulate decision making – it is inadequate to sustain the process of implementation. Insufficient regulatory power may disable the issued polices to set clear objectives and guidance as measurements, which introduces uncertainties and ambiguities into the empirical operations.

5)In this research the policy implementation at local level is conditional. Although the hierarchical structure enables the

Chinese government to maintain a higher degree of unity, modified polices can still be implemented by the local government, and the user and provider companies may furthermore introduce their own agendas. Thus, a very clear finding to emerge from this study is that effective policy implementation requires better coordination and negotiation among central government, local government, and user and provider companies. A mechanism of policy evaluation is necessary to collect feedbacks from lower hierarchical levels to support policy design, and a better supervision of policy implementation is also required.

6) DiMaggio & Powell [11] institutional isomorphism is generated from the power of uncertainty. For the cases in this specific research the mimetic power is predominantly derived from market competition. SMEs are very aware and heavily influenced by what others are doing. The normative isomorphism is primarily from professionalisation. The SMEs, without internal expertise, are hugely influenced by the ES providers. Arguably the relatively weak influence of Chinese policy aimed at introducing technology innovations and good practice to SMEs means that SMEs lack guidance. Without this SMEs become more uncertain of how to incorporate and benefit from the new technologies. In this way the institutional isomorphic effect is shown in this research to be very important. Much more so in fact than the classic CSFs such as senior management support or educational levels.

We recognise the limitations in this paper. It has focused on one case and on the right-hand side of the theoretical framework, based on King et al.'s [17] institutional actions. However, the indications from the other three cases are largely consistent with Case A: Battery-Shell. The implications for theory relating to SMEs in a developing country context are profound. It suggests that an ES 'user-provider' model, in an institutional setting, is likely to provide a more relevant and robust approach to the issues involved in bringing ES – a complex technology – to successful implementation.

7 References

[1] Alves, M.D.C. & Matos, S.I.A. "ERP Adoption by Public and Private Organizations - A Comparative Analysis of Successful Implementations," Journal of Business Economics and Management (14:3), pp.500-519. 2012.

[2] Avison, D. & Malaurent, J. "Impact of cultural differences: A case study of ERP introduction in China", International Journal of Information Management (27:5), pp.368-374. 2007.

[3] Baki, B. & Çakar, K. "Determining the ERP package-selecting criteria: the case of Turkish manufacturing companies", Business Process Management Journal (11:1), pp.75-86. 2005.

[4] Berchet, C. & Habchi, G. "The implementation and deployment of an ERP system: An industrial case study", Computers in Industry (56:6), pp.588-605. 2005.

[5] Brown, D.H. & Kaewkitipong, L. "Relative size and complexity: e-business use in small and medium sized tourism enterprises in Thailand", Journal of Enterprise Information Management (22:1/2), pp.212-231. 2009.

[6] Brown, D.H. & Lockett, N. "Potential of Critical E-applications for Engaging SMEs in E-business: A Provider Perspective," European Journal of Information Systems (13:1), pp.21-34. 2004.

[7] Brown, D.H. & Thompson, S. "Priorities, Policies and Practice of E-government in A Developing Country Context: ICT Infrastructure and Diffusion in Jamaica," European Journal of Information Systems (20:3), pp.329-342. 2011.

[8] Callon, M. "Some Elements of A Sociology of Translation: Domestication Of The Scallops And The Fishermen Of St Brieuc Bay," in Power, action and belief: A New Sociology of Knowledge?, Routledge. 1986.

[9] Davenport, T.H. "Putting the Enterprise into the Enterprise System", Harvard Business Review, Vol. 76, Issue 4, pp.121-131. 1998.

[10] Davis, F. D. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology", MIS Quarterly (13:3): 319–340. 1989.

[11] DiMaggio, P.J. & Powell, W.W. "The iron cage revisited: institutional isomorphism and collective rationality in organizational fields", American Sociological Review (48:2), pp.147-160. 1983.

[12] Esteves, J. & Bohorquez, V. "An Updated ERP Systems Annotated Bibliography: 2001-2005," Communications of the Association for Information Systems (19:20), pp.286-446. 2007.

[13] Easterby-Smith, M., Thorpe, R., and Jackson, P. "Management Research", 3rd Edition, SAGE publication, London. 2008.

[14] Ge, L.P. & Voß, S. "ERP application in China: An overview," International Journal of Production Economics (122:1), pp.501-507. 2009.

[15] Holland, C & Light, B. "A Critical Success Factors Model For ERP Implementation", Journal IEEE, (16:3), pp 30-36. 1999.

[16] Ifinedo, P. "Examining the Influences of External Expertise and In-House Computer/IT Knowledge on ERP System Success," Journal of Systems and Software (84:12), pp.2065-2078. 2011.

[17] King, J.L., Guibaxani, V., Kraemer, K.L., McFarlan, F.W., Raman, K.S., and Yap, C.S. "Institutional Factors in Information Technology Innovation", Information System Research (5:2), pp.139-169. 1994.

[18] Liang, H. & Xue, Y. "Coping with ERP-related contextual issues in SMEs: a vendor's perspective", The Journal of Strategic Information Systems (13:4), pp.399-415. 2004.

[19] Lockett, N., Brown, D., and Kaewkitipong, L. "The Use of Hosted Enterprise Applications by SMEs: A Dual Market and User Perspective," Electronic Markets: The International Journal (16:1), pp.85-96. 2006.

[20] Lun, Y.H.V. & Quaddus, M.A. "Firm size and performance: A study on the use of electronic commerce by container transport operators in Hong Kong", Expert Systems with Applications (38:6), pp.7227-7234. 2011.

[21] Marble, R.P. & Lu, Y.P. "Culturalizing Enterprise Software for The Chinese Context: An Argument for Accommodating Guanxi-based Business Practices", International Journal of Production Economics (107:2), pp.364-379. 2007.
[22] Ministry of Industry and Information Technology of China. "The Completion Status of Main Economic Indicators of Software and Information Technology Service Sector (January–November, 2013)", 2013. (http://www.miit.gov.cn/n11293472/n11293832/n11294132/n12858477/15780902.html), accessed 28.02.2014.
[23] Ministry of Science and Technology of China. "National Hi-Tech research development program (*863 program*)", (http://www.863.gov.cn/default.htm), accessed 28.03.2014.
[24] Ministry of Science and Technology of China. "The development centre of torch Hi-Tech industry (*Torch program*)", (http://www.chinatorch.gov.cn), accessed 28.03.2014.
[25] Ministry of Science and Technology of China. "Law of China on Science and Technology Progress", 1993. (http://www.most.gov.cn/fggw/fl/200710/t20071025_56667.htm), accessed 28.03.2014.
[26] Ministry of Science and Technology of China. "Law of China on Popularization of Science and Technology", 2002. (http://www.most.gov.cn/fggw/fl/200601/t20060106_53394.htm), accessed 28.03.2014.
[27] Ngai, E.W.T., Law, C.C.H. and Wat, F.K.T. "Examining the critical success factors in the adoption of enterprise resource planning", Computers in Industry (59:6), pp.548-564. 2008.
[28] Panorama consulting, "2013 ERP report" (http://panorama-consulting.com/services/erp-software-implementation/) , accessed 26.02.2014.
[29] Scheer, A.W. & Habermann, F. "Enterprise resource planning: making ERP a success", Communications of the ACM (43:4), pp.57-61. 2000.
[30] ShenZhen City Council, "Implementation Plan for the Convenient Services (*Blue Tunnel Project*) for SMEs in ShenZhen", 2005. (http://www.szsmb.gov.cn/content.asp?id=26218), accessed 28.02.2014.
[31] ShenZhen city council, [No.9]. "Opinions to implement '*peacock scheme*' to introduce oversea high-level talents", 2011. (http://www.szsti.gov.cn/info/policy/sz/4) accessed 28.03.2014.
[32] ShenZhen SME service centre. "Provisional measures on special fund management for the development of SMEs In ShenZhen", 2006. (http://www.szsmb.gov.cn/content.asp?id=39547) accessed 28.02.2014.
[33] Srivastava, M. & Gips, B.J. "Chinese cultural implications for ERP implementation", Journal of Technology Management and Innovation (4:1), pp.105-113. 2009.
[34] Tan, J., Tyler, K. and Manica, A. "Business-to-Business adoption of eCommerce in China", Information & Management (44:3), pp.332-351. 2007.
[35] Venkatesh, V. & Davis, F. D. "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies", Management Science (46:2): PP.186–204. 2000.
[36] Xu, Q. & Ma, Q. "Determinants of ERP Implementation Knowledge Transfer", Information & Management (45:8), pp.528-539. 2008.
[37] Yin, R.K. "Case Study Research: Design and Methods", 4th Edition, SAGE Publishing. 2009.

SESSION

POSTER PAPERS

Chair(s)

TBA

An English Listening Learning System based on Brainwave Meditation Recognition Technology

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Abstract - *In the context-aware learning, the learners interact with the learning environment. It is necessary to understand the learners' learning situation in the learning process and give learners learning support according to their situation to enhance their learning performance. In the context-aware learning, how to recognize the learners' emotions such as the attention and the meditation during learning is an important topic. In this paper, we will develop an English listening learning system based on brainwave meditation recognition technology. The learning system will detect the learner's brainwave and then identify his meditation state during the learning. The system helps the learner through the meditation improving mechanism when his meditation decreased so that the learner could stay in a good meditation state and thus enhance his learning performance.*

Keywords: e-learning technologies, learning emotion, meditation, brainwave, English listening learning, emotion recognition technology

1 Introduction

In the traditional learning, each learner learned from the same textbook. But, each learner had his own learning emotion. Some learner was happy to learn and some was anxious to learn. Thus, there were only few learners can have good learning performance. The learning performance could be improved if we apply emotion recognition technology to help learners to improve their learning emotion.

1.1 Learning emotion

The attention and the meditation are two familiar learning emotions. The learners' attention is an important factor during the learning process. Savage et al. [1] found that the learners' attention and learning performance have a significant positive correlation. On the other hand, some scholars found when learners are in the state with calm, clear, pleasant and relax, they could enhance their self-efficacy and concentration. Gockel et al. [2] found that a short 10 minutes of mindfulness training could make self-efficacy improved. Jain et al. [3] found that mindfulness meditation and body relax have the effect of positive emotions, and further to reduce the distracting effect. Thus, the learning emotions such as the attention and the meditation will affect learners' learning performance.

1.2 Emotion recognition technology

In general, there are some ways to identify learning emotions such as facial expression recognition, voice recognition and physiological signal recognition. Physiological signal recognition has the high accuracy to identify the learner's learning emotion. In this paper, the headphone NeuroSky MindSet [4] is utilized to deal with the brainwave signal. The quantified brainwave value could identify the attention state and the meditation state of the learner. Chen and Huang [5] used Mindset to build a Web-based reading annotation system which included the attention alarm and monitoring. The system could enhance the learners' reading comprehension and sustained attention. The study also confirmed MindSet having good accuracy and comfort.

1.3 Research motivation

In the past, most of scholars had discussed the effect the attention but not meditation [6]. Hence we design an English listening learning system using MindSet to identify learners' meditation states. We want to explore the affective of learning performance by the meditation, and to find out the correlation between the meditation and the attention during the learning.

2 Methods

We will use the MindSet to observe learners' brainwave while they're learning, and identify their meditation and attention. We will divide the learners into 2 groups. There are 1 experimental group and 1 control group. The experimental group will be aided by the system with the meditation improving mechanism; the control group will be aided by the system without the meditation improving mechanism.

2.1 Experimental group

The process of the experimental group is shown in Fig.1. First, the learner login the English listening learning system and starts learning. Meanwhile, MindSet will start to identify the learner's meditation. If the learner's meditation fell behind the standard, the system will pause the learning, and provide the meditation improving mechanism to enhance his meditation. After completing the mechanism, if the learner's meditation is raised, then the system will provide the quiz and

then return to 5 seconds before the stopped English listening film so that the learner could continue the learning. The system process is followed till finishing the English listening learning.

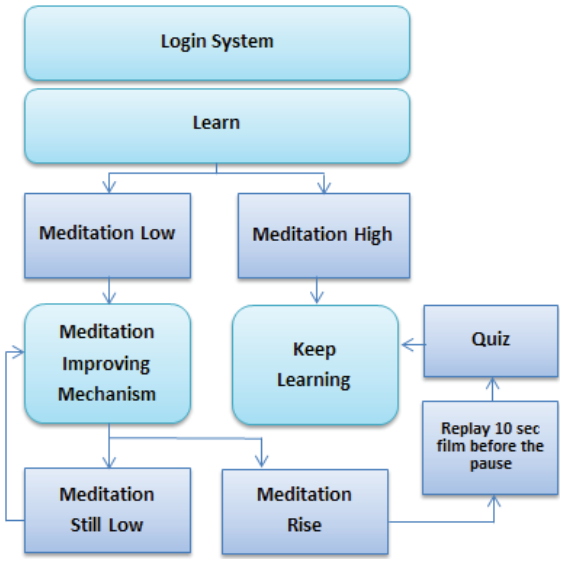

Fig.1. Process of the experimental group

2.2 Meditation improving mechanism

When the learner's meditation decreases, the system would pause the learning and provide the meditation improving mechanism as shown in Fig.2. The mechanism displays a pendulum and the pendulum will begin to swing with the same speed of the beat sound. The learner will take breath according to the speed of swing pendulum. It will let the learner enter a state of relaxation. We expect that the mechanism could increase the learner's meditation. When the learner's meditation is raised, the learner can continue to learn. The system will replay 10 seconds English listening film before the pause and then provide the quiz according to this 10 seconds English listening film so that the learner could be pleasant and confident to continue the learning.

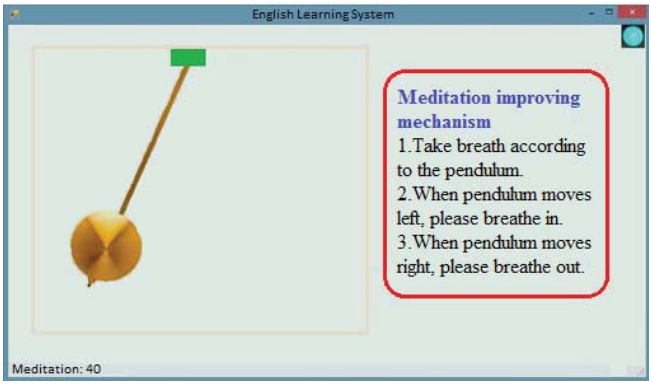

Fig.2. Meditation improving mechanism

3 Conclusions

We expect to be able to produce the following results through our experiment.

3.1 Meditation will affect the learners' learning performance

Through comparing the pretest and the posttest of learners on English listening ability, we expect learners in experimental group will improve their learning performance significantly by using the meditation improving mechanism.

3.2 Meditation and attention are related

With the aid of our system, we expect learners in the experimental group will increase not only their meditation but also their attention. We want to find out the correlation between the meditation and the attention. Thus, the meditation and the attention are both the important factors to affect the learning performance of English Listening.

4 References

[1] Savage, R., Cornish, K., Manly, T., & Hollis, C. (2006). Cognitive processes in children's reading and attention: The role of working memory, divided attention, and response inhibition. *British Journal of Psychology, 97*(3), 365-385.

[2] Gockel, A., Burton, D., James, S., & Bryer, E. (2013). Introducing mindfulness as a self-care and clinical training strategy for beginning social work students. *Mindfulness, 4*(4), 343-353.

[3] Jain, S., Shapiro, S. L., Swanick, S., Roesch, S. C., Mills, P. J., & Schwartz, G. E. (2007). A randomized controlled trial of mindfulness meditation versus relaxation training: Effects on distress, positive states of mind, rumination, and distraction. *Annals of Behavioral Medicine, 33*(1), 11-21.

[4] NeuroSky, Inc., "NeuroSky's eSense™ Meters and Detection of Mental State." 2009, http://www.neurosky.com/

[5] Chen, C. M., & Huang, S. H. (2014). Web- based reading annotation system with an attention- based self- regulated learning mechanism for promoting reading performance. *British Journal of Educational Technology, 45*(5), 959-980.

[6] Wang, C. C., & Hsu, M. C. (2013). Flow Experience and Challenge-Skill Balance in E-Learning. In *PACIS* (p. 203).

InkAnnotation: An annotation tool for e-learning environments

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Abstract - *e-Learning environments are applications that use the Web infra-structure to support teaching and learning activities; they are designed to have good usability using a desktop computer with keyboard, mouse and high resolution medium-size display. Devices equipped with pen and touch sensitive screen have enough computational power to render Web pages and allow users to navigate through the e-learning environments. But, pen-based or touch sensitive devices have a different input style; decreasing the usability of e-learning environments due the interaction modality change. To work on mobile contexts, e-learning environments´ interface must be improved to consider the interaction through pen and touch and to get the benefices of these modalities. In this paper, we present the InkAnnotation, a tool for review documents, pictures and sketches by handwrite comments using a pen-based tablet or computer.*

Keywords: Human-Computer Interaction; Electronic Learning Environment; Mobile Devices; Interaction Styles.

1 Introduction

Mobile devices, such as smartphones and tablets, are becoming increasingly popular; most of them have touch screen displays, Internet access and enough computing power to process Web pages and turn possible mobile users access e-learning environments. But, it is important to consider that these environments are developed to be accessed by desktop computers equipped with keyboard, mouse and a medium size display.

So, we believe that e-learning environments need to be improved to be easier to use in mobile devices and other contexts, e.g., areas which need sketches or drawing such Mathematics. In our previous work, we developed the InkBlog tool to easily write handwrite or sketched posts in pen-based devices by adding features to manipulate electronic ink into a blog tool from Ae, an e-Learning environment. In this paper, we present a tool to allow mobile users use pen to review a document inside the e-learning environment, the InkAnnotation tool.

This paper is being submitted as a poster. Section 2 presents a literature review about electronic ink technology and e-Learning environments. Section 3 presents the InkAnnotation, describing how the technologies are employed to allow users handwriting reviews and comments using pen-based devices over a document. The Section 4 presents the final considerations and future work.

2 E-Learning Environments and Interaction Styles

e-Learning environments, such as Moodle, SAKAI, Ae [1], are applications that use the Web infra-structure to support teaching and learning activities. The e-Learning environments are designed to support a variety of users and learning contexts, but they are designed to conventional computers, usually equipped with keyboard and mouse as input and a medium screen and speakers as output; a limited set of interaction styles for nowadays devices. These modalities, and the technology that support them, shape the teaching and learning activities done in the e-Learning environments; they focus on reading and writing skills. In your previous work we described when a user interface designed for a set of interaction styles is accessed by a different set of interaction styles the users face interaction problems [2]. Another problem is not possible to take advantage of the interaction style features; for example, in a desktop computer, users use the keyboard to typing the post text. In a pen-based computer without handwrite recognition, users need to type each letter pressing the pen in the respective key in a virtual keyboard. This way of writing texts takes a lot of time, make boring the writing task and do not take the mainly pen purpose: handwriting and do sketches easily.

HyperText Markup Language (HTML) is used for any web application to describe the page interface and its content. The HTML have some improvement defined in the last version, the HTML5, related with support multimedia, keep it easily readable by humans and consistently understood by computers and devices [3]. HTML5 adds the new <video>, <audio> and <canvas> tag elements, as well as the integration of Scalable Vector Graphics (SVG, a vector image format for two-dimensional graphics based on eXtended Markup Language - XML). These features are designed to easily include and handle multimedia and graphical content on the web without having proprietary plugins and Application Programming Interface (APIs) installed. Another evolution in HTML is standardizing how the browser must handle events from touch

and pointer inputs [4]. Having different event types for input data generated by each modality gives flexibility for the developers define the actions to be trigger for each modality.

In pen-based devices when the user moves the pen in the screen, the pen trace should result in electronic ink that must be treated by the application to be rendered and stored. But, desktop applications, that running in the Tablet PCs, do not treat electronic ink, so it is necessary to incorporate special applications to treat the electronic ink to have benefices of the pen interaction style. Desktop applications that do not manipulate the electronic ink loose the Tablet PC potential because the pen is used just as a pointer device. This is valid for web applications.

3 The InkAnnotation Tool

Based on your experience in develop the InkBlog and analyzing open-purposed application to do handwrite annotations [5] we specified and develop the InkAnnotation for the Ae e-learning environment [1]. InkAnnotation is a tool for review documents, pictures and sketches by handwrite comments using a pen-based tablet or computer. The first use is trigger the tool as another environment tool, in this case, the InkAnnotation will be similar as a whiteboard, here the user can handwrite or sketch in a blank space.

Another use is trigger the InkAnnotation inside another e-learning tool, e.g., the Portfolio tool. Portfolio is a space where each user can use to typewrite an item or do files upload, e.g., PDF files, Word files, and pictures. When the user wants to handwrite a Portfolio item to review it, the user trigger the option "Do Annotation with Ink", and a new window will be open with the document in the background. This document will be draw in a canvas tag, allowing user to handwrite or do sketch over it (Figure 1).

To treat the data generated by a pen, we reused the InkBlog´s components: InkRenderer and InkController. When the user touches the interface within the pen and draws a trace, the InkController will listen to the user actions, getting the dots that compose the trace. Each dot is recorded and a line connecting the preceding point to the new point is drawn until the user releases the pen. After the pen is released, the InkController will generate the InkML´s trace node for the new trace. The user can draw as many traces she wants, all them will be stored and will compose the InkML data. When finished handwriting the review, the user will click in the Confirm button and the generated InkML data will be sent to the server to be stored. Since we used HTML5, any browser that support it can render the electronic Ink draw by the InkRenderer.

4 Final Considerations

This paper presents an annotation tool for e-learning environments that allow mobile users to review documents, pictures and sketches doing handwrite annotations with a pen. The user can trigger the tool as a whiteboard tool or can trigger the tool to review a file, doing handwrite or some sketch. For future works, we will finish to implement the InkAnnotation and integrating it with another e-Learning environment tools, such as, support material and lectures.

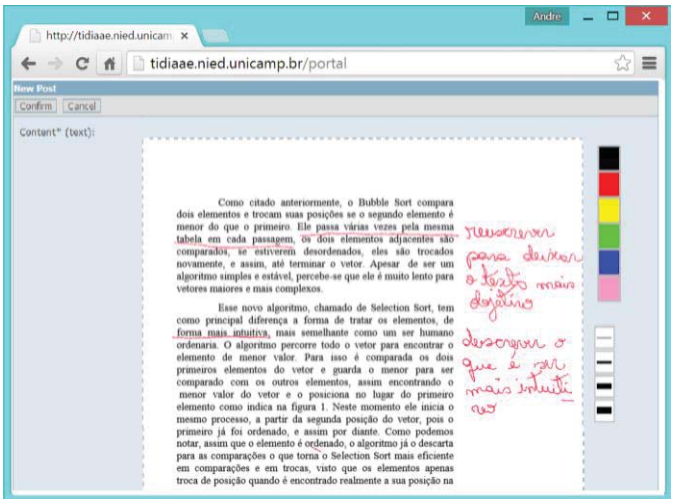

Figure 1. An example of using the InkAnnotation tool to review a document.

5 References

[1] Ae Project, "Ae - Aprendizado Eletrônico Environment", available at <http://tidia-ae.iv.org.br/>. [retrieved: Nov. 2013]

[2] A. C. da Silva, F. M. P. Freire, H. V. da Rocha, "Identifying Cross-Platform and Cross-Modality Interaction Problems in e-Learning Environments", Proceedings of The Sixth International Conference on Advances in Computer-Human Interactions (IARIA), 243-249, Feb. 2013.

[3] R. Berjon, T. Leithead, E. D. Navara, E. O´Connor, and S. Pfeiffer, "HTML5 - A vocabulary and associated APIs for HTML and XHTML W3C Candidate Recommendation", available at <http://www.w3.org/TR/html5/>. [retrieved: Nov. 2013]

[4] D. Schepers, S. Moon, M. Brubeck, and A. Barstow, "Touch Events", available at < http://www.w3.org/TR/touch-events/>. [retrieved: Nov. 2013]

[5] A. C. da Silva, H. V. da Rocha, "InkBlog: A Pen-Based Blog Tool for e-Learning Environments", Issues in Informing Science and Information Technology (Informing Science Institute), vol. 10, 121-135, 2013.

Research on the development of smart application for e-learning as an assistive device for people with hearing impairment

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Abstract – *Teachers of students with learning disabilities are well aware of the necessity of English teaching books suitable for their students. Additionally, they often support independent educational programs that focus on these students' particular needs to better ensure student learning. Some IT companies have already begun developing English learning programs that can be provided on digital devices, but there are few programs being developed for students with hearing impairment. This is an obvious and immediate need. This study reviews the development of English learning application for hearing impaired students. By conducting a field survey and examining previous research, we were able to develop an application constructed to meet the needs of students with hearing impairment. The purpose of this work is to develop and secure resources for instruction of the hearing impaired, and to increase their self-esteem and social participation.*

Keywords: e-Learning, Application development, Hearing impairment, English pronunciation, Unit system

1 Introduction

Teachers of disabled students see a great need to develop English textbooks for their hearing impaired students. Another identified need is for educational programs that meet specific individual needs. (Yoon, Sun-hwa, 2010) Therefore, textbooks should be constructed to work both as individual learning tools for students and as well as textbooks for teachers. While considering needs and necessities of users, many IT companies still struggled to develop learning tools from the different viewpoints.(Koh, Jin Bok, 2013) Since the development of universally designed smart devices, a variety of applications for learning English have been created. Those programs help students learn on their own, regardless of the user's location or time of day. However, there has been a certain restraint on the use of applications already made before for students with hearing impaired due to limited instructional methods. Language teaching methods for them can be divided into three. First is a sign language using gesture and the second is oral method using vocalization and look of lips. And the third is the one using both above mentioned. These days, many schools employ sign language to communicate and

Figure 1. Searching results of 'English conversation' in Google play.

focus on teaching letters. However, it is hard to perfectly express sentences in a sign language, and the limitation of sign language makes it difficult for hearing impaired students to both learn grammar and acquire knowledge. Students with hearing impairment may also have problems understanding others' feelings and thought. To solve this problem schools use letters to educate them, but this medium is limited because of hearing impaired people's limited understanding of sentences. (Moores, D. F, 2001) Although learning through an oral method is difficult, it has an advantage to help them to grammatically understand sentences and what speakers mean. Studies have compared students educated via a sign language with those educated by oral method in terms of how they complete sentences. Results indicated that students who are educated by an oral method attain higher achievements in making sentences. (Jeon, Gye-ja, 1988; Nah, Kwon-soo, 2003) Moreover, they also showed a higher rate of admission to colleges. Once they are educated well by oral method, they tend to be enthusiastic about learning and are more likely to consider going to college. On the other hand, students educated via a sign language tend to feel afraid of expressing their opinions, and going to college. According to the research on a special school, mostly teachers who don't have a specialized training about a sign language teach classes. But those who teach English already knew about the importance of oral method. Students with hearing impairment have difficulties leaning a native language as non-disabled students do when learning a foreign language. Due to these reasons, necessity of oral method is increasing. However,

it was found that applications to systematically teach hearing-impaired students via an oral method have not been invented yet.

1.1 Current status of App development for training of English pronunciation

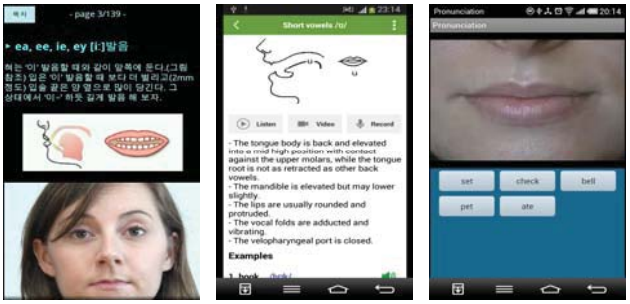

Figure 2. From the left side, each image shows ‘”Applearning, English Pronunciation of the Korean word “Kepham.”

Developed applications for oral method programs are usually aimed at non-disabled people. As shown in Figure 2, most of the applications use 2D images. In these applications, it is hard to see the movement of the tongue and structure of mouth. In addition, since the explanations are quite vague and consist of technical terms, they are hard for users to understand. Furthermore, it causes hardships for teachers because things must be explained through sign language or other means. Therefore, to secure meaningful instruction for students with hearing impairment, the development of an English pronunciation training application is needed.

2 Body

2.1 Storyboard and development of design

2.1.1 Extraction of English words and categorization

First, we identified words in both Korean English textbooks and American ones and populated a vocabulary list with nouns, verbs, adjectives and adverbs suitable for sentence creation. Since target users are students who do not know English well, we set the level at the 4th grade of elementary school. Then, we extracted 85 words and divided them into seven groups, as seen in Figure 4. First, words are categorized alphabetically. Users can easily find the words they want in either capital or lower-case letters. This is because it was shown during our research that students with hearing impairment have problems distinguishing between lower-case and capital letters. Second, words are categorized according to their meanings in Korean. A given word can be searched for alphabetically in Korean. This is because most users are Korean and do not know the English alphabet. Third, words are categorized according to the order of Korean consonants and vowels. For instance, the initial sound of the word “gas” is similar to 'ㄱ' in Korean. Connecting two similar

Figure 3. Interface according to 7 standards.

sounds in both Korean and English is aimed at helping users to memorize them more easily. Third, words are categorized according to look of lips and breathing. It shows whether they are vibrating or plosive sounds and explains the characteristics of each sound. This categorization helps users to discern characteristics of the words they speak and allows them to practice pronunciation easily and repeatedly. Lastly, words are categorized according to word class, which includes noun, pronoun, adjective, and verb. With this information, students can develop their syntactic abilities and make sentences.

2.1.2 Development of Application

The interface of the application includes distinct, individual buttons that can be clearly distinguished so users will not be confused. Some of the words that may be confusing are illustrated with pictures to make them easier to understand. Main categories are based on 7 standards mentioned earlier. In order to make structure of oral cavity clearly visible, 3D modeling technique was used to produce an authentic face model unlike previously developed applications which are in 2D. And using UNIT technique, each part of the face can be zoomed in and the exact place of a tongue and movement of lips and tooth can be observed on the whole.

2.2 Title Design and plan of the application

2.2.1 Interface

Figure 4. Interface with pictures

According to the importance of picture cards mentioned earlier, an interface was developed as in Figure 3.(Kim, Hee-

Young,2009) This interface can provide visual and auditory effects simultaneously. Furthermore, this can make lower grades who can't be focused easily feel more interested than when showing just letters in a simple way.

2.2.2 Category.

In this application, when touching the screen on the higher menu, the screen would change to a screen like that shown in Figure 4. Users can scroll through a list of words and select the one they want. Once users select a word, an explanation of the pronunciation, sound, and the meaning would be offered with pictures, vocalization sound, and 3D model in the next phase.

2.2.3 Unit

Figure 5. 3D face model created using the UNIT technique

For this project, the application was developed in 3D using the UNIT technique. This application made the man in the picture of Figure 5 a three dimensional model, that students can rotate. With this function, users can closely look into the structure of the oral cavity. By doing so, 3D images offer a learners a better chance to understand how to pronounce specific words and phonemes.

2.2.4

Avoid using too many capital letters. All section headings including the subsection headings should be flushed left.

3 Conclusions

For this project, an English learning application as an assistive device for people with hearing impairment was developed, featuring the above mentioned elements. This application was developed as an assistive device for hearing-impaired students who are inclined to learn English. To the end, this application has the purpose of supporting learning in various places, including outside of school. In addition, this application provides help for students with hearing-impairment to learn and better understand English. We believe this application will play a positive role in learning English among the hearing impaired. This application can also be effective for other disabled people and non-disabled ones. Even though the number of words is limited to 85 due to the lack of funding, further research will help to expand constantly this project for the hearing impaired.

References

[1] Yoon, Sun-hwa : "Analysis of English Class Operation Status in Hearing Impaired Schools". Special Education, Graduate School of Education, Daegu University, 2010.
[2] Kim, Hee-Young : "The Actual Conditions and The Improvements of English Educations of Middle-School Courses at Special Schools for Hearing-Impaired Students". Dept. of Special Education Graduate School, Changwon National University, 2009.
[3] Jeon, Gye-ja : "A comparative Study on Syntax Characteristics Among Children with Hearing Impairment According to the Use of the Sign Language and the Oral Languag
[4] ". The Journal of Special Education, 1988
[5] Nah, Kwon-soo : A comparative Study on the Degree of Sentence Comprehension and their Strategies Among the Children with Hearing Impairment According to the Use of the Sign Language and the Oral Languag". Graduate School, Kong Ju National University, 2003.
[6] Koh, Jin Bok : "The Study on the Actual Utilization and the Awareness of Smart Learning Teaching Media in Special Education". Journal of Rehabilitation Research, 2013.
[7] Balint. T, Gez. N, & Geza. K. : "Mobile Devices Converted into a Speaking Communication And". Proc. Of 9th Int. Conf. Computers Helping People with Special Needs, 2004.
[8] moores, D. F. : "Educating the deaf : psychology, principles, and practices. 5th Ed". Boston : Houghton Mifflin, 2001.
[9] "Supplemental Information for Appendix A of the Common Core State Standards for English Language Arts and Literacy : New Research on Text Complexity"

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SESSION

E-LEARNING + EDUCATIONAL CONCEPTS AND TOOLS, AND ACADEMIA RELATED ISSUES

Chair(s)

TBA

Visualizing the Top 400 Universities

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Abstract— *Visualization is a powerful tool to represent and analyze the data. Meanwhile, visualization became essential for decision making. In this paper, we provide a visualization of the top 400 universities based on the Time Higher Education Universities Rankings [1]. The ranking is based on five different criteria: teaching, research, international outlook, industry income and citation. The visualization system is hosted on a Web- based platform. It visualizes the geographical distribution of the top universities, the score distribution in all ranking criteria and a classification of all universities by area of study in each country. The main goal is to present data in a friendly way that helps to promote people's understanding and help them gain insight and make decisions. We also utilized different visualization tools to show how it could be used for educational purposes.*

Keywords: Top Universities, Visualization, D3, Higher Education

1. Introduction

Every year, more students around the world are seeking a higher education with different criteria. The Internet has opened the world for all the students worldwide and made it easier for them to find opportunities and scholarships to study abroad. Universities rankings is one way to look for the university that best fits the students' ambitions. Additionally, graduates who are seeking jobs in high-profile universities, professors, and researchers are all interested in the annual rankings. There are some magazines that have developed methodologies and criteria to analyze and rate the universities worldwide, for example, US news, Times Higher education, and QS. The majority of the rankings use classic visualization tools such as tables or pie charts. However, these classic tools do not give the users the ability to navigate the universities rankings easily. Of course, that directly affects the usability of the rankings. In addition, these tools are out-dated in the era of big data and information visualization.

Providing a useful and efficient platform for users is essential to increasing the usability and readability of the data. It is also crucial to avoid overwhelming users with the clutter of data. Achieving this is not easy, due to the large volume of information related to the rankings. However, the advancement in visualization tools has led to a better visual perception. Well-designed data graphics is usually the simplest and the most powerful way to help the users think visually.

There are two main goals of this paper. The first goal is to present data in a friendly way that helps to promote peoples' understanding and help them gain insight from it. Thus, using visualization to support interactive visual representations of data helps to amplify cognition. It has been said "A picture is worth a thousand words".

Reasoning is an important way to make decisions and comparisons. Using visualization tools could help to enforce the data to be within the scope of eye span. Consequently, more precise and reasonable decisions could be taken. The current way of visualizing the top universities does not provide an efficient representation of the data which make it harder for the users to draw a conclusion.

The other goal of this paper is to illustrate how to utilize the available visualization tools for educational purposes. Google Developers provide a wide range of tools that can be utilized to analyze and visualize different types of data. An example of that is Google Charts [2], which allows the developers to present raw data as a histogram, line chart, timeline, etc., using JavaScript. To visualize the top universities, Google Bar Chart was used to give an overview of the rankings in a bar chart as shown in section III. Google Maps was used to show the geographical distribution of the top universities as shown in section III. Data-Driven Documents (D3) [3] library was utilized to develop other visualization elements with more detailed information about each university as shown in section IV.

The contributions of this paper are summarized as follows:

- Utilizing the available visualization tools to present the top universities to help data mining and knowledge discovery.
- Visualization of the top 400 universities, clustered based on the location and area of study.
- Comparing universities to visually facilitate decision-making for the students who are seeking higher education.

Time Higher Education magazine's ranking of universities was used as a resource for the dataset, which is one of the most influential and widely observed rankings. They use 13 different metrics to provide comprehensive comparisons and a balanced evaluation. These metrics are grouped into five groups: teaching, research, citations, industry income, and international outlook. This visualization of the top 400 universities would help the students who are thinking of studying overseas, students who are planning on getting enrolled in Global Exchange programs, innovative students

who need funding for their research, and all other students locally and globally. The goal is to visualize the dataset of the top universities so the students can gain knowledge and insights about the universities, in order to decide their future institution of higher education. The visualization system visualizes the top universities with the following aspects:

- The overall ranking.
- The geographical distribution of the universities worldwide.
- Classification of the top universities by subject in each country.
- Detailed information (ranking by criteria) for all universities in each country.

The subjects or area of study were classified based on the classification used in the Times Higher Education magazine, which includes 5 subjects: arts and humanities, clinical, preclinical and health, engineering and technology, life sciences, and social sciences. In addition to that, the visualization will show the top 100 universities under 50 years old. Visualizing those universities can give an insight about the future of higher education.

2. Design and Development

2.1 Data Collection

No dataset was available. Therefore, we had to collect raw data, analyze and reproduce the data to use it. Data were collected from Time Higher Education World University Rankings magazine. Noteworthy, Times Higher Education provides detailed data about the first 200 universities such as the score for each evaluation criteria. Therefore, some parts of the visualization system were limited to the top 200 universities due to the lack of information from the main resource. The data was organized in many formats as needed such as Comma-Separated Value (CSV) and nested JavaScript Object Notation (JSON) [4] to represent the hierarchy of the data. To represent the geographical distribution of the top universities, OpenRefine [5] were used to retrieve the geocoding for each university.

2.1.1 Framework

The visualization system was developed on a Web-based platform using HTML, JavaScript, JQuery, and Bootstrap library to make it scalable to any browsing environment such as desktop, laptop, tablet, or smartphone. The website was carefully designed to ensure simplicity and usability. Guidelines were provided to the user throughout all the web pages.

3. Utilizing Google Charts

Google Chart package was used to give a general overview of the universities' rankings. It is also packed with many features such as tooltips and graph legend to customize the charts.

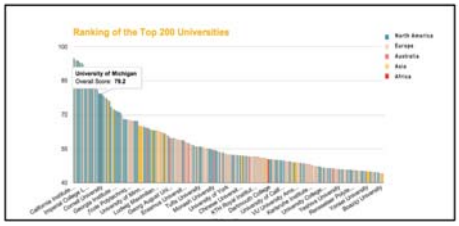

Fig. 1: Bar Chart

Fig. 2: Google Map with Map layout

3.1 Bar Chart

The bar chart was implemented to show the top universities due to its simplicity and most of the users are familiar with this kind of visualization. The column length represents the overall score of each university which reflects the rank. The colors were used to distinguish universities in different continents as shown in 1. It is also packed with many features such as tooltips and color encoding to customize the charts.

By moving the mouse over any column; the user will see a tooltip that shows the university's name and its overall score.

3.2 Google Map

Due to the need to represent a large number of universities, 400, it was necessary to tackle the scalability issue and represent these universities in a simple and intuitive way. Google Map API [4] was used to visualize the universities according to their geographical distribution. This way of visualization shows the location of each university so the user can get insights about the city size, terrain and location either coastal or mountainous area. Google Map provides different layouts which can be chosen by the user. The layouts include map, terrain, and satellite. These layouts are shown in 2 3 respectively.

It is also zoomable to facilitate the navigation through the map. Tiny markers were used to point to the countries that have universities in the top 400 rankings list. Additionally, each marker is linked with a tooltip that shows a general description of the selected university. Clicking on the university's name will open the university's website.

Fig. 3: Google Map with Satellite layout

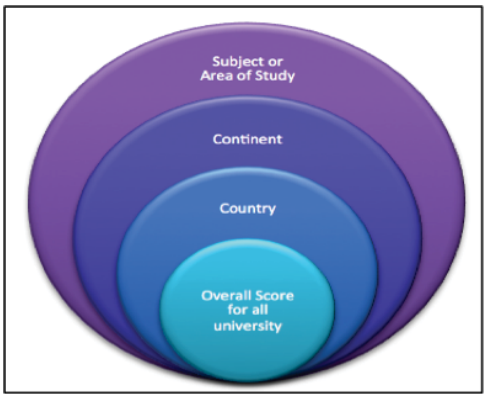

Fig. 4: Data hierarchy

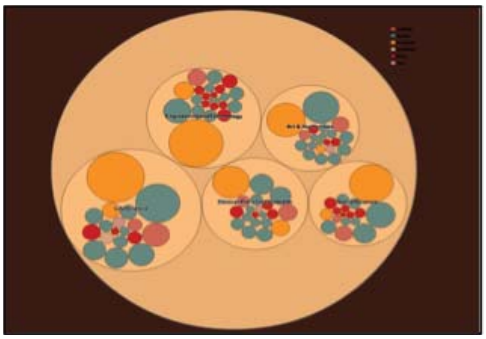

Fig. 5: Circle packing

Fig. 6: Circle packing after zooming in

4. Utilizing D3 Library

4.1 Circle Packing

This part of the visualization system was developed to represent the hierarchical data. The hierarchy of the data as shown in 4. It was used to visualize the top universities classified by the subject or area of study.

This circle packing answers the question: which subject is good at which country? so the student can decide on the countries that have a good reputation in his/her area of interest. The circle packing provides simple and effective interaction. By clicking on a subject, the circle will take the student into a lower level of the hierarchy to show the countries with top universities in that subject. Circle packing is useful to visualize the hierarchical data. The size of the circles represents the overall score and the color was utilized to represent the continent of each country. To make the circle packing more efficient, the zooming effect was added to make the circles zoomable so the student can navigate the hierarchy of the data easily. The final result of this part is shown in Figures 5 and 4 respectively.

4.2 World Map Visualization of The Universities With Heatmaps and Pie Charts

The main idea of this part is to simplify the searching for a university by utilizing different techniques. This visualization incorporates three different techniques, namely, geographical distribution on the world map, heatmaps and pie charts. Figures 7 and 8 shows the final results of this part.

To make the navigation easier for the user, the map has markers that point to the countries with universities ranked as the top 200 universities. The student can interact with this visualization as follows:

Map Interaction:

The top 400 universities are distributed worldwide. The best way to visualize the universities in a simple and intuitive way is using the map. That makes it easier for the student to determine the location of the university and how far it is from his home country. By clicking on the country, a little tooltip will appear to give the option for the user to go to the detailed information about the universities in this country as shown in Fig. 7. The

Fig. 7: World map visualization

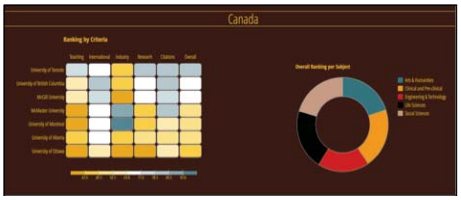

Fig. 8: The detailed information for each country

link in the tooltip will take the student to a detailed information, which is represented by an interactive heatmap and pie chart as shown in Figure 7. To make the navigation through the map easier, the map is zoomable, so the user can zoom in and out.

Heatmap Interaction

The heatmap was implemented to represent the variation in the scores for each evaluation criteria. It is an effective technique to visualize the scores using the colors by normalizing the scores and mapping them into a specific color scale. That make it easier for the student to infer and compare the scores by the colors instead of reading the scores for each individual university and criterion. The order of the universities in the heatmap reflects the rank of the universities in the country as shown in Figure 8. By moving the mouse over the heatmap, the scores will appear to the student. Additionally, moving the mouse on the heatmap will show the scores that fall under the selected range.

Pie Chart Interaction

The pie chart is a simple and easy visualization tool to infer the information from. Additionally, most of the users are familiar with the pie chart. It shows the subjects that have the highest scores in each country which is calculated by the average overall score for all the universities in each subject. That reflects what this country is strong in and what are the offered subjects in the top universities in this country. Colors encoding were also used to distinguish different subjects. Figure 8 shows the pie chart beside the heatmap.

4.3 Bubble Chart

This visualization will show the top 100 universities under 50 years old. Visualizing those universities can give an insight about the future of the higher education. Specifically, it will show the prediction of the leading universities in the future. In addition, it might provide alternative choices for students who cannot pay the tuition for the high-profile universities such as Harvard and Oxford. When the user place the mouse over a circle it will show a tooltip that shows detailed information about the university such as university's

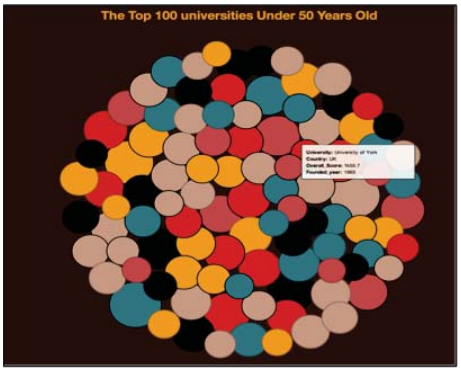

Fig. 9: 100 universities under 50 years bubble chart

name, country, overall score, and the founded year as shown in Figure 9. The bubble chart in the D3 library was used to implement this part. Each university is represented by a bubble. Six colors were used to encode the six continents based on the location of the university. The size of the circle reflects the overall score of the university.

5. Related Work

Information visualization techniques have been improved over the years. A few of these techniques have been utilized to visualize the top universities. Generally, tables are used by the magazines that announce the rankings, such as U.S. News and Times Higher Education. A team from Harvard University and Johannes Kepler University developed LineUp [6]. This tool visualizes the dataset in a tabular view with headers that show the histogram of the scores. It allows the user to explore, refine, and combine these attributes to see the effect on the rankings. However, the tabular view may lead to ambiguity due to the large volume of data. Additionally, it needs understanding of how to use the Lineup interface. Another effort had been made in [7] to visualize the top universities based on publications and citations. The authors represented the universities on a map to show the geographical distribution, which is easier to understand. However, the ranking was limited to certain criteria.

6. Implementation

The visualization system is hosted on a Web-based platform to ensure the accessibility and the availability for all the users. The entire visualization system is available on the following link: `http://www.cs.kent.edu/~ralshahr/Project/dashboard/`

7. Evaluation

A survey was developed to evaluate and test the usability of the visualization system by real users. It consisted of 10 questions using the Likert scale, ranging from strongly agree to disagree, and one open-ended question to allow students

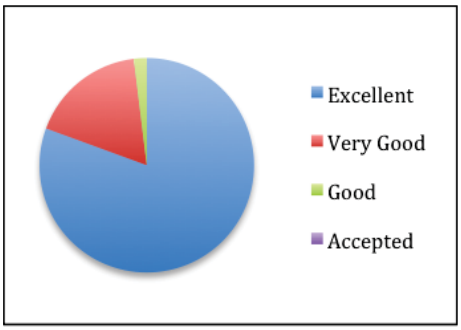

Fig. 10: Survey results

suggestions for any further improvement. This survey manipulates three major aspects:

- Navigation through the visualization system.
- How the system helps the student to gain insight about the universities.
- The interface and the design of the visualization system.

The survey was distributed to around 60 users and 52 responses were received. The survey was distributed to users from different countries and diverse backgrounds. The result of the survey is shown in 10.

8. Conclusion

In this paper, the Top 400 universities data was collected, analyzed, organized and visualized in different ways. Multiple visualizations were presented in order to help the students achieve the goal of this visualization system. Different techniques and tools were utilized to provide a meaningful view of the data. The system can be updated with the most recent rankings as needed.

References

[1] (2014) The times higher education world university rankings. Times Higher Education. 26 Red Lion Square, London. [Online]. Available: https://www.timeshighereducation.co.uk/world-university-rankings/2014-15/world-ranking

[2] Z. Ying, "Introducing google chart tools and google maps api in data visualization courses." *IEEE computer graphics and applications*, vol. 32, no. 6, pp. 6–9, 2011.

[3] M. Bostock, V. Ogievetsky, and J. Heer, "D^3 data-driven documents," *Visualization and Computer Graphics, IEEE Transactions on*, vol. 17, no. 12, pp. 2301–2309, 2011.

[4] C. J. Ihrig, "Javascript object notation," in *Pro Node. js for Developers*. Springer, 2013, pp. 263–270.

[5] R. Verborgh and M. De Wilde, *Using OpenRefine*. Packt Publishing Ltd, 2013.

[6] S. Gratzl, A. Lex, N. Gehlenborg, H. Pfister, and M. Streit, "Lineup: Visual analysis of multi-attribute rankings," *Visualization and Computer Graphics, IEEE Transactions on*, vol. 19, no. 12, pp. 2277–2286, 2013.

[7] L. Bornmann, M. Stefaner, F. de Moya Anegón, and R. Mutz, "Ranking and mapping of universities and research-focused institutions worldwide based on highly-cited papers: A visualisation of results from multi-level models," *Online Information Review*, vol. 38, no. 1, pp. 43–58, 2014.

MPEG-SCORM: an Ontological Approach of Interoperable Metadata for Multimedia e-Learning

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Abstract— *The convergence of digital media offers an integration of ICT focused on telecommunications and multimedia domain (under responsibility of the Moving Picture Experts Group, ISO/IEC JTC1 SC29) and the ICTE (the ICT for Education), managed by the ISO/IEC JTC1 SC36, highlighting the MPEG standards, employees as content and metadata to the Multimedia domain and technologies applied to e-Learning. Regarding this, there are problems of developing an interoperable matching for normative bases, achieving an innovative proposal in the convergence between digital telecommunications and applications for e-Learning, also essential to multimedia. To reach this purpose it is proposed to create a standard ontology of interoperable metadata for web, digital TV and extensions for mobile devices based on the integration between MPEG-21 and SCORM metadata standards. The methodology used consists of building ontology MPEG-21 SCORM which can be achieved on making a correspondence through the XPath language, managed by the W3C. The use of the XPath language is desirable for matching and mapping both metadata schema patterns – integrating MPEG-21 (mostly Digital Item Declaration Language) and SCORM metadata schema. The practical purpose is the creation and storage of objects for use in digital multimedia casting as the Web and Digital Television, in an interoperable way with the e-Learning industry, here as description metadata for all sorts of media and hypermedia to create learning objects.*

Keywords: e-Learning, Metadata, MPEG, Multimedia, SCORM

1. Introduction

The technological innovation issue comprehends a research in a hybrid field that comprises a breakthrough on the media convergence process, on purposing an interface between the norms and standard implemented in the field of interactive multimedia, highlighting the digital Multimedia (standardized by the ISO SC29[1] subcommittee), and the field of the technologies for e-Learning (standardized by the ISO SC36[2] subcommittee).

Technically, the e-Learning domain extends to the field of MPEG[3] multimedia, since it employs as its audiovisual content format the digital video standard MPEG-4 AVC H264, the worldwide industry standard today.

However, the standardization of the multimedia MPEG is not restricted to MPEG-4, since other MPEG technologies are in process of specification by the SC29 subcommittee and actually are more powerful in terms of metadata description and so on, as MPEG-7 and MPEG-21.

These distinct MPEG norms and its main defining characteristics are highlighted in the Figure 1, translated from the source reference in French [1]:

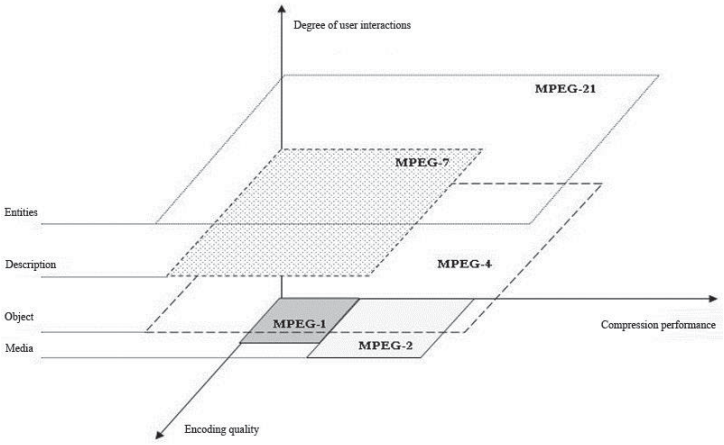

Figure 1. Different MPEG norms and its main characteristics in terms of encoding quality, compression performance and user interaction [1].

It can be noted that the main characteristic for MPEG-4 is the possibility of object creation and manipulation. For MPEG-7, it would be the metadata description of all media content only; MPEG-21 allows the modelling of entities, on

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[1] ISO/IEC JTC1 SC29, a standardization subcommittee in charge of the technical specifications within the field of audio, picture, multimedia, and hypermedia information coding.

[2] ISO/IEC JTC1 SC36, a standardization subcommittee that develops and facilitates standards within the field of information technology (IT) for learning, education and training.

[3] Moving Picture Experts, ISO/IEC working group established in 1988 with the purpose of developing and facilitating standards for coding representation of related data in digital audio and video.

content and within an object oriented domain of descriptors.

MPEG21 become the most suitable option for metadata description as a breakthrough in this field since its framework allows not only content description, but all kinds of elements presented within the consumption channel, from the content and object creation, through broadcasting and reaching the end user (who otherwise can be also a producer).

Regarding this, the main objective on this work is contributing on the development of an interoperable matching between the normative bases in question, achieving an innovative proposal in the convergence between digital telecommunications and applications for e-Learning, also essentially multimedia, integrating MPEG-21 (mostly its Digital Item Declaration Language) and SCORM metadata schema. To reach this purpose the proposition is developing a standard ontology of interoperable metadata for web, digital TV and extensions for mobile devices based on the integration between MPEG-21 and SCORM metadata standards.

This hybrid standard would allow the creation and storage of objects for use in digital telecommunications, as Digital Television, in an interoperable way with the e-Learning industry, which in its turn employs all sorts of media and hypermedia technologies to create learning objects.

Regarding the challenges for the standardization of the ICT applied to e-Education, it comprises a telecommunications engineering problem still in developing the issue concerning how the MPEG Video family, especially the MPEG-21 [2] standard, could offer a normative basis for the implementation of multimedia metadata related to e-Learning.

This development demands the adoption and the usage of some tools to match all these learning and media objects, further to the content itself (video, still images, sound, text, hypertext etc), and must lie within a normative frame to guarantee interoperability, reusability and referring to the major platforms or digital environments in both fields, multimedia and e-learning.

For this purpose it was adopted in this research the XPath language, managed by the W3C[4].

The software engineering to support this normalization comprehends XML, MPEG-7, MPEG-21, themes approached by the SC36. Otherwise, ADL[5] experts, entity which developed the SCORM standard, are engaged in SC36 subcommittee too, and already proposed to in a certain way explore the capabilities of MPEG-21 to make this idea viable.

ADL strategy lies on capitalize the other subcommittees norms, and encourage the adoption of the Part 5 of MPEG-21 [3] (REL, or Rights Expression Language), to solve copyright issues, besides delegating to the LOM [6] standard its metadata description (or parts to other standards like IMS or DCMI – Dublin Core). This reveals a very converging approach and acceptation concerning the metadata and MPEG-21 issue on the industry and market.

2. Learning Objects and Metadata Standards

A Learning Object can be defined, in a perspective of Engineering, according to IEEE 1484.12.1 standard (Standard for Learning Object Metadata) [4], "For this standard, a learning object is defined as any entity, digital or non-digital, that may be used for learning, education, or training".

According to the IEEE LTSC [4], the LOM standard focus on the minimum attributes needed to allow a learning object to be found and evaluated. Metadata allow the cataloging and coding of the objects to turn them comprehensible within most e-learning platforms.

SCORM doesn't define itself a metadata model – it recognizes the LOM standard as the standard in fact [5]. Yet, SCORM defines XML as the syntax for metadata representation (process called *XML binding*). That is why LOM is used when representing SCORM metadata.

Within its CAM model published by ADL [5], SCORM defined in its part related to Metadata nine categories to describe learning objects attributes.

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[4] World Wide Web Consortium.

[5] *Advanced Distributed Learning*, iniciativa do governo americano datada de 1999, tendo como vetor o Departamento de Defesa, que tem a missão de recomendar e desenvolver padrões para software de treinamento.

[6] *Learning Object Metadata*, padrão de metadados ente os pioneiros, cujo *metadata schema* é adotado pelo padrão SCORM.

The definition must be applied to assets, SCO (groups of assets), activities, content organizations and content aggregations, for their identification, categorization, consult and findability, to facilitate sharing and reusability.

To match specifications of theses metadata standards the proceeding is mapping their categories using, in this research, the XPath language, as it was primary done mapping and matching DCMI–Dublin Core and SCORM metadata standards, as shown in Table 1. Mapping is expressed in *XPath syntax*.

As we can observe in Table 1, these identifiers cover from the most generic ones to the most specifics, related to the Rights, for example, which is a focus of ADL standardization concerning MPEG-21 and SCORM.

TABLE 1. MAPPING OF SCORM AND DCMI METADATA (XPATH SYNTAX)

Matching SCORM (LOM) / DCMI	
SCORM	**DCMI**
/lom/general/identifier/entry	/dc/identifier
/lom/general/title	/dc/title
/lom/general/language	/dc/language
/lom/general/description	/dc/description
/lom/general/keyword ou /lom/classification/keyword com classification/purpose equals to "Discipline" ou "Idea"	/dc/subject
/lom/general/coverage	/dc/coverage
/lom/educational/learningresourcetype	/dc/type
/lom/lifecycle/contribute/date com lifecycle/contribute/role equals to "Publisher"	/dc/date
/lom/lifecycle/contribute/entity com lifecycle/contribute/role equals to "Author"	/dc/creator
/lom/lifecycle/contribute/entity with the contributing type specified in lifecycle/contribute/role	/dc/othercontributor
/lom/lifecycle/contribute/entity com lifecycle/contribute/role equals to "Publisher"	/dc/publisher
/lom/technical/format	/dc/format
/lom/rights/description	/dc/rights
/lom/relation/resource/description	/dc/relation
/lom/relation/resource com relation/kind equals to "IsBasedOn"	/dc/source

3. Multimedia e-Learning Metadata

The metadata systems integration is already a longtime issue of investigation for the telecommunications community, mostly linked to multimedia broadcasting. In [1], [6], [7] and [8], we have samples of the discussion involving MPEG-7 and MPEG-21. Even the issue of learning through TV exhibition and SCORM was initially discussed [11].

MPEG-21 became the modular development and standardization platform (a *framework*) [12] towards global integration of all multimedia documents. The multimedia are not the product of an specific area of knowledge, but is a direct consequence of standardization of digital practices such as telecommunications, audiovisual, informatics.

Although the fact that MPEG-21 came up from a community that focuses on audio and video, the so called *MPEG-21 Framework* [12] can host all kinds of complex digital objects, such as electronic text, digital magazines, scientific data etc.

As can be seen from the scientific literature [13], [7] and [1] and from the norm itself [3], the MPEG-21 standard have a non-rigid structure of metadata, and Part 2 standard, DID, exposes the digital Item as the most generic approach for this purpose structural description of the use of metadata in digital objects of all kinds.

The MPEG-21 standard holds today 21 parts [3]. MPEG-21 is an XML-based metadata specification that brings two fundamental pillars: the definition of a unit or essential object of distribution and transaction, which is called *Digital Item*; and the notion of "reader" – the concept of users interacting with it.

The central concept within the MPEG-21 is the DI – *Digital Item*, as defined in Part 2 of the standard [12].

The DID, or *Digital Idem Declaration*, relates a digital product, which can be simple or composite. A typical example is a webpage, containing different multimedia resources.

The use of MPEG-21 DIDL (*Digital Idem Declaration Language*) as a generic standard for the representation, cataloging and storage of digital learning objects in the library has been proposed by

[14]. It demonstrated the applicability of the DIDL for representing complex objects of any type of media or content to create a digital collection in the library.

The second key concept in MPEG-21 format is the description of the production and interaction with the media, for all stakeholders in the process, from content producer to the end user. Therefore, it can be said that the main objective of MPEG-21 is to define the technologies needed to support the exchange, access, consumption, trade or handling of Digital Items in an efficient and transparent way [12].

4. Methodology: a Convergent Ontology for the Integration Between MPEG-21 SCORM

Ontology between SCORM and MPEG-21 can be carried out by matching their syntax correspondences, through the W3C XPath language. The use of XPath language is directed to carry out the comparative study of mapping between the standards of SCORM metadata and MPEG-21, applying this methodology. XPath is a language maintained by the W3C with the primary objective of addressing parts of an XML document, and it is also used to test whether a code matches a pattern, or another code.

The MPEG-21, as already stated, provides the DIDL (*Digital Item Declaration Language*), but also other schemes and their languages, within other of the many parts of the standard, for the cataloging of objects and the flow of information, the case also DII (*Digital Item Identification*), and DIA (*Digital Item Adaptation*); but also for dealing with copyright data (MPEG-21 Part 5 REL - *Rights Expression Language*), CEL (*Contract Expression Language*), IPMP (*Intellectual Property Management and Protection*); and even use cases (UD - *User Description*).

The orientation of the work of JTC1 SC36, as can be accompanied by papers published by IEEE [13] and [17] is based essentially on the portability, interoperability and adaptability of technologies for education, teaching and learning. The SC36 does not, therefore, calling to extend the work carried out by other technical committees, such as the SC29 itself, the media committee, which deals with sound encoding, image, multimedia and hypermedia information.

However, the SC36 was a pioneer in pointing to the need for synergy with the SCORM MPEG-21 standard, proposition however limited to addressing issues of copyright and eventually the e-commerce of ICTE (Part 5 of the standard).

The MPEG-21 normalization lies in perfect continuity with the ones previously carried out within the MPEG-7 framework. And many MPEG-7 standard descriptors are part of the MPEG-21 metadata schema [12] scope.

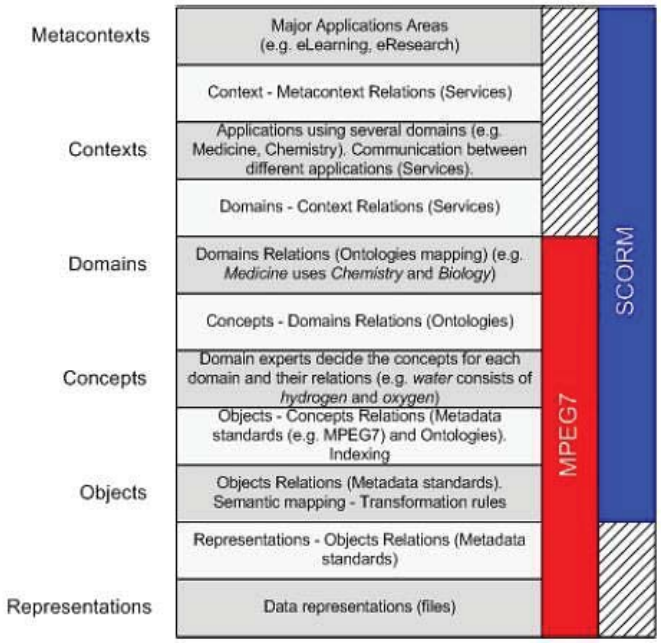
The descriptors and corresponding description schemes are developed under the responsibility of MDS group, whose data description is founded on the semantics of XML markup language.

The inter-relationships between MPEG and e-Learning metadata standards are outlined in Table 2 [15] and in Table 3 [16]:

TABLE 2. MAPPING AMONG THE MPEG AND E-LEARNING MAIN METADATA STANDARDS [15]

	Métacontextes des applications	Relation métacontextes - contextes	Contexte des applications	Relation contextes - domaines	Domaines	Relation domaines-concepts	Concepts	Relation concepts-objets	Objets	Relation Objets-représentations	Représentations	Relation représentations-échanges	Echanges
DUBLIN CORE													
SCORM													
LOM													
MPEG-7													
MPEG-21													

TABLE 3. MAPPING BETWEEN MPEG-7 AND SCORM [16]



DIDL documents are actually XML 1.0 documents. The DIDL syntax is based on an abstract structure defined in the *Digital Item Declaration Model*. This model defines the DIDL elements, namely: *Container; Item, Component, Anchor, Descriptor, Choice, Selection, Condition, Annotation, Assertion, Resource, and Statement*. These are structurally represented as Figures 2 and 3.

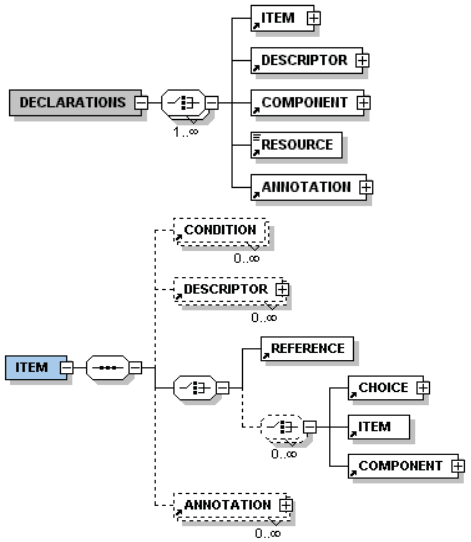


Figure 2. Partial graphical representation of DIDL schema [12]. Highlighting the Declarations and Item elements.

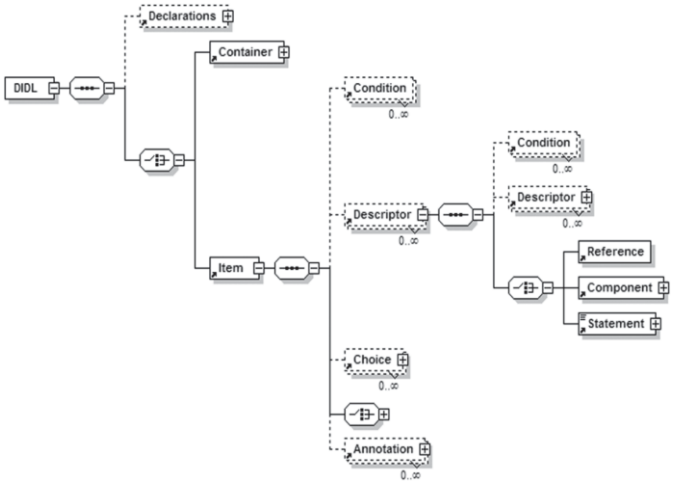


Figure 3. Partial graphical representation of DIDL schema [12] as a whole.

The DIDL XML code on the *Declarations* element (a special element that defines a selection of elements without instantiate them) would be displayed in the following generic form [12]:

```
<xsd:element name="DECLARATIONS">
    <xsd:complexType>
        <xsd:choice maxOccurs="unbounded">
            <xsd:element ref="ITEM"/>
            <xsd:element ref="DESCRIPTOR"/>
            <xsd:element ref="COMPONENT"/>
            <xsd:element ref="RESOURCE"/>
            <xsd:element ref="ANNOTATION"/>
        </xsd:choice>
    </xsd:complexType>
</xsd:element>
```

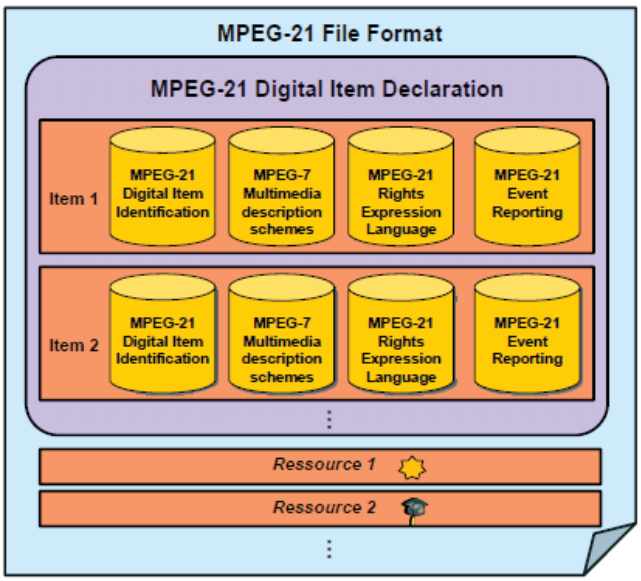


Figure 4. Hierarquical metadata structure within a MPEG-21 file [18].

To perform the integration of standard patterns, solutions are being implemented to make the correspondence between the categories of SCORM metadata and those defined by MPEG-21 metadata schema.

Using the XPath language as the default to format the taxonomies and create a new ontology, there were first mapped the following standard SCORM metadata (LOM), which would correspond to the multimedia standard MPEG-21, aligned to the concept of platforms convergence. As follows in Table 4:

TABLE 4. SCORM METADATA TO BE MATCHED WITH MULTIMEDIA MPEG-21 STANDARD, FOR WEB, MOBILE OR DTV

SCORM Multimedia Metadata	MPEG-21 Metadata (under development)
/lom/general/identifier/entry	<mpeg21>
/lom/general/title	<mpeg21>
/lom/general/language	<mpeg21>

/lom/general/description	<mpeg21>
/lom/general/keyword	<mpeg21>
/item[@identifier]	<mpeg7>
/lom/general/coverage	<mpeg21>
/lom/educational/learning/resource/ type	<mpeg21>
/lom/lifecycle/contribute/role	<mpeg7>
/lom/lifecycle/contribute/date	<mpeg7>
/lom/technical/format	<mpeg7>
/lom/technical/size	<mpeg7>
/lom/technical/location	<mpeg7>
/lom/technical/duration	<mpeg7>
/lom/rights/description	<mpeg21>
/lom/relation/kind	<mpeg7>
/lom/relation/resource/description	<mpeg21>
/lom/relation/resource/catalogentry	<mpeg21>

5. Conclusions

Until the present moment it was possible to obtain successful results concerning the stages already overcame on this research, which progresses at an advanced pace regarding to the implementation of the specific goal of correspondence between metadata standards of the knowledge domains issued.

The development work has consisted in creating an Ontology focused on these mapped taxonomies in order to propose, from this ontology, an integration between the fields of Multimedia (*on demand* and *streaming*) and MPEG ICTE for Distance Education / e -Learning.

In other words, the convergence between MPEG-21 and SCORM as a standard for describing objects used for cataloging and for use in e-learning, in a broader sense, and e-learning via internet multimedia and digital broadcast diffusion (TV) in a specific perspective of the field of research.

A SCORM MPEG-21 Ontology, using the W3C XPath language, is already in an advanced stage in order to make its contribution to the body of knowledge and the process of standardization in the metadata study domain.

It also contributes to a latent need for integration between the universes of Multimedia and e-Learning, represented by working groups of SC29 and SC36 standards subcommittees, ISO / IEC JTC1, in this context of convergence.

6. References

[1] T. Laquet, F. Prêteux, Vaucelle, A, and T. Zaharia, "Les normes MPEG-7 et MPEG-21 pour la déscription des contenus multimédias," TAIMA'09 Conference, Hammamet (Tunisia), 2009.

[2] A. Vaucelle, "MPEG-21: la norme des ICTE du XXIème siècle?," Rétrospective et Perspective H2PTM'09, Paris, 2009.

[3] MPEG-21 ISO/IEC N5231. MPEG21 Overview v.5. 2002.

[4] IEEE LTSC. Standard 1484.12.1 for Learning Object Metadata. New York: IEEE, 2002.

[5] ADL Advanced Distributed Learning, SCORM 2004 4th Edition Content Aggregation Model. 2009, p.4-65.

[6] L.G.P. Alves, G. Bressan, P. Jucá. R. Kulesza, F. Silva, "Compared analysis on Digital Television Metadata," Workshop DTV SBRC2006, Curitiba (Brazil), June 2006.

[7] S. Kalli, A. Lugmayr, S. Niiranen. Digital interactive TV and Metadata: Future Broadcast Multimedia. New York: Springer, 2004.

[8] J. Hunter. Reconciling MPEG-7 and MPEG-21 Semantics Through a Common Event-aware Metadata Model. Ithaca, NY (USA): Cornell University Library, 2002.

[9] S. Pfeiffer, U. Srinivasan, "TV-Anytime as an application scenario for MPEG-7," Proc. ACM Multimedia, Los Angeles, 2000, pp. 89-92.

[10] S. Christodoulakis, F. Kazasis, P. Polydoros et al, "Ontology-Based Semantic Indexing for MPEG-7 and TV-Anytime Audiovisual Content," Multimedia Tools and Applications, vol. 26, August 2005, pp. 299-325.

[11] A. Burlamaqui et al., "T-SCORM: an Extension of SCORM Standard for T-Learning," XXII SBIE - XVII WIE, Aracaju (Brazil), 2011.

[12] MPEG-21 ISO/IEC 21000-2:2003. Multimedia framework (MPEG21) Part 2: Digital Item Declaration. 2003.

[13] J. Bormans, I. Burnett, F. Pereira, R. Van Walle, K. Hill, "MPEG-21: Goals and Achievements," IEEE Multimedia, vol.10, October-December 2003, pp.60-70.

[14] J. Bekaert, P. Hochstenbach, H. Van de Sompel, "Using MPEG-21 DIDL to Represent Complex Digital Objects in the Los Alamos National Laboratory Digital Library" D-Lib Magazine, vol. 9, n. 11, November 2003.

[15] M. Ben Henda, F. Prêteux, A. Vaucelle et al. MPEG-21: une Base Normative pour le e-Procurement des ICTE. Évry (France): École Télécom SudParis, 2008.

[16] L. Lyon, M. Patel, S. Christodoulakis et al., "Project n507618 DELOS: status report for work package 5. In: Joint Programme of Activities (JPA3)," February-September 2006.

[17] I. Burnett, S. Davis, G. Drury, "MPEG-21 Digital Item Declaration and Identification," IEEE Multimedia, vol. 7, n. 3, June 2005, pp.400-407.

[18] F. Schreiner. Content management and protection using Trusted Computing and MPEG-21 technologies. Dissertation (Master in Informatics) – Munich Technical University (Germany), 2010.

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Assessment of Scoring Content and English in the first CLIL Project at a High School in Sardinia

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Abstract – *The present study is based on the first experiment of introducing a Content and Language Integrated Learning (CLIL) to a technical high school in Sardinia, Italy. In CLIL there is an assumption that Content teachers and Foreign Language teachers cooperate in teaching and scoring. However, Content teachers and Language teachers have different backgrounds and may have different standards. It is necessary to investigate how a teacher of Content and that of English score students' production in their fields and compare their standards with the criteria, which is made by an analytical rubric. The research questions are: 1) How do a Content teacher and an English teacher score Written and Oral Production in CLIL classes? 2) What is the correlation between the scoring of a Content / an English teacher and the criteria? 3) What do a Content and an English teacher think about the scoring of each other and the correlation of their own scoring? The results show that the scoring of Content and that of English teachers are highly correlated in Written and Oral Production of content but they are not correlated in Oral Production of English. The scoring of contents by English and that of Content teachers, and the scoring of English by the English teacher and the criteria are very highly correlated. However, the correlation of the Content teacher and the criteria is low especially in English. The reason why the Content teacher scores differently in English of Oral Production might be his low English proficiency and his difficulty in hearing. In the future, Content and Language teachers should collaborate to design a rubric to score appropriately when they start regular CLIL classes.*

Keywords: CLIL, assessment, scoring, criteria, 1-5 points scale, rubric

1 Introduction

Content and Language Integrated Learning (CLIL), where a subject is taught through the medium of a second language, is a growing trend in all levels of education in Europe and in other parts of the world. In CLIL classrooms, children are learning subjects such as history, geography and science in their second or third language in primary and secondary school. CLIL in Europe has been partly due to a commitment of the European Union (EU) to a multilingual Europe. In 1995 EU proposed that every European citizen should master two other languages in addition to their mother tongue as one of the objectives of the language policy. Following this proposal, EU leaders at the March 2002 Barcelona European Council declared that every child in the EU should be taught at least two foreign languages from an early age. These requirements have given "CLIL" a great importance and have resulted in its establishment in many schools all around Europe. Coyle et al. define, "(CLIL) is a dual-focused educational approach in which an additional language is used for the learning and teaching of both content and language. That is, in the teaching and learning process, there is a focus not only on content, and not only on language. Each is interwoven, even if the emphasis is greater on one or the other in a given time (p.1) [1]."

Though many schools in Europe have adopted CLIL, there are many challenges to implement it. This paper is based on the first experiment of introducing CLIL to a technical high school program in Sardinia, Italy. Among these challenges, we would like to focus on the assessment in CLIL classrooms. In this study, the Italian teachers and the Japanese researchers collaborated to find out how teachers with different backgrounds score students' production.

In this study, the words "score" and "assess" are defined as follows: "Score" is used when Content and English teachers evaluate their students' production. "Assess" is used to evaluate teachers' scoring with the criteria based on analytical rubric designed by one of the authors. In addition, the participants of this study; a Content teacher and an English teacher are abbreviated as follows. The Content teacher who teaches IT is marked as ITT and the English teacher is marked as ET.

2 Assessment in CLIL

"The European Framework for CLIL Teacher Education" is published on-line as "a tool for guiding the design of curricula for CLIL teacher professional development" (Marsh et al.) [2]. In this booklet, the target professional competences that the CLIL teacher is expected to acquire are listed. In "Assessing" CLIL teachers are expected to be able to "articulate CLIL-specific assessment needs and goals, and to develop and implement related assessment tools or further develop during the training programme". However, assessment in CLIL is not a simple issue.

First of all, as CLIL aims a dual focus of content and

language, assessment in CLIL is inevitably a dual focus (Kiely, 2014) [3]. It tends to happen that content and language are assessed at the same time and through the same tasks and activities. However, it is hard to find out the reason why students are poor in thier performance. For example, when students cannot explain some features of a historical event, it might be their poor understanding of content or it might be their poor verbal ability.

Secondly, the purpose of CLIL is varied in each classroom setting. Clegg (2012) wonders if the programme is supposed to develop learners' knowledge of language as well as content, should both content and language be assessed? [4] In CLIL there are many types of programs and modules depending on the situation, context, and aim. According to Ikeda, there is a basic division of the CLIL approach into two types depending on purposes: one in which the teaching and learning is focused primarily on language and the other on the subject content [5]. The former is called Soft CLIL and the latter is called Hard CLIL. Therefore, assessment is different depending on whether it is Soft or Hard CLIL.

Thirdly, it might be difficult for subject teachers to assess learner performance in a foreign language which they may feel themselves not qualified or confident (Clegg, 2012) [4]. At the same time, language teachers might also find it difficult to assess learner performance in content which they may feel themselves not qualified or confident.

Fourthly, it is unknown what assessment tools are the most useful for measuring learner performance. Clegg suggests a useful assessment tool may be a bandscale, a set of performance descriptors which allow the teacher to rank a piece of student performance on several sub-skills of a given task, using a pre-constructed scale(2012) [4].

In the present study, the third and fourth questions are investigated. We would like to see how Content and English teachers score Written and Oral Production in the same activity. Performance descriptors to assess students' performance were made to compare and contrast with the scoring of teachers.

3 The Present Study

The research questions of this study are as follows:

1) How do a Content teacher and an English teacher score Written and Oral Production in CLIL classes?
2) What is the correlation between the scoring of a Content / an English teacher and the criteria?
3) What do a Content and an English teacher think about the scoring of each other and the correlation of their own scoring?

3.1 Method

3.1.1 Participants

The participants were 12 Italian high school students at a Technical High School in Sardinia, Italy. Their English proficiency levels are A1, A2, and B1 in Common European Framework (CEF). Among the six levels of CEF, A1 is the lowest, whereas C2 is the highest. These students took a 5-day-program of IT in CLIL as an elective course. Although it was the first experience for them to learn under CLIL approach, they were used to learn content in English as their textbooks were theme based such as on environment and energy.

Two Italian teachers, one IT teacher (hereafter ITT) and one English teacher (hereafter ET) participated in the study. They were both experienced in teaching their own fields more than 20 years, but it was first time for them to teach in CLIL. The English proficiency level of ITT was between A2 and B1 and that of ET was native speaker's level as she was an examiner of the Cambridge Test examiner.

3.1.2 Materials

The class was designed to use the textbook, "Information technology: a story of people and machines" by Davies, P. A., Oxford Bookworms, OUP. Four Writing Prompts and one Oral Prompt were used. The prompts are as follows.

1) Writing Prompts

The students were asked to write 50-80 words in about 5-10 minutes (Table 1).

Table 1: Writing Prompts

1. Analyze the roles of "People and / vs machines". Compare the roles of people and machines in the development of IT.
2. Draw a pie-chart to show percentages of time devoted to everyday free time activities (besides school and sleeping time) with and without computers. Do you think you depend on computers too much? Explain why / why not.
3. What is the role of Alan Turing in developing a computer?
4. List 5 to 7 key words and draw a mind map.
5. Summarize the text.

2) Oral Prompt

The students were asked to give a presentation for about 5-10 minutes as a final project (Table 2).

Table 2: Oral Prompt

Summarize the text using 5-7 keywords. Draw a mind-map and based on the mind map, give a presentation.

3.1.3 Classes

The classes were intensive IT CLIL courses from February 3rd to 7th in 2014. In 5 days, totally 6 hours were taught by ITT and ET. The classes were managed in English most of the time. The teachers encouraged the students to interact with self, content-material, other students and teachers.

3.2 Instruments

3.2.1 Teachers' Scoring Scale

ITT and ET scored the Written and Oral Production on a 1-5 point-scale from the viewpoint of content and English (Table 3).

Table 3: Teachers' Scoring Scale

	Content	English
Scores	5	5
	4	4
	3	3
	2	2
	1	1

The criteria were made by one of the authors, Chiharu NAKANISHI, an educational researcher who was the observer of CLIL classes. After observing CLIL classes, she made the criteria of assessment by constructing analytical rubrics; a band scale, which is a set of performance descriptors. In her daily classes, she uses analytical rubrics to evaluate her students' production. She thinks the analytical rubric is a convenient and objective tool to share the criteria of evaluation with her students. She also thinks the analytical rubric can be used to show the goal to her students. Based on her experiences of making and using the analytical rubric, which is the criteria, she evaluated all Written and Oral Production. The criteria for Written Production (Table 4) were adapted from Tabak et al (2012) and Merli (2012). The criteria for Oral Production were adapted from Tabak et al (2012) and (http://rubistar.4teachers.org/) (Table 5).

Table 4: The Criteria for Written Production

	5 (Excellent)	**4 (Good)**	**3 (Satisfactory)**	**2 (Almost satisfactory)**	**1 (Unsatisfactory)**
Content	Student shows a complete and thorough knowledge of the subject.	Student shows a complete knowledge of the subject.	Student has essential knowledge of the subject.	Student is lacking necessary background knowledge of the subject.	Student shows no knowledge of the subject.
English	Consistent grammatical control and appropriate use of vocabulary. No mistakes except for some articles (1-2).	Good grammatical control and generally appropriate use of vocabulary. Some mistakes may be present (2-4).	A few mistakes in grammar and vocabulary use that do not lead to misunderstanding. Mistakes in structures and verb forms may be present (5-8).	Systematically makes mistakes in grammar and vocabulary use but the message is generally clear. Mistakes in structures and verb forms (5-8) are disturbing the meaning.	Systematic grammar mistakes and narrow range of vocabulary make the message meaningless. Mistakes prevent understanding of content.

Table 5: The Criteria for Oral Production

Scores / Descriptions	5 (Excellent)	4 (Good)	3 (Satisfactory)	2 (Almost satisfactory)	1 (Unsatisfactory)
Content	Student summarizes the text using appropriate 5-7 keywords. S/he draws an appropriate mind-map and gives a presentation based on the mind map. S/he shows a complete and thorough knowledge of the subject.	Student summarizes the text using 5-7 keywords. S/he draws a mind-map and gives a presentation based on the mind map. Student shows a complete knowledge of the subject.	Student summarizes the text using more or less than 5-7 keywords. The choice of keywords is safisfactory. S/he draws a satisfactory mind-map and gives a presentation based on the mind map. S/he has essential knowledge of the subject.	Student summarizes the text using more or less than 5-7 keywords. The choice of keywords is not satisfactory. S/he draws an almost satisfactory mind-map and gives a presentation based on the mind map. Student lacks necessary background knowledge of the subject.	Student summarizes the text using more or less than 5-7 keywords. The choice of keywords is unsatisfactory. S/he draws an unsatisfactory mind-map and gives a presentation based on the mind map. Student shows no knowledge of the subject.
English	Speaks clearly and distinctly all (100-90%) the time, and mispronounces no words.	Speaks clearly and distinctly all (90-80%) the time, but mispronounces no more than 2 words.	Speaks clearly and distinctly most (80-70%) of the time. Mispronounces more than 4 words.	Speaks clearly and distinctly most (70-60%) of the time. Mispronounces more than 6 words.	Often mumbles or can not be understood or mispronounces more than 8 words.

3.3 Procedures

1) ITT and ET scored 4 Written and 1 Oral Production separately on a 1-5 point-scale.
2) ITT and ET held a meeting for scoring students' Production, when they evaluated two Writing Production in one day.
3) One of the authors, Chiharu NAKANISHI (hereafter CN) observed and videotaped the classes. After observing CLIL classes, she made the analytical rubric, which was used as the criteria. After she read through all Written Production and watched Oral Production, she evaluated the Written and Oral Production by using the criteria. The analysis of scoring by ITT and ET is based on CN's assessment.
4) ITT and ET were interviewed about their scoring and the correlation between their scoring by CN.
5) Hodaka NAKANISHI, the other author, calculated and examined the correlation of scoring by ITT, ET and of assessing by CN.

4 Results

All scoring by ITT, ET and assessing by the criteria were analyzed from the viewpoints of content and English.

Research Question 1: How do a Content teacher and an English teacher score Written and Oral Production in CLIL classes?

Correlation of scoring by ITT and ET in Written and Oral Prodcution is shown in Table 6 & 7. Between ITT and ET, the average of correlation for scoring Content is higher (Written Production:0.70, Oral production: 0.74) than that of English (Written Production: 0.57, Oral Production: 0.39).

On both Feb. 5th and 7th, ITT and ET had a short scoring meeting between Activity 1(A1) & 2(A2) and Activity 3(A3) & 4(A4). After the meeting, both the correlation of scoring content and that of scoring English increased.

Table 6: Correlation of Scoring by ITT and ET in Written Prodcution

Evaluator	Viewpoints	Date and Activity				
		Feb.5 A1	Feb.5 A2	Feb.7 A3	Feb.7 A4	Average
ITT and ET	Content	0.59	0.82	0.74	0.73	0.70
	English	0.49	0.76	0.39	0.72	0.57

Table 7: Correlation of Scoring by ITT and ET in Oral Prodcution

Evaluator	Viewpoints	Average
ITT and ET	Content	0.74
	English	0.39

Research Question 2: What is the correlation between the scoring of a Content / an English teacher and the criteria?

The correlation of scoring by ITT & CN and ET & CN in Written and Oral Production is shown in Table 8 and 9.The result shows that the correlation of scoring by ET and CN is high both in Content and English in Writing and Oral Production (Content: Written Production 0.90, Oral Production 0.88) (English: Written Production 0.94, Oral Production 1.0). When to see scoring by ITT and CN, it is relatively highly correlated in Content (Written Production 0.83, Oral Production 0.74). However, the correlation of English scoring by ITT and CN is low (Written Production 0.62, Oral Production 0.39).

Table 8: Correlation of Scoring by ITT & CN and ET & CN in Written Prodcution

Evaluators	Viewpoints	Date and Activity				
		Feb.5 A1	Feb.5 A2	Feb.7 A3	Feb.7 A4	Average
ITT & CN	Content	0.82	0.87	0.91	0.75	0.83
	English	0.50	0.81	0.40	0.81	0.62
ET & CN	Content	0.91	0.94	0.92	0.85	0.90
	English	0.95	0.94	0.90	0.95	0.94

Table 9: Correlation of Scoring by ITT & CN, and ET & CN in Oral Prodcution

Evaluators	Viewpoints	Average
ITT & CN	Content	0.74
	English	0.39
ET & CN	Content	0.88
	English	1.00

Research Question 3: What do a Content and an English teacher think about the scoring of each other and the correlation of their own scoring?

Both ITT and ET were asked what they thought about their scoring. ITT and ET said that they were not used to score by 1-5 point-scale, but were glad to see the high correlation of their scoring in Content. They said that this outcome may be the consequence of a long and deep collaboration of teaching and managing classrooms.

ITT confessed that his low English proficiency affected his scoring English. He also said that he had difficulty in hearing in his left ear. He said he was not confident of scoring students' English especially in Oral Production.

ET said that English teachers had to keep studying subject contents when they teach advanced students and when they teach in CLIL. She also said it was not possible to teach English without contents. She mentioned that it was not easy for her to study a variety of contents. She said though she made an effort to study content, she was not confident enough of scoring students' production in content.

ITT and ET said that when they score students' production in next CLIL program, it might be possible that ITT would focus on content, IT and ET would focus on English. They thought it would be easy and save their energy to care their own fields.

5 Conclusions

The present study showed that scoring content by ITT was correlated significantly with the scoring by the criteria, whereas scoring English by ET was correlated significantly with the criteria. The correlation of scoring English between ITT and ET, or ITT and the criteria in Oral production is low. It could be caused by ITT's low English proficiency and his hearing problem. The interviews showed that scoring is not easy for both ITT and ET. For ITT to score English was not easy. For ET to score content was not easy.

In order to score more appropriately in CLIL, there are 2 possible cues. First, when the gap between Content and Language teachers is more than 2 points on the 1-5-point-scale, the scoring should be checked to find out the reasons of the gap and how each teacher actually did the scoring. Secondly when they implement the CLIL program, Content and Language teachers and other related staffs should collaborate with designing a rubric. According to Stevens and Levi, rubrics can be shared to determine whether or not there is a consensus on what is being taught, how it is being taught, and why (2013) [6]. They also state, "sharing rubrics can also reveal the degree to which grading is consistent" (2013, p.24). They insist that rubrics cannot indicate what to do when teachers grade differently, but rubrics can at least make us aware of the situation.

There is a limit to the present study. The 1 set of teachers, Content and English, and 12 students are not enough to generalize about scoring and assessing.

For our future study, we'd like to improve on the rubrics to allow both Content and English teachers to score easily. Then we'd like to create and provide a variety of CLIL rubrics for teachers. Moreover we are also interested in CLIL teacher training in their scoring.

According to key data on teaching languages at school in Europe (2012), CLIL seemed to have been implemented in primary and secondary education in Sardinia, Italy (p.39) [7]. However, in the present study's technical high school it was completely the first experience for the teachers to implement CLIL. Though the teachers were working hard to start CLIL, they were not trained enough as CLIL teachers. How to score appropriately had never been discussed. Moreover, the Content teacher's English proficiency is too low to teach in English. The education of CLIL teachers and the improvement of Content teachers' English proficiency are two essential issues.

6 Acknowledgements

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7 References

[1] D. Coyle, P. Hood & D. Marsh. "Content and Language Integrated Learning". Cambridge: Cambridge University Press, 2010.

[2] D. Marsh, "The European Framework for CLIL Teacher Education"Viewed on 5 April, 2015

[3] R. Kiely (2014)."CLIL-The question of assessment" Developing Teachers.com <http://www.developingteachers.com/articles_tchtraining/clilpf_richard.htm> Viewed on 5 April, 2015

[4] J. Clegg. "Preface" In Quartapelle (Ed.) Assessment and Evaluation in CLIL, 2012

[5] M. Ikeda. "CLIL no kihongenri (Principles of CLIL) " In Y. Watanabe, M. Ikeda, and S. Izumi (Eds.), CLIL New Challenges in Foreign Language Education at Sophia University Volume 1: Principles and Methodologies, Sophia University Press. 2011

[6] D. Stevens & A. Levi Introduction to Rubrics, An assessment tool to save grading time, convey effective feedback, and promote student learning, VA: Stylus. 2013

[7] European Commision, Key data on teaching languages at school in Europe, 2012, <http://eacea.ec.europa.eu/education/eurydice/documents/key_data_series/143en.pdf> Viewed on 5 April, 2015

Building a Game-Based Internet Security Learning System by Ontology Crystallization Approach

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Abstract*—In recent years, with the rapid growth of the Internet applications and services, phishing becomes one of the most severe threats on the Internet. A phishing can be composed of scenarios and attacking techniques. It is a challenge to collect and analyze scenarios and attacking techniques of phishing efficiently since they can evolve rapidly in diversified media. This research proposes an ontology crystallization process for building the phishing ontology. The layers of phishing ontology is firstly set up based on the attacking intention and the attacking media. More sub-nodes are then added subsequently by analyzing keywords in the collected phishing cases to enrich the attacking process layer of phishing ontology. The proposed construction process and the resulting ontology have also been applied in the anti-phishing game-based learning system for students. In the system, the proposed assessment method indeed helps in promoting the ability of anti-phishing. In addition, the card game called iMonsters has also been designed and developed to help students to easily understand the attack or defense strategies and concepts in Internet security domain. In our experiment, the students were engaged in the game-based learning activity. It shows game playing is a good way to introduce the Internet Literacy .*

Keywords— phishing, assessment, ontology crystallization

I.INTRODUCTION

1.1Background and Motivation

With the rapid development of information technology and network technology, the Internet-based services and applications of human daily life have been growing dramatically. Phishing refers to the attacker's use of deceptive e-mail and web site for fraud. The victims often divulge their personal information and financial data, including the technical data, personal contact, e-mail, bank account number, password, etc. The information is used for future target advertisements or theft attacks [1]. It implies that direct and indirect economic losses caused are increasing rapidly. Therefore, it is important to find a good way to prevent or mitigate Internet crimes, and the fundamental solution lies in enhancing the Internet security literacy education.

In recent years, network security threat issues has been widely discussed, [1], and the traditional phishing attacks usually use social engineering methods and advanced computer skills to steal user's sensitive information (account passwords, credit card information, etc.), and then use the information causing the victim's loss. Besides, with the popularity of smart mobile devices, phishing attacks combined with APTs(Advanced Persistent Threats) are also increasingly sophisticated.

To enhance the user's anti-phishing capabilities, education is still one of the most effective methods [2] [3]. Previous anti-phishing learning content seems very simple, and most of them focused on the technical description of the methods of attack. In the context of rapid changes in phishing attacks, how to establish or maintain complete domain knowledge becomes a very important and challenging problem. The traditional way usually acquires the domain knowledge from experts and requires a lot of efforts. In this paper, we propose an ontology crystallization method to gradually crystallize phishing ontology by analyzing newly obtained phishing cases and refining the existing knowledge base if needed. Accordingly, the anti-phishing game-based learning system fulfilling the following criteria has been constructed: 1) knowledge can be easily understood and explained, 2) knowledge can be easily refined, and 3) knowledge can be able to interact with diagnostic assessment in order to effectively enhance the learner's learning experience and the effectiveness of anti-phishing.

II.RELATED WORK

Current anti-phishing education can be roughly divided into e-book-based learning and game-based learning. Some e-commerce companies including IT security ones built their own e-book for anti-phishing [4] [5] [6] [7]. However, the static content cannot stimulate the motivation of learning [8]. On the other hand, game-based learning has been extensively studied and shown to enhance learner motivation, increase participation, and thus can enhance the effectiveness of learning [9] [10]. Currently known anti-phishing educational games, Anti-Phishing Phil developed by Carnegie Mellon University allows users to play the role of a small fish Phil, picking the right bait to eat [11]. Paypal and VeriSign have also provided user quizzes to enhance learning motivation [12] [13].

In our previous study, the phishing attack pages composed of phishing attack knowledge and phishing scenario knowledge can be generated automatically by knowledge inference [14]. While providing positive and negative examples of anti-phishing cases, we can help users to understand the concepts easily.

With the diversification of the media, the attack techniques through various scenarios packaging are rapidly changing, so we have to quickly construct and maintain the domain knowledge and speedup the ontology construction process.

III ONTOLOGY CRYSTALLIZATION PROCESS

The ontology crystallization process [15] [16] [17] can be divided into the following four phases as shown in Figure 1.

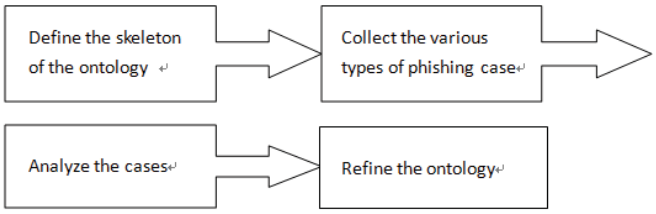

Figure1. Ontology crystallization process

As we know, the main purpose of phishing is to destruct the basic information security of the services including confidentiality, Integrity and availability; therefore, the phishing scenario including phishing purpose, media presentation and phishing action is shown in Fig.2

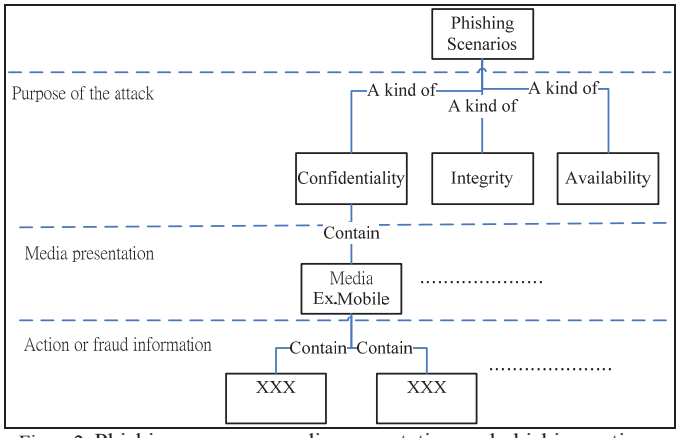

Figure2. Phishing purpose, media presentation and phishing action

There are many attack technologies have been proposed. Accordingly, the skeleton of phishing ontology can be shown in Figure 3.

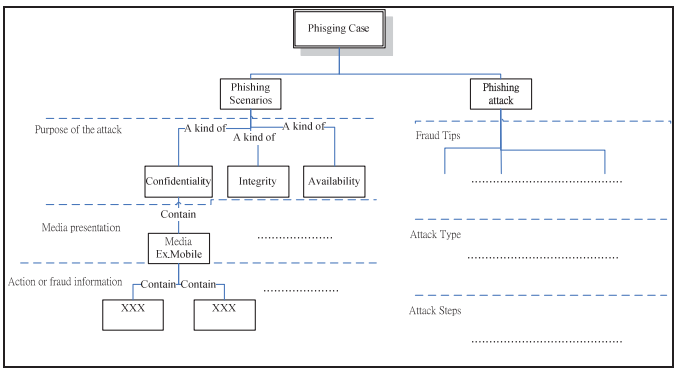

Figure3.The skeleton of the Phishing ontology

According to the skeleton of the ontology, each case can be represented as a subtree of the ontology. For example, if someone clicks Black Cats Company website, the unknown URLs with a hidden and malicious link will automatically download the program, and then he/she received authorization code request for small amount of payment. According to the description, the purpose of the attack, the media, action or fraud information can then be extracted to enhance the subtree, and we have the purpose of this attack is to destroy confidentiality, the media is SMS, and the action includes the use of a fake sender information, malicious URL link, and micro-payments. Another example is shown in Figure 4. It shows the press newsletter has been redirected to the goo.gl URL using malware as the Intrusion System.

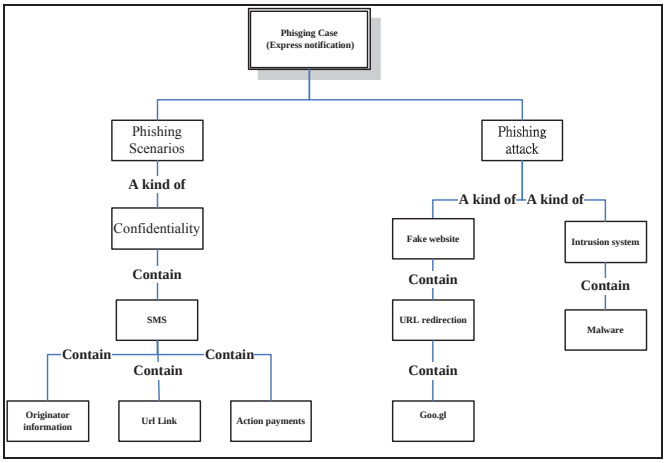

Figure 4. Phishing Case

Therefore, we have proposed ontology fusion and splitting operation. For each new collected phishing case, the ontology refinement including fusion or splitting operation is repeatedly executed, and the resulting ontology is shown in Figure 5.

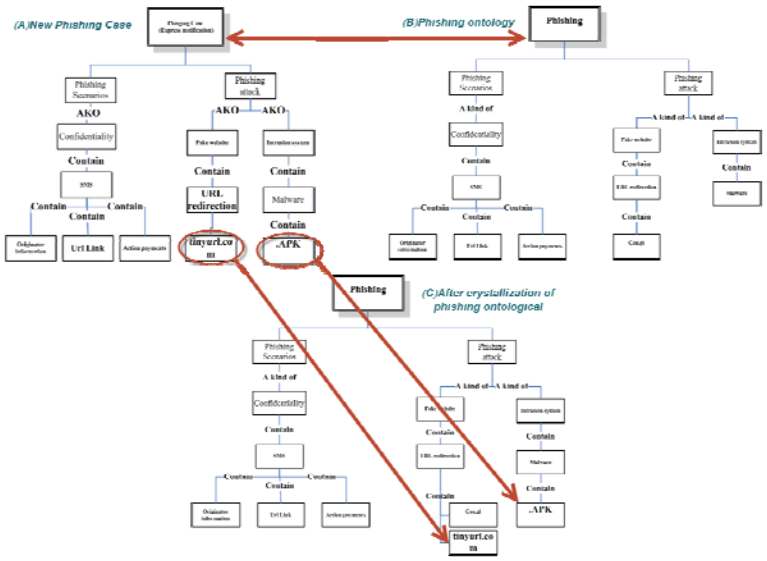

Figure5. Phishing ontology fusion or splitting operation

I would like to mention here that when a new concept occurs, it will be added to the ontology. But once the number of nodes at some level exceeds a given threshold, the splitting operation is applied and the decision of splitting could be made according to the consensus of the domain experts. Through such ontology crystallization method, we can gradually construct the complete phishing attack ontology from bottom to top as shown in Figure 6.

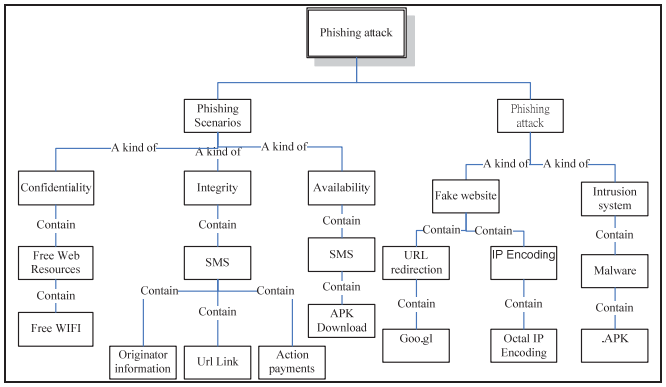

Figure 6. Part of ontology phishing attack ontology

With the ontology crystallization method, are required to construct the complete phishing ontology with only little expert assistances. Moreover, we have designed a simple phishing case evaluation form to help summarize the analysis results of the collected phishing cases as shown in Table 1.

The summarized analysis results of the collected phishing cases can also be used for phishing knowledge construction or assessment. Now, we would like to introduce the experiment to help perform and examine the ontology crystallization process.

Table 1. Phishing case evaluation form

Phishing Stories	Phishing scenario Attack techniques
Someone received an authorization code request for small amount of payment after clicking on a malicious website.	SMS, website links, small payments Website redirecting, malware
In a Taipei MRT Station, there is a very attractive tourist advertisement with the printed QR code to attract the attention of mobile phone users to download a suspicious .apk program.	Marketing advertisement, QR code URL with a hidden and malicious link
Hackers use the e-mail of a car parking system, requiring people to access the designated malicious website to defraud the personal profile.	e-mail with fake sender information, popular URL links malicious website, social engineering
Hackers set up a free hotspot AP, no password needed, to intercept network data to crack the password of mobile phone users.	Free resources, fake Wi-Fi hotspot DNS kidnapping
Through FACEBOOK instant message service, users are required to confirm their account; otherwise, it will be blocked.	Social networking platform, instant message fake website
A lot of complaints about poor maintenance services are obtained due to visiting fake official website.	Search engine, website ranking, website links Search engine poisoning

In our experiment, ten university students are involved. Firstly, they need to learn the network security knowledge through the traditional material and the normalized typical phishing/anti-phishing cases. Five randomly selected cases are further provided, and then they are asked to analyse the cases to tell the difference between the discovered features and the similar ones by filling out the phishing case evaluation form. Therefore, all the new concepts or new options can be used to refine the existing phishing ontology by our ontology crystallization method.

After the experiment, we interview the students to know the difficulty of learning new concept or knowledge on phishing/anti-phishing topic during the ontology crystallization process. We can find that the students can easily understand the content of the simple email attack and can correctly fill out the form, but some complex attacks or mobile phone attacks are difficult to understand for non-IT background students. The possible reasons are that the traditional email attacks can be easily detected, the mobile devices attacks are likely ignored due to the belief of safety of the personal communication with close friends through mobile devices, and some ICT literals are difficult to understand for non-IT background Students.

In the near future, we will further use CBR (Case-Based Reasoning) methodology to explore the relationships of all the collected cases of phishing attack techniques and phishing scenarios to predict some possible new phishing cases with the knowledge base.

IV Development of Anti-Phishing Learning Card Game

To enhance the structure of the knowledge of network security attack and defence, we further apply Bloom taxonomy of cognitive psychology to restructure it. In other words, we transform the knowledge into the strategy knowledge from the educational point of view. The strategy ontology is then designed corresponding to the six levels of Bloom taxonomy, knowledge, comprehension, application, analysis, synthesis, and evaluation levels, respectively.

According to Bloom cognitive psychology, in Figure 7, the network analysis layer is composed of damage avoidance and data theft avoidance; the network application layer is composed of offensive material damage, resource depletion attack, computer hostage attack, data theft offense and defense, and phishing scams; comprehension layer consists of 10 subclasses; and knowledge layer consists of 20 subclasses.

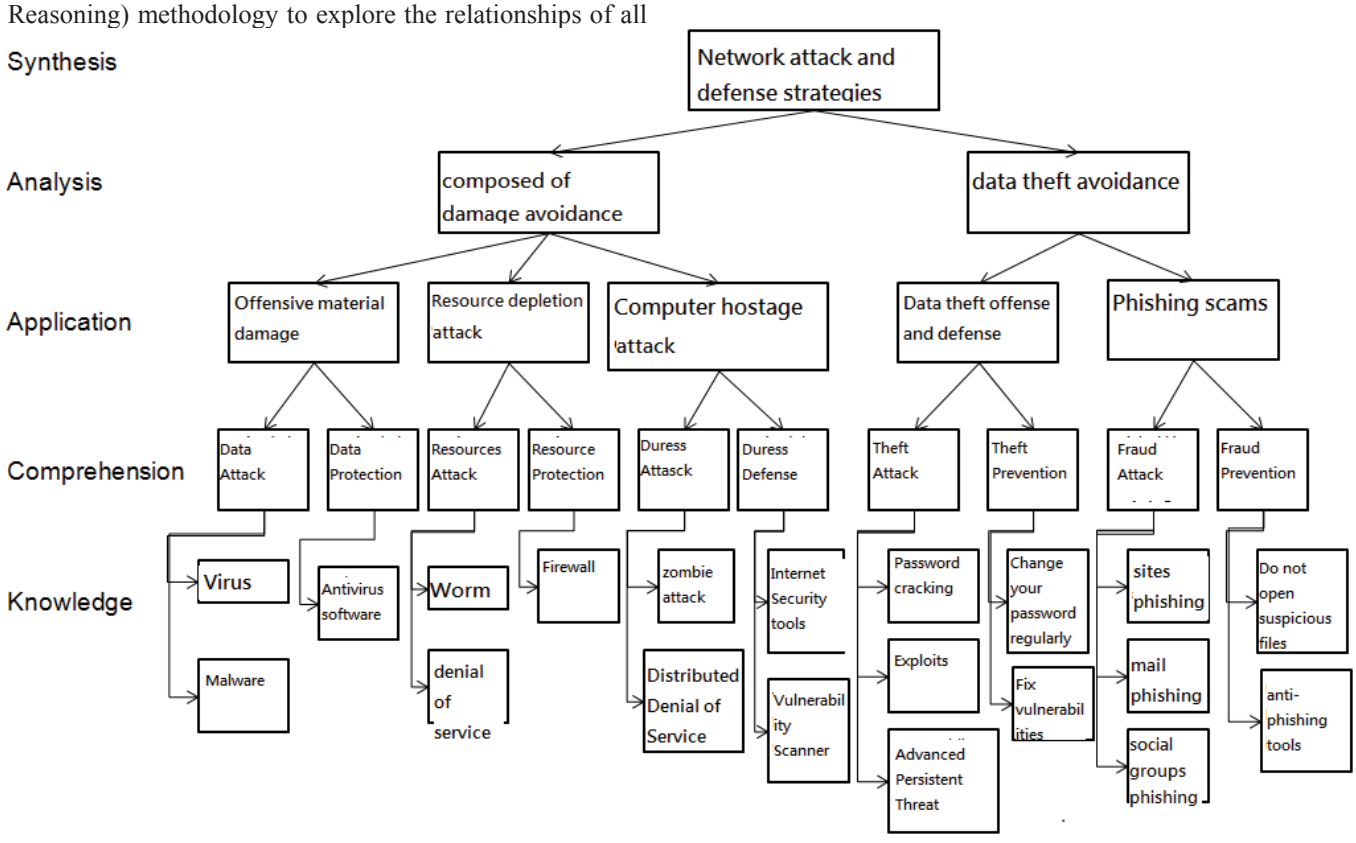

Figure 7. Network attack and defense strategies ontology

After building the complete network attack and defense strategies ontology, we can further design learning activities in the network security field for the assessment of different parts of domain knowledge. In Table 2, the relationships between the learning activities and the roles including the basic concepts, the comprehensive concepts, resources understanding, behavior understanding, strategy understanding, and evaluation understanding are shown.

Table 2. The relationships between the learning activities and the roles

	Domain knowledge	Game elements
Basic concepts	Types of viruses and hackers	Attack role
The comprehensive concepts	The concept of anti-virus and phishing prevention	Defensive role
Behavior understanding	Virus and hacker behavior	The role of action rules
Resource understanding	Computer memory, computing power and money	Game action and resource constraints
Strategy understanding	Network attack and defense strategies	Offensive and defensive strategy roles
Evaluation understanding	Internet Defense Effectiveness	Game winner and scoring rules

With this approach, we have designed a battle card game called iMonsters, and its game rules are shown in Table 2.

Table 3. iMonsters card game rules

Game Rules	Description
Game cards and accessory	Website cards, network monster card, dices for recording resources, and the wooden blocks for recording the site held.
Game playing procedure	Each player draws a website card first and five role cards at the beginning, where different websites have different initial token resources and computing powers, and all the other websites are called public websites. Player takes turns to use resources to summon monsters role card, or use role cards monster to attack or defense.
Resource constraints	The strength of each player will be increased by one per round.
Attack public website	Players can attack the public website to gain additional resources.
Winning rules	The player wins if he/she accumulates more than 20 tokens, or the blood of another player becomes zero.

During the game playing, the players take turns to use resources to summon monsters role card, or use role cards monster to attack or defense by taking the following attributes into consideration: the concepts of network viruses, phishing, hacker attacks, the favorite strategy or character of role card, accumulated tokens, and current strength. Table 4 shows several different types of role cards and their properties, including type, name, the strength, etc.

Table 4. Properties of the role cards

Role Cards	Card Properties
	Card Type: virus attack Name: Phishing Piggy Attack: 1 (social engineering attack) Waiting time: 1 round Consumption of token: 1 Computing power consumption: 0 Occupancy Memory: 1
	Card Type: defending player Name: Super Rabbit Defense: 5 (system security update service) Consumption tokens: 2 Computing power consumption: 0 Occupancy Memory: 1
	Card Type: hackers Name: Script Kiddie Attack effect: the opponents should wait one more round (denial of service attacks) Waiting time: 2 rounds Consumption tokens: 0 Computing power consumption: 2 Occupancy Memory: 3
	Cards Type: Website Name: auction site Initial vitality: 15

The game playing scenario is shown in Fig. 8. Through the practice of card game playing, we can find the students can understand the properties of different viruses and attacks. With proper use of roles, they can further comprehend the complicated concept and resource properties. Moreover, the problem of how to make the best use of limited resources in the game, which is the most effective action to play, is very interesting and challenge. We are trying to write the handbook to guide students to explore the impact of combination attack/defense and understand the overall effect of the outcome of the combination actions.

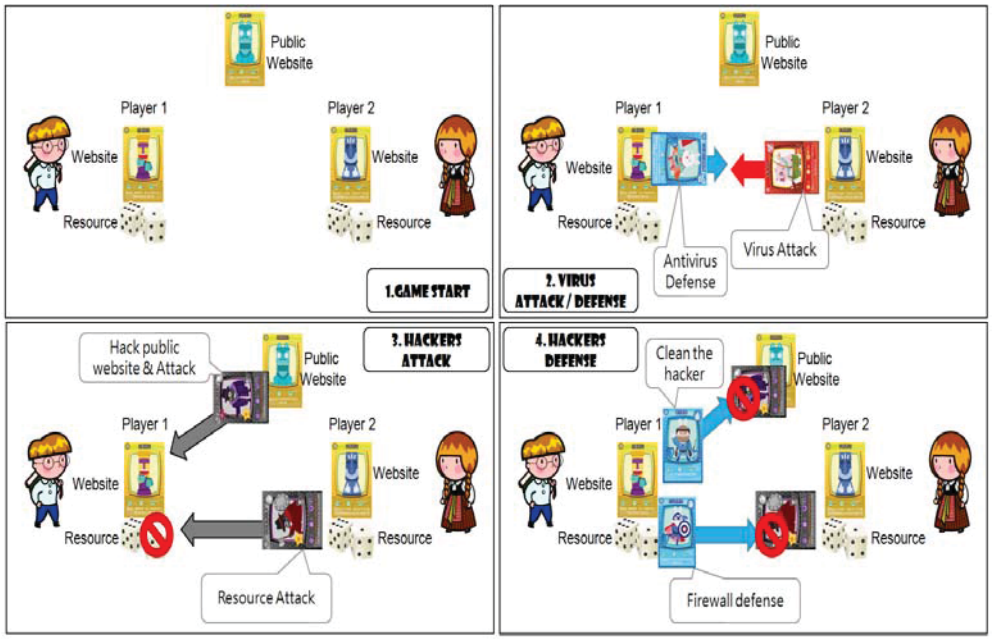

Figure 8. Games virus, hacker attack and defense scenario

Phishing ontology crystallization process also can be done during the iMonsters card game playing. Through the discussion of the used cases, we can also enhance the phishing ontology by the bottom-up way.

V. Conclusion

Due to the rapid changes of context in phishing attacks, in this paper we use the ontology crystallization approach to building the phishing scenario knowledge base and phishing attack knowledge base, and then the efforts and the time spent in the knowledge construction process can be reduced. Besides, different game-based activities have been designed according to Bloom cognitive psychology theorem to enable students easily understand the network security attack and defend knowledge. According to our experimental results, game-based learning can not only assist students learn network security knowledge, but also help them to highlight the differences between different viruses, phishing attacks and other attacks during the game playing. Furthermore, iMonsters card game allows students to actively participate in the discussion of the relationships between the network attacking and defending.

Acknowledgment

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References

[1] Phishing Scams: Understanding the latest trends, June 2004.
[2] Ming Qi and Chang-Yi Zou, "A study ofanti-phishing strategies based on TRIZ",Proceedings of the International Conferenceon Networks Security, WirelessCommunications and Trusted Computing, pp.536-538, 2009.
[3] Carly Wilson and David Argles, "The fight against phishing: technology, the end userand legislation", Proceedings of IEEE, pp.501-503, 2011
[4] Bay (2011), http://pages.ebay.com/education/spooftutorial.
[5] Microsoft(2011),http://www.microsoft.com/athome/security/email/phishing.mspx.
[6] Dennis, D., William, R., "Games are made for fun": Lessons on the effects of concept maps in the classroom use of computer games. Computers & Education, 56(3), 604-615, 2011
[7] OnGuardOnline(2011), http://www.onguardonline.gov/games/phishing-scams.aspx
[8] Gorling, S., The Myth of User Education, in Proceedings of the 16th Virus Bulletin International Conference, 2006
[9] Admiraala, W., The concept of flow in collaborativegame-basedlearning, Computers in Human Behavior, P 1185-1194, 2011
[10] Papastergiou, M., Digital Game-Based Learning in high school Computer Science education:Impact on educational effectiveness and student motivation, Computers & Education 52, page 1–12, 2009
[11] Sheng, S., Magnien, B., Kumaraguru, P., Acquisti, A., Cranor, L. F., Hong, J., & Nunge, E. (2007, July). Anti-phishing phil: the design and evaluation of a game that teaches people not to fall for phish. In Proceedings of the 3rd symposium on Usable privacy and security (pp. 88-99). ACM.
[12] Paypal(2011),https://www.paypal.com/au/cgi-bin/webscr ?cmd=xpt/Marketing/securitycenter/antiphishing/CanYouSpotPhishing-outside.
[13] VeriSign(2011),https://www.phish-no-phish.com/default.aspx
[14] Tsung-Ju Lee, et al. "Game-based Anti- Phishing Training", Proceedings of the TWELF, 2010
[15] Weng, Jui-Feng. " A Self-Organizing Behavior Modeling on Programming e-Learning." Ph. D. Dissertation, Department of Computer Science, National Chiao Tung University, Hsinchu, Taiwan, R.O.C., Dec. 2010.
[16] Lin, Hsin-Nan, et al. "An iterative, collaborative ontology construction scheme." Innovative Computing, Information and Control, 2007. ICICIC'07. Second International Conference on. IEEE, 2007.
[17] Tseng, Shian-Shyong, et al. "Building a Frame-Based Anti-Phishing Model based on Phishing Ontology.", Proceedings of the AIT2013, 2013

Research on community resident autonomous learning based on virtual learning

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Abstract - *Community resident learning is the key part of lifelong education. In the era of mobile Internet, virtual learning is becoming more and more important. Nowadays, there are some problems in community resident autonomously virtual learning, which affect learning quality. Aiming at the current state and problems of community resident virtual learning, we investigate how to improve community resident autonomous virtual learning ability, based on the theories of connectivism, constructivism, humanism and distributed cognition*.

Keywords: Community resident; Virtual learning; Autonomous learning; Strategy

1 Introduction

John Dewey, in his book *Democracy and Education*, introduced learning communities in teaching, thought that learning was for getting knowledge and ability by interactive activity of mind and emotion among learners, and persons' learning can't be separated from interaction with environments. With the rapid development of mobile Internet technology and smart equipment, people's studying ways were greatly changed, there are more channels for receiving information, and studying time is becoming more and more of fragments. Persons' studying more relies on networks and increacing people, by virtual studying platform such as MOOC (Massive Open Online Courses), WeChat, QQ and Weblog, go to virtual learning community to study.

Communities are basic units of the society and residents in some regional space. Persons residing in communities are called community residents. Modern people's life, from birth to developing, depends on communities and is restricted by community environment. In all of phases of lifetime, persons receive all kinds of education including not only school education but also society education, or formal education and informal education.

Virtual learning is one important means of lifelong learning for community residents in modern society. It is one kind of online learning ways. Network platform is its interactive interface. Among it, learning groups, interactive environment and existing relations constitute virtual learning communities. Learning groups in Internet communicate, exchange and share all varieties of learning resources with one another. It comprises remote school education which includes college network education with record of formal schooling, college network open courses, all sorts of network schools and so on, and remote society education that involves online learning website, weblog, BBS (Bulletin Board System) and so forth. Harvard University Internet open courses, Tencent QQ forum, Baidu post bar, Sina Blog, Tencent WeChat and MOOC Cloud classroom provide shared platform of knowledge spreading. In recent years, massive online open courses are fashionable in the world. Virtual learning breaks restriction of time and space, helps people construct shared information resources in greater range, promotes human being culture propagation and civilization exchange, and powerfully drives social development.

The United States and other developed nations, in 1970s, proposed the conception of autonomous learning. In 1990s, American scholar B.J. Zimmerman synthesized opinions of all kinds of school thoughts and greatly developed autonomous learning theory. Autonomous learning is one kind of modern learning means compared with traditional reception learning. In the learning way, learners are the principle part of learning and realize learning objectives by learners' independent analysis, searching, practice, query and creation.

According to different ways of taxonomies, there are several varieties of modern community resident autonomous learning. In content, community resident autonomous learning can fall into the classifications of education background, technical ability, relaxation and entertainment. In form, it can be individual or collaborative. In function, it can be formal or informal. In studying media, it can be online or offline. Online learning is one important means for community residents.

In the paper, we will organize the content as follows. In Section 2, we will analyze current situation and existing problems of community resident virtual learning. In Section 3, community resident virtual learning autonomy training strategy will be proposed. Finally the conclusion will be drawn

2 Current situation and existing problems of community resident virtual learning

We have come into the era of lifelong learning. Community resident learning is the core content of lifelong education. However, the complexity of community residents easily makes community education only of form. Residents' autonomous learning is the key problem. Mr. Wei Hu, in the book *Make learning become one living way*, mentioned that in

the times of information, knowledge updating time is shorter and lifelong learning becomes more and more important. One Indian engineer, in his flight, noticed that after the lights were turned off, those who were playing with iPad and didn't sleep were by and large Chinese. They were playing games and watching movies and no one was reading. Not only in flight, but also in long-distance buses, metros and buses, a lot of children, youths and middle-aged adults are addicted to games, films and movies. The development of online education and social networking services is making education activities more flexible and convenient. It can motivate learners' interests and promote collaborative learning. Although to some extent, virtual learning has more advantages than traditional education, the autonomy of virtual learning are facing many challenges.

With more abundant network learning materials and quick development of social networking, people more depend on network learning. In 2014, the authors investigated five typical communities in Shanghai; the statistics showed that on average each person spent more than three and a half hours online, if on holiday, it was longer. Some persons surf the Internet for the sake of searching learning materials and watching network teaching videos, or in virtual communities, study, exchange, communicate and share learning resources. But, people in virtual learning communities can't do what they want to do in the course of all studying. Seeking mass information often makes learners lose heart.

The era of big data derives from mass information and its explosive increasing in Internet. In the beginning of 21st century, the global data quantity was about several EB (ExaByte), which is tens of thousands of times of total books in the world. In the present age of mobile Internet, Internet of things and smart mobile equipment such as smart phones will generate more data, and global data quantity has rapidly added to the level of ZB (ZettaByte). How much is the "big data" on earth? International Data Corporation (IDC) showed that in 2011 global data was 1.8 ZB or so. If we use DVD compact disk of 9GB to store them, the total height of all needed CDs will exceed two hundred sixty thousand kilometers, about second thirds the distance between the earth and the moon. Moreover, in the age of big data, with the rapid development of mobile technologies and social contact media, among persons new interactive means are being constructed. Therefore, the scale, speed, classification and complexity are far beyond cognition and response ability of human brains. On one hand, people need study by virtual learning. On the other hand, persons hope computer intelligent systems to help human beings think about and solve problems.

For example, people search required information from mass information. Previously, artificial rules usually are used. Nevertheless, when to some extent data are accumulated, the system with this kind of artificial rules can't exactly understand learners so that it can't provide personalized services and has much disadvantages.

Because cognitive systems during intelligent interaction with people provide them with all kinds of information supporting, lots of structured and non-structured data have to be analyzed for the sake of processing obscure information and finding inherent relevance and trends. So, cognitive systems are not limited by predefined rules by experts any more, but on their own learn conceptions from big data, analyze conceptions and mine relations among them and set up big data models of scaled and intelligent machine learning.

Virtual learning is faced with not only the difficulty of big data cognition, but also obstacles from software and hardware, reality and reliance of learning resources, differences of languages and culture, acknowledge of society and psychology and conflict from responsibility and obligation. Furthermore, it will face the problem of how to increase learning efficiency. Therefore, if learners can really make it come true to get autonomously virtual learning, there are still many open problems to solve.

3 Community resident virtual learning autonomy training strategy

Educators' anticipation is to have learners acquire innovative education where they get knowledge by themselves from passive filling type education where they are required to learn, that is to say, learners can autonomously learn. Compared with traditional education, virtual learning has a number of advantages such as no restriction of space and time, flexibility, convenience and higher autonomy. But, autonomy of virtual learning need be cultivated.

3.1 Scenario establishment of constructivism

In the field of vision of lifelong education, community resident autonomous learning focuses on interior quality of learning, different from rote learning and passive learning by teaching. The theory of constructivism is the main theoretic foundation of autonomous learning. Learning theory of constructivism suggests that learning is the course of constructing internally psychological expression on learners' own and underlines autonomy, situationality and sociality of learning. That is to say, learning patterns should focus more on learners' construction and organization of knowledge, it is stressed that knowledge should be constructed by mutual interaction between cognitive subjects and objective settings, and all varieties of influence effects in learners' learning environment should be researched.

In the era of mobile Internet, in order to trigger community resident learning autonomy, software and hardware platform for autonomous learning must be set up to establish scenarios for autonomous learning. People usually attach importance to accumulation of software resources – information content, but neglect construction of technical support of learning platforms.

Virtual community learning needs multimedia technology to integrate graphs, texts, audios and videos. Virtual reality technology is required to finish interaction such as the representation of reality by special input perceiving equipment and some multi-dimension output equipment. It also requires network communication technology to efficiently gather information from learners in real time to break the restriction from regions and time for the purpose of communication and

exchange among learners. Therefore, virtual learning relies on the development of network and electronic communication technology, and maturity of some key technologies such as bandwidth, video quality and guarantee of online sharing tools. However, incompatibility among technology decreases residents' learning interests, for example, smart phones not supporting Android system can't login WeChat. Similarly, mobile Internet equipment not supporting Android system can't login MOOC cloud classrooms supporting Android system. Even if smart phones with Android system are used, because operating systems are not compatible with installed applications by users, the configuration for core functions is not compatible, and equipment providers have no updated strategies, it will result in large loss of mobile learners.

Present virtual community learning platforms have some shortcomings such as incompatibility between PC operating systems and mobile platforms, incompatibility between iOS (mobile operating system from Apple Corporation) and Android systems, and deficiency of mobile learning experiences and shared functions. Most of virtual community learning platforms solve the problem of video playing across terminals by adopting HTML 5. Virtual learning communities should provide similar scenario creation and learning experiences like PC platforms to make mobile learning terminals have not only functions of video playing, but also functions of exchange, group discussion, exercises and voting for the purpose of free switch between desktop systems and mobile systems. By integrating WeChat public platform open interfaces, in WeChat friends circles, it is realized to share course content. Relying on large-scale users of WeChat and other social contact platforms, by functions from interactive answer questions based on WeChat public service, and discussion learning based on WeChat grouping, community resident learning autonomy can be activated, providing community residents with free community Wifi to use.

3.2 Connectivism resource integration

Connectivism was proposed by Canadian scholar George Siemens and was the product of the age of digital network. Connectivism suggests that learning is not just personally psychological activity of learners, but one connection procedure and one learning model adapting to current social structure changes. Because social structure is changing, people's needs and learning ways are changing as well. In the era of network, knowledge is increasing in exponential order and exists in form of fragments. Individual knowledge reserve and management space are contradictory with explosive increasing of knowledge. Thus, the means of knowledge acquiring are more important than mastery of knowledge. So, studying is where knowledge connects, recombines and recycles by different forms. In addition, connection studying is of society and drove by interests. Connectivism provides community residents with ways and methods for autonomous learning. Connectivism derived from the age of digital network, suggests that knowledge exists in multiple channels, and the ways of acquiring knowledge are more important than mastering knowledge. In order to promote sustainable learning, it is needed to cultivate and maintain connection.

Community residents have common characteristics with social groups: groupment, distributivity and autonomy. As connectivism shows, in the course of virtual learning, community residents' individual knowledge and relations form one small network, which is integrated into all kinds of organizations and structures, whose knowledge is connected, changed, expanded, and further transmitted to individual networks, which serve personal continuous learning. Thus, organizers for community resident learning should provide community residents with necessary services such as learning resources, learning platform tools and related connection service.

Firstly, integrate learning resources. On one hand, provide community residents with appropriate needed learning resources with all kinds of majors for autonomous learning. On the other hand, basing on abroad and excellent learning resources, provide Chinese with online learning service suiting community resident learning. Take as one example, Coursra, one of three MOOC giants in the world, released the project plan of crowdsourcing The Global Translator Community (GTC) and agreed with cooperators to make captions for Coursera courses to help learners from non-English-speaking countries to more conveniently use their MOOC. Secondly, provide learning tools and platforms. By using mobile communication technology, multi-media technology and relevant IT technology in the age of big data, through MOOC, Facebook and so on, provide community residents with network learning connection platform, learning tools and other suitable software and hardware equipment. Thirdly, optimize internal and external networks, and reinforce connection service. The following three connections should be noted: connection among virtual learning platforms such as the one among schools, families, communities and museums in order to develop free connection of learning settings; interaction between people and machines such as mobile inter-connection for increasing human-machine collaboration; inter-connection among persons such as setting up community resident virtual learning network by WeChat group, QQ group, WebBlog and Email to promote networking communication in the course of teaching and studying.

3.3 Decentralized construction of distributed cognition

In the middle 1980s, Robert Maynard Hutchins et al. from University of California proposed the conception of distributed cognition, thought that knowledge exists in different positions and cognition is distributed in brains and external environment, especially structure and time of society and culture, and stressed that learning resources should be decentralized.

Virtual learning communities are learning collections where physics, society and culture are of distribution. Their learning individuals, personal learning time, learning resources and environment are of distribution as well. Their knowledge dissemination complies with sociology distribution cognition theory. It permits mentors, learners and learning

contents to distribute in different non-centralized positions and makes teaching and learning independent of time and space. It makes real open education, lifelong education and universal education possible and is an efficient path to increase development of learning society. It underlines non-centralization of resources, eliminates teachers' absolute authorization, changes traditional teacher-centered patterns into learner-subjected ones, and makes learners have bigger initiative and autonomy. It focuses on scenarios, construction, cooperation and exchange, and provides students with individualized learning schemes to make learning not depending on top teachers and classrooms. Learners are resources providers and receivers. For example, MOOC has several innovations on online education. Learners who are of distribution can share rich distributed course resources. In the distributed learning, learners own more initiatives and accelerates changing from "want me to learn" to "I want to learn". This is learning idea updating.

Big data overturns famous teacher effect. Community resident learning organizers necessarily need self-adaption to meet learners' requirements. Thus, it is required to distribute educational resources to sufficiently embody education fairness.

3.4 Humanistic content pushing

Humanistic learning theory originated from Abraham Harold Maslow's self-actualization and Carl Rogers's personality ego psychology and learner-centered self-actualization education. Humanism suggests that human beings own learning potential in their blood and anticipation of self-actualization, educational fundamental objectives are guiding learners' self-actualization, and educational key aims are to enlighten learners' soul to have them liberate, discover and go beyond themselves.

Due to big differences among community resident individuals, particularly the differences among learning ability, learning style and learning strategy, makes personal learning procedure very different. In addition, different community residents have different learning needs. One learner has different learning needs in different learning stages. Therefore, teaching content and methods with "one size fits all" is not suitable for all community residents. One of means of solving the problem is community resident autonomous learning. Thus, community education should fully respect learners' personality and individuality. Learning content should be designed according to students' potentials and personality development. It should be done to consider learners' psychological sensing and behavioral habits. Furthermore, perfect importing of new technology, new tools and new conceptions provides diversified learning resources.

3.5 Social identification and stimulation

Low cost, social identification and having learners acquire experiences of successful learning, benefit cultivating learners' interests and increasing learners' initiative and autonomy.

(1) Encourage community residents to join in virtual learning community for free education

community residents have otherness of cognition degree and knowledge base. Traditional education has higher requirements of enrollment, tuition and learning cycle, and makes community residents shrink back at the sight. Online education based on MOOC is one good choice, as online virtual learning materials are abundant, materials getting is convenient, prices are low and learning time is of freedom. It pretty suits community resident autonomous learning.

(2) Construct virtual learning testing and certificate stimulation schemes

Community residents finish online virtual learning, pass related testing, and are eligible to get corresponding academic certificates and non-academic certificates. It can stimulate community residents' enthusiasm for virtual learning. The United States integrates training, evaluation and promotion, and stimulates the public's positivity for autonomous learning.

(3) Study in order to apply and increase social sense of identity

Our society is composed of communities and should make each social member fully sense the dignity of existence. Besides setting courses for different majors, some courses on psychology and laws should be appended. Study is for applying. Encourage old persons on their own intention to participate in some social work to provide their contribution. Let them sense that they are useful. Increase their social sensing of belonging and social sense of identity. The kind of sense of belonging and identity is the source of social public spirit and is the root of establishing learning society. Having this kind of sense of belonging and sense of identity, each community resident's potential ability can become the consciousness of autonomic learning with some possibility.

4 Conclusions

Learning once for "charging" in the life had become history. The theory of storage battery told us that one high energy battery can only store limited electricity. As long as keeping charging, it is possible and sustainable to keep releasing energy. Human beings' brains are one kind of high energy storage battery. Life is one procedure of keeping studying. In the times of big data, social network incredibly grows, intellisense is increasingly increased, updating period of knowledge is becoming shorter, and new ideas and new knowledge are emerging endlessly. Virtual learning by its advantages of quick charging for brains is being loved by people of all ages and levels. However, community resident virtual learning autonomy needs cultivation. Aiming at current situation and existing problems of community resident virtual learning, basing on connectivism, constructivism, humanism and theory of distributivity cognition, the authors discussed how to promote autonomy of community resident virtual learning. With the development of information technology, lifelong learning and autonomous learning for community residents will be and are being one main topic forever.

5 Acknowlegements

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6 References

[1] Junhua Yin. “Introduction to Educational Technology” . Beijing, Higher Education Publishing House, 2002.

[2] Fengying Li, Yuxin Qi and Qingshui Xue. “Research on Security of Virtual Learning Community Based on Big Data：Collaboration Learning System Based on Threshold Proxy Signature“ ; Journal of Distance Education, 76-82, April 2013 (in Chinese)

[3] Fengying Li, Qingshui Xue and Haixia Li. “Research on Energy Expenditure and Strategy of MOOC “ ; Modern Distance Education Research, No. 6, 69-78, 2014 (in Chinese)

[4] Enhong Chen et. al. “Personalized Recommendation Technology of Mobile Scenario Perception“ ; Communications of the China Computer Federation. No. 6, 18-23, 2013.

Evaluating presence perception in video-mediated activities in real time

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Abstract - *Video mediated activities are used for diverse purposes, such as education, work, games, internet, mobile devices and leisure. Presence perception is a psychological characteristic related to engagement, involvement and attention, which are important for performing tasks, especially educational. As presence perception evaluations have been a challenge to researchers, methods applying physiological and psychological data were used in this evaluation. This research presents a tool developed to evaluate presence perception in video-mediated activities in real-time, making use of gaze tracking technologies. Eye and gaze tracking have been studied since the 19th century. Currently, the most advanced gaze trackers use video oculography techniques to indicate where the person is gazing. Two experiments were conducted. The first uses a stressful video with stressful audio and the second uses a stressful video with relaxing audio. The results show significant differences between them, which illustrates and validates the uses of the developed tool.*

Keywords: Presence Perception, Gaze Tracking, Evaluate, Video, Education.

1 Introduction

Video is a powerful medium once it can present information in attractive, consistent and linear ways. Advances in information and communication technologies have enabled the development of powerful e-learning tools based on interactive instructional videos. Interactive or not, video-mediated activities are widely used in e-learning [1].

The most commonly used technologies for e-learning are internet multimedia, video streaming, web conferencing, instant messaging, blogs, wikis, virtual worlds and digital games. With the miniaturization of components and the expansion of wireless communication, the technologies mentioned above reach people through mobile handheld devices such as tablets and smartphones [2]. Distance education and some classroom activities are also video-mediated. Even 3D applications, such as Second Life and OpenSim, immersive or not, are mediated by video. Eye and gaze trackers have been studied for a long time. The first studies took place in the 19th century with works by Louis-Émile Javal [3]. However, gaze trackers became robust enough for field use only recently [4].

The first Trackers used direct observation with the help of mirrors, lenses attached to pens and photos, making the process very invasive [3].

Currently, these devices use video cameras, infrared light and tracking software [5]. Inexpensive commercial gaze tracking systems [6][5] are available, despite having less precision and frequency compared to expensive equipment [7][8]. The first option is more practical and open software platform is available [6].

This paper presents an approach and a tool to perform presence perception evaluation for video-mediated activities in real time. The approach considers the relationship between presence perception and conditional entropy of gaze tracking [9]. The tool developed uses inexpensive eye tracker and a program developed in Java. The program receives data from the eye tracker and provides values of conditional entropy (Hc) and intermediates conditional entropy (Hci), further than plot the scanpath.

2 Attention, perception and sensation.

Perception is a complex process that depends on both, the environment and the person that perceives it [10]. It is a conscious sensory experience that occurs when electrical signals representing a sensation are transformed by the brain into a meaningful experience that involves recognition and action. Recognition is the ability to place an object in a category and action is one causing the motor activity of perception [11].

Among sensation, perception and attention, there is a very strong relationship, not yet fully elucidated by science (Figure 1). Despite the lack of completion, researches have continued and of all the human senses, the most widely studied is the visual perception, since it is the primary mean of recognition and orientation for interacting with the objects that surround us. Maybe this is why the most advanced research of the human perception uses vision [12][13].

Some researchers work with the hypothesis that the perception of presence happens bottom-up, assuming that the stimulus is what leads to perception (perceptual illusion) [14][9]. There are, however, studies that assert that perception and cognition are top-down processes, that is, the mind is the one leading to perception (illusory perception) [15]. There is no perception without stimulation and the bottom-up, or database processing, happens when we receive input data or

stimuli. The top-down, or knowledge processing, happens by processing prior knowledge of the stimulus [11]. E.g. what do you see in Figure 2?

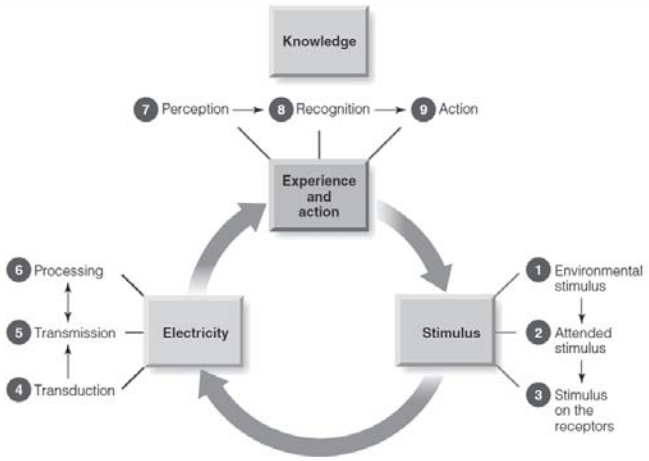

Figure 1 – Perceptual process [11].

Figure 2 – Vintage Photo – A woman, man and a face – bottom-up perception. A woman, a man and a child – top-down perception [16].

3 Presence Perception.

The term telepresence was first used in 1980 to refer to the teleoperation technology that provided users with "remote presence" through feedback systems, allowing them to "see and feel" what is happening at a different place [17]. Currently, most researches do not differentiate telepresence from the broader concept of "presence". In this work, despite the focus being telepresence, the broader concept of "presence" is used.

Studies conducted in 1997 formally defined that "presence" is the "perceptual illusion of non-mediation", when the user fails to realize or to recognize the participation of technological mediation and behaves as if the medium does not exist [18].

This definition is limited to technologically-mediated situations (also known as second order experience) [19], e.g., teleconferencing systems. Several authors now follow the same concept [20][21][22][23].

Considering that everything we feel and perceive is captured by the our sensory system, which provides us with information by interacting with the environment, it can be assumed that even without technologically-mediated interactions, we do have mediations [24]. We call this phenomenon of "natural mediation" first-order experience [19].

Several researchers consider only the phenomenon of presence perception in second-order experience [17][23][25][18], while others regard presence perception as a psychological state that occurs independently of the use of technology [21][26][27].

This research considers the top-down and bottom-up perceptions. First and second-order experiences are also considered.

There are several methods and techniques to assess presence perception and the most prominent are the physiological and psychological methods. Physiological methods use sensors to capture physiological signals from the subject and psychological methods use of questionnaires. The most widely used questionnaires to assess the presence perception are PQ [28](top-down), SUS [29](bottom-up) and IPQ [30][31](top-down and bottom-up). However, the use of questionnaires as the reference standard for evaluating presence perception has been criticized [32][33].

A paradigm shift was proposed in 2009 for presence researches and a new line of research began. Some researchers believe that presence is how a virtual environment can cause a user to respond as if it was real, concept presented as RAIR (Response As If Real), which replaced the widely accepted definition of the perceptual illusion of non-mediation [34].

Considering the new concept, a study was conducted to verify the existence of a relationship between the perception of presence and eye tracking [9]. The results indicated a relationship between conditional entropy and presence perception. Significant variations in the conditional entropy values were observed, which was consistent with the presence perception results from the electrodermal responses and the questionnaire [9]. It was also shown that head movements are also related to presence perception and, because the movements of the head were tracked, this relationship was more appropriate [9].

Tool to evaluate presence perception using gaze tracking technologies.

The relationship between presence perception and eye tracking is obtained by calculating the conditional entropy of the fixing points of the gaze movement [35][36][9]. The Equations are presented below:

$$H_c = -\sum_{i=1}^{n} p(i)\left[\sum_{j=1}^{n} p(i \to j)\log_2 p(i \to j)\right], i \neq j \qquad (1)$$

p(i, j) is the probability of transitioning from region i to j. It may be considered as the number of i to j transitions divided by the total number of transitions.

p(i → j) is defined as the conditional probability of transitioning from region i to j, assuming region i as the starting point:

$$p(i \to j) = \frac{p(i,j)}{\sum_k p(i,k)} \qquad (2)$$

p(i) is the marginal probability of foveating region i, estimated as:

$$p(i) = \sum_k p(k,i) \qquad (3)$$

For this paper, variables i and j correspond to 64 screen divisions.

According to the information theory, the less information about a system, the greater its entropy; conversely, the more information about the system, the lower its entropy [37]. That is, they are inversely proportional values and the same applies to presence perception: Increased presence perception (increased meaningful interpretation) is indicated by lower values of conditional entropy and lower perception of presence (decreased meaningful interpretation) is represented by higher values of conditional entropy.

Scanpath was not used to perform the calculation of the conditional gaze tracking entropy in three-dimensional environments; instead, we considered the crossing of the line-of-sight of the gaze with a polyhedron of 20 or 80 faces, ignoring the information about the depth of the gaze [9]. In this research, this adjustment is not required as it uses only two-dimensional images, thus allowing the use of actual scanpath data.

Another function of the polyhedron was to determine a maximum number of states to calculate the conditional entropy; in this case, each face of the polyhedron corresponded to one state. A small number of faces could lead to lower entropies while very large numbers lead to greater entropies. Consistent data were obtained from 80 faces [9]. This type of division is also required for the two-dimension cases; therefore, this study uses 64 divisions.

To calculate the conditional entropy, at least two fixations and one change of state must have occurred (or fixations in different quadrants). Previous work performed calculations every 30 seconds [9]. This research considered the minimum conditions for initiating the calculations, i.e., two fixations and one change of state.

Hc will be considered the final entropy obtained after the volunteer completes the experiment. The Hc values are accumulated during the video display. Intermediate conditional entropy (Hci) is also calculated while the volunteer watches the video. To calculate Hci, equations (1), (2) and (3) are used. Hci and all variables used to calculate it, are set to zero as soon as no transition between the regions occurs. This approach to the calculation of Hci provides information about the variation of the conditional entropy all along the video display. This procedure was adopted because it considered that the moments when there is no change on the region, Hci is zero. For specific periods of time, Hci is the arithmetic mean obtained for that interval, as shown in equation (4)

$$\text{Hci} = \sum_{\text{j}} \frac{\text{Hci}_\text{j}}{\text{j}} \qquad (4)$$

The IPQ questionnaire was chosen to evaluate presence perception, as it joins the main features of the PQ and SUS questionnaires. IPQ has 3 independent variables and one general variable related to the other three, mainly to space presence. These variables are: Spatial presence (SP - feeling physically in the virtual environment), involvement (INV - experienced Involvement), experienced realism (REAL - subjective experience of realism) and an additional general item assesses the general "sense of being there" (G). 14 questions were added to IPQ to obtain the stress levels of the volunteers for each of the 13 video snippets. Volunteers regarded 0 as no stress and 4 as maximum stress.

Eye Tribe gaze tracker was used for gaze tracking since it is inexpensive and nonintrusive.

To avoid external interference, an intra-atrial headphone was used and to achieve more accurate data, a chin rest was provided, maintaining the volunteer's head as still as possible.

The connection between the gaze tracker and the computer is made via a USB 3.0 port. To collect data and compute the calculations of Hc and Hci, a program was developed in Java. Hc was reported at the end of the video display and Hci was informed in real time.

Results and analyses.

Two experiments were conducted to validate the tool. One used a stressful video with stressful audio and the other used a stressful video with relaxing audio. The stressful video contained 13 video clips with images of spiders, snakes, sharks and stressful situations. These videos were the same for both cases, except for the audio. Sounds with fast pace and rapid tone changes were regarded as stressful audio, while sounds with slow pace and without abrupt tone changes, as relaxing . Figures 3 and 4 show images of two video snippets (the original is a color video). Figure 5 shows the screen with the 64-division grid.

Figure 3 – Image of the fourth video snippet.

Figure 4 – Image of the eleventh video snippet.

Figure 5– Image of the eighth video snippet and the 64-division grid screen.

22 volunteers participated in the experiment, 11 experienced the stressful video with stressful audio (EVEA) and 11 experienced the stressful video with relaxing audio (EVRA).

The averages of the results from EVEA and from EVRA using IPQ are shown in Table 1.

	EVEA				EVRA			
Vol.	**REAL**	**SP**	**INV**	**G**	**REAL**	**SP**	**INV**	**G**
AVG	**1.95**	**1.94**	**1.65**	**1.27**	**2.00**	**1.89**	**1.97**	**1.90**

Table 1 - Averages of the results from EVEA and EVRA.

Statistical analysis of variance and Student t's test (α=15%) indicated that there was significant variation only for the variable involvement and for independent variable G, thus indicating higher presence perception for EVRA .

Figure 6 shows the graphic representation of the questionnaire results.

The average results of Hc from the gaze tracker are shown in Table 2.

Vol.	**EVEA**	**EVRA**
Hc. AVG.	2.83134091	2.698513625

Table 2 – Averages of Hc for EVEA and EVRA.

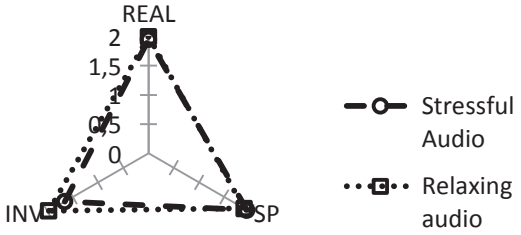

Figure 6 – Results for IPQ for EVEA and EVRA.

Statistical analysis of variance and the Student t's test (α=15%) indicated that there was significant variation of Hc for the EVEA and EVRA cases, indicating greater conditional entropy for EVEA, or greater presence perception for EVRA (Table 1).

The results obtained from the questionnaires and the gaze tracker are consistent, indicating that the tool is suitable for assessing presence perception in video-mediated activities (Table 1 and Table 2).

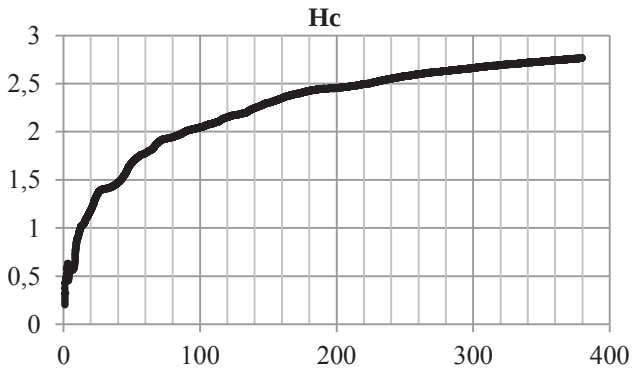

Figure 7 - Hc typical graph obtained with data from a volunteer.

Table 3 and Table 4 show the results obtained from the questionnaires and the Hci for each volunteer, for each of the thirteen video snippets. Out of the twenty-two volunteers, 27% showed no correlation between the results from the

questionnaire and the Hci, while for 73% such correlation is observed (column C in Table 3 and Table 4). These results demonstrate that the tool developed is also suitable to perform assessments of presence perception in video-mediated activities in real time.

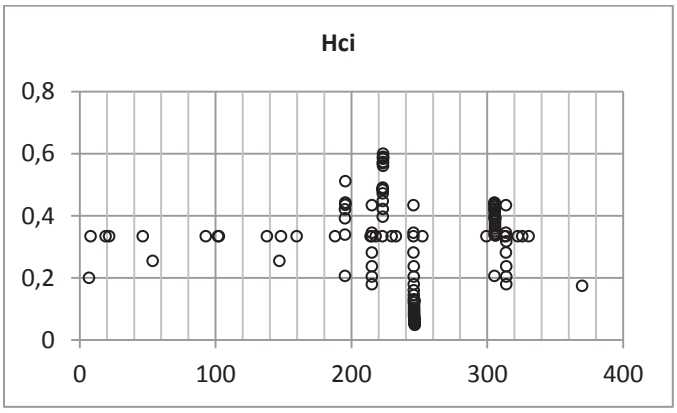

Figure 8 - Hci typical graph obtained with data from the volunteer.

4 Conclusions

Video-mediated activities are used for many different purposes and despite its wide use, there are no mechanisms to assess the presence perception of a person watching the video in real-time. The most widely used method to evaluate the perception of presence is by questionnaires after the experience. However, one should not rely entirely on it, since it fails to deliver real-time information and reflect the real perception felt during the experience.

The results from IPQ and the gaze tracker via Hc show that the tool developed is suitable for presence evaluation of video-mediated activities as a whole and in real-time.

The approach considering that Hci and all the variables used to calculate it are zeroed as there is no transition between regions, along with equation 4, provide data that support the suitability of the tool developed to assess presence perception in video-mediated activities in real time.

The data collected showed no correlation between the results from the questionnaire and from Hci for 27% of the volunteers. Although 32% of the results present low correlation, 36% had moderate and only 5% present high correlation (column C in Table 3 and Table 4). Taking into account the fact that questionnaires are the standard for evaluating presence perception, for 73% of the volunteers the results were positive. However, they should be considered with caution [32][33].

The approach and tool here presented contribute to the field as an improvement in the present techniques and technologies for assessing presence perception. These technologies can endorse or even avoid the use of questionnaires, with the advantage of enabling the access of intermediate values of presence perception during the video-mediated activity.

EVEA															
V		**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**C**
V1	**Q**	0	0	0	0	0	0	0	0	0	0	1	0	0	-0.49
	Hci	0.29	0.39	0.26	0.39	0.28	0.22	0.33	0.00	0.33	0.44	0.00	0.00	0.33	
V2	**Q**	1	0	1	0	0	0	0	1	1	0	2	2	0	0.29
	Hci	0.00	0.33	0.33	0.33	0.33	0.33	0.00	0.39	0.44	0.44	0.41	0.29	0.30	
V3	**Q**	0	0	0	0	0	0	0	0	1	1	0	3	0	-0.72
	Hci	0.28	0.30	0.33	0.27	0.33	0.45	0.33	0.32	0.33	0.39	0.25	0.00	0.33	
V4	**Q**	0	1	1	1	2	1	2	3	2	1	3	3	4	-0.45
	Hci	0.30	0.29	0.33	0.30	0.33	0.34	0.26	0.00	0.00	0.38	0.29	0.33	0.17	
V5	**Q**	0	1	0	0	1	0	1	1	4	3	3	3	3	-0.50
	Hci	0.35	0.25	0.33	0.25	0.00	0.30	0.24	0.14	0.00	0.33	0.00	0.19	0.24	
V6	**Q**	0	2	3	4	3	4	4	4	4	3	3	4	3	-0.00
	Hci	0.30	0.29	0.00	0.33	0.00	0.33	0.30	0.00	0.33	0.29	0.00	0.33	0.33	
V7	**Q**	0	4	2	0	1	0	1	1	4	1	3	4	1	-0.02
	Hci	0.37	0.33	0.28	0.38	0.00	0.00	0.35	0.37	0.38	0.33	0.29	0.00	0.23	
V8	**Q**	0	1	1	1	1	1	1	1	4	1	3	4	3	0.05
	Hci	0.00	0.33	0.28	0.33	0.00	0.33	0.00	0.00	0.33	0.26	0.00	0.00	0.33	
V9	**Q**	0	0	0	0	0	0	0	0	1	0	0	0	0	0.22
	Hci	0.00	0.31	0.29	0.30	0.33	0.27	0.39	0.33	0.33	0.00	0.00	0.00	0.30	
V10	**Q**	3	4	3	3	3	3	4	3	4	3	4	4	3	-0.47
	Hci	0.37	0.26	0.33	0.17	0.33	0.33	0.19	0.17	0.00	0,17	0.00	0.33	0.29	
V11	**Q**	0	0	0	0	0	0	0	0	0	0	1	0	0	-0.64
	Hci	0.00	0.35	0.33	0.30	0.33	0.27	0.24	0.33	0.27	0,33	0.00	0.33	0.42	

Table 3 – Results of Hci from the questionnaires for stressful moments. EVEA case.

EVRA															
V		a	b	c	d	e	f	g	h	i	j	k	l	m	C
V12	Q	0	2	3	4	2	4	2	4	0	2	3	2	4	0.15
	Hci	0.27	0.36	0.39	0.26	0.29	0.29	0.33	0.42	0.29	0.29	0.00	0.00	0.39	
V13	Q	0	1	0	0	0	0	0	0	4	1	4	1	3	-0.29
	Hci	0.23	0.30	0.00	0.33	0.33	0.25	0.33	0.33	0.00	0.33	0.25	0.00	0.28	
V14	Q	0	0	0	0	0	0	0	0	1	0	0	1	0	-0.69
	Hci	0.33	0.29	0.31	0.39	0.33	0.29	0.31	0.38	0.10	0.00	0.29	0.00	0.33	
V15	Q	0	0	1	0	2	0	2	3	1	1	2	2	0	-0.20
	Hci	0.00	0.33	0.25	0.33	0.33	0.32	0.00	0.33	0.00	0.33	0.00	0.00	0.22	
V16	Q	0	3	4	4	4	4	4	4	0	2	3	0	4	0.12
	Hci	0.27	0.33	0.24	0.33	0.00	0.33	0.17	0.17	0.00	0.00	0.00	0.33	0.33	
V17	Q	1	1	1	0	2	0	2	2	2	1	3	1	3	0.06
	Hci	0.00	0.30	0.41	0.29	0.33	0.30	0.30	0.33	0.25	0.00	0.33	0.15	0.12	
V18	Q	0	2	2	1	1	1	1	1	3	1	1	2	2	0.32
	Hci	0.28	0.28	0.28	0.37	0.33	0.35	0.27	0.00	0.44	0.00	0.42	0.39	0.27	
V19	Q	0	2	4	0	3	0	2	3	4	2	4	4	4	0.02
	Hci	0	0.32	0.33	0.45	0.33	0.31	0.21	0.00	0.00	0.00	0.33	0.29	0.36	
V20	Q	0	0	0	0	0	1	0	0	0	0	0	0	0	0.07
	Hci	0.33	0.21	0.17	0.09	0.33	0.25	0.30	0.28	0.00	0.00	0.33	0.33	0.27	
V21	Q	0	2	4	1	4	1	4	4	1	0	1	4	1	-0.29
	Hci	0.29	0.00	0.22	0.00	0.00	0.33	0.00	0.39	0.17	0.00	0.40	0.00	0.39	
V22	Q	0	0	0	0	0	0	0	0	0	1	0	0	0	-0.36
	Hci	0.00	0.33	0.00	0.00	0.40	0.33	0.33	0.42	0.27	0.00	0.00	0.33	0.29	

Table 4 - Results of Hci from questionnaires for stressful moments. EVRA case.

5 References

[1] D. Zhang, L. Zhou, R. O. Briggs, and J. F. Nunamaker, "Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness," *Information & management*, vol. 43, no. 1, pp. 15–27, 2006.

[2] T. Anderson, *The theory and practice of online learning*, 2nd ed. Athabasca: AU Press, 2010.

[3] E. B. Huey, *The psychology and pedagogy of reading: With a review of the history of reading and writing and of methods, text, and hygiene of reading*. New York, NY: Macmillan, 1908.

[4] D. W. Hansen, J. S. Agustin, and A. Villanueva, "Homography normalization for robust gaze estimation in uncalibrated setups," in *Proceedings of the 2010 Symposium on Eye-Tracking Research & Applications*, 2010, pp. 13–20.

[5] J. San Agustin, H. Skovsgaard, J. P. Hansen, and D. W. Hansen, "Low-cost gaze interaction: ready to deliver the promises," in *CHI'09 Extended Abstracts on Human Factors in Computing Systems*, 2009, pp. 4453–4458.

[6] "The Eye Tribe." [Online]. Available: https://theeyetribe.com/products/. [Accessed: 29-Oct-2014].

[7] "SensoMotoric Instruments." [Online]. Available: http://www.smivision.com/en.html. [Accessed: 18-May-2015].

[8] "Tobii." [Online]. Available: http://www.tobii.com/en/. [Accessed: 19-May-2015].

[9] J. Jordan, "Gaze Direction Analysis for the Investigation of Presence in Immersive Virtual Environments," 2010.

[10] L. L. Davidoff, *Introdução à psicologia*, 3rd ed. São Paulo: Pearson, 2001.

[11] E. Goldstein, *Sensation and perception*. Cengage Learning, 2013.

[12] S. L. P. Vicente, "Atenção e percepção," 2009.

[13] B. E. RIES, B. E. Ries, E. W. Rodrigues, and E. W. RODRIGUES, *Psicologia e educação: fundamentos e reflexões*. EDIPUCRS, 2004.

[14] J. Jordan and M. Slater, "An analysis of eye scanpath entropy in a progressively forming virtual environment," *Presence*, vol. 18, no. 3, pp. 185–199, 2009.

[15] S. P. Marshall, "Identifying cognitive state from eye metrics," *Aviation, space, and environmental medicine*, vol. 78, no. Supplement 1, pp. B165–B175, 2007.

[16] "Optical Illusions, Videos, Images, Brain Teasers and more! | Mighty Optical Illusions." [Online]. Available: http://www.moillusions.com/. [Accessed: 28-May-2015].

[17] M. Minsky, "TELEPRESENCE," *OMNI magazine*, Jun-1980.

[18] M. Lombard and T. Ditton, "At the heart of it all: The concept of presence," *Journal of computer-mediated communication*, vol. 3, no. 2, p. 20, 1997.

[19] "International Society for Presence Research." [Online]. Available: http://ispr.info/. [Accessed: 29-Oct-2014].

[20] W. A. Ijsselsteijn, J. Freeman, and H. De Ridder, "Presence: Where are we?," *Cyberpsychology & Behavior*, vol. 4, no. 2, pp. 179–182, 2001.

[21] M. Garau, "The impact of avatar fidelity on social interaction in virtual environments," University College London, 2003.

[22] K. Nowak and F. Biocca, "The effect of the agency and virtual image of virtual humans on users' sense of presence, copresence, and social presence."

[23] Y. Jung and K. M. Lee, "Effects of physical embodiment on social presence of social robots," *Proceedings of Presence*, pp. 80–87, 2004.

[24] F. Obana and R. Tori, "Conceitos de Presença," in *VII Workshop de Realidade Virtual e Aumentada*, São Paulo: Universidade Presbiteriana Mackenzie, 2010.

[25] M. L. M. P. . Santos and et al., "A proximidade mediada: um estudo experimental em ambientes de aprendizagem online," 2008.

[26] R. Schroeder, "Copresence and interaction in virtual environments: An overview of the range of issues," 2002, pp. 274–295.

[27] G. Riva, "Is presence a technology issue? Some insights from cognitive sciences," The Guildway, Old Portsmouth Road, Artington, Guildford, GU3 1LP, United Kingdom, 2009, vol. 13, pp. 159–169.

[28] B. G. Witmer and M. J. Singer, "Measuring presence in virtual environments: A presence questionnaire," *Presence*, vol. 7, no. 3, pp. 225–240, 1998.

[29] M. Slater, M. Usoh, and A. Steed, "Depth of presence in virtual environments," *Presence*, vol. 3, no. 2, pp. 130–144, 1994.

[30] T. Schubert, F. Friedmann, and H. Regenbrecht, "The experience of presence: Factor analytic insights," *Presence*, vol. 10, no. 3, pp. 266–281, 2001.

[31] "www.igroup.org – project consortium." [Online]. Available: http://www.igroup.org/index.php. [Accessed: 28-May-2015].

[32] M. Slater, "How Colorful Was Your Day? Why Questionnaires Cannot Assess Presence in Virtual Environments," *Presence: Teleoper. Virtual Environ.*, vol. 13, no. 4, pp. 484–493, 2004.

[33] M. Slater and M. Garau, "The Use of Questionnaire Data in Presence Studies: Do Not Seriously Likert," *Presence: Teleoper. Virtual Environ.*, vol. 16, no. 4, pp. 447–456, 2007.

[34] M. Slater, "Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments," *Philosophical Transactions of the Royal Society B: Biological Sciences*, vol. 364, no. 1535, pp. 3549–3557, 2009.

[35] S. R. Ellis and L. Stark, "Statistical dependency in visual scanning," *Human Factors: The Journal of the Human Factors and Ergonomics Society*, vol. 28, no. 4, pp. 421–438, 1986.

[36] L. Brillouin, *Science and information theory*, 2nd ed. New York: Academic Press, 1962.

[37] C. E. Shannon and W. Weaver, *The mathematical theory of communication*. University of Illinois Press, 1959.

Layering information literacy: A taxonomy of literacies for academic and lifelong learning

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Abstract - *The technological advancement and proliferation of information resources has precipitated the increase of information stored in electronic format, providing wider and varied information choices to individuals. Lack of necessary computer competencies and skills are contributing factors in hindering the users from accessing, retrieving, evaluating and selecting relevant information from electronic sources for academic purposes. The inadequacy of literacies such as computer, basic, and media literacies in their individuality makes it imperative for the contemporary literate student to be equipped with skills from multiple layers of literacy that fit together in order to access, use and critically evaluate the information from varied existing sources. We examine the role of information literacy and how different types of literacy concepts and models integrate to promote the effectiveness of academic and lifelong learning. A taxonomy of literacy for academic and lifelong learning based on basic literacy, information literacy, computer literacy, media literacy and visual literacy is proposed.*

Keywords: Lifelong learning, Information literacy, computer literacy, digital literacy, visual literacy, metaliteracy.

1 Introduction

Individuals who depend solely on traditional literacy may find it difficult to integrate into the information age which is now dominated by information technology gadgets that aid in information access, storage, creation and sharing. Undoubtedly information explosion cannot promote an informed society on its own, instead, the importance of information literacy cannot be over-emphasised in developing a multi-literate student whose information skills should go beyond traditional literacy. Currently, information literacy is no longer understood in standalone terms [28], but in relation to other emerging literacies. A number of authors, such as [31], [36] and [14] have made efforts comparing information literacy with other types of literacy. A literacy spectrum comprising of alphabetic, functional, social, information and digital literacies is proposed by [31] while [36] and [32] also regard information literacy as an integral component of the electronic literacy spectrum grouped as computer literacy or information and communication technology literacy [32].

Information literacy has also been discussed from the perspective of learning styles [37], where it could support distance teaching and learning. [10] reports current efforts made by various researchers who attempt to establish connections between information literacy with other important literacies.

This paper gives an overview of the types of literacy skills that are related to information literacy, and the connections that exist among them.

2 Defining Literacy

According to [12] the term literacy is still most commonly used to refer to the acquisition of the basic competencies of reading, writing, and numeracy (3Rs) which are important in everyday life. Traditionally, literacy means the ability to write, manipulate numbers, read, understand, and use information. This meaning is tied to those basic skills required by an individual to function sufficiently in an industrialised society. With the emergence of new forms of technologies and with an increase in information access and demands, there has been a rethink on what literacy means. Literacy has a broader meaning that encompasses a range of knowledge, skills and abilities relating to reading, mathematics, science and technology [16], [1], [21]. An individual's literacy is now related to both information and technological terms [12], [17].

The 3Rs literacy is no longer adequate for students in institutions of higher learning who engage in advanced academic practices. These practices require the students to (1) read information from different sources and present it in various formats,(2) interpret and understand what they have read, (3) derive new meanings from it, and, (4) use and share it with others [12]. This type of literacy is information literacy. The literacy spectrum comprises of alphabetic literacy (the ability to write), functional literacy (ability to read and write), social literacy (ability to communicate in a cultural context), information literacy (one's ability to locate, critically evaluate and use information) and digital

information literacy (being able to apply information literacy in the digital environment) [31], [32]. The connections among these various literacies are the subject of this paper and are explored in subsequent sections.

3 Information Literacy

Interpreting information literacy (IL) as one of the many literacies has brought many positive ideas likely to resolve the confusion between information literacy and related literacies [21]. Information literacy refers to the ability to determine the information needs, to access and critically evaluate information, and to use it effectively to solve problems [33]. Therefore, the purpose of information literacy is to empower and enable an individual to effectively access, evaluate and use appropriate and relevant information regardless of how the information is packaged [7]. The main goal of information literacy is to equip students with appropriate educational skills in traditional literacy, library skills, computer skills and critical thinking skills. An information literate person should have a set of abilities to identify what information is needed, understand how the information is organised, identify the best sources of information for a given need, locate those sources, evaluate the sources critically, and share that information [24]. Information literacy is the knowledge of commonly used research techniques that every individual student in institutions in higher learning should acquire [32]. Two information literacy frameworks, the relational model [5] and Seven Pillars standards of Information [30] define skills that an information literate individual should possess. Both frameworks consist of seven basic information skills. Table 1 summarises ideas from these two frameowkrs by mapping the latter framework on the former. The relational framework uses category one to seven while the Seven Pillars framework uses descriptive terms.

The relational framework presents general ideas of information literacy skills required which are further refined in the Seven Pillars' framework. However, the relational framework takes into account the use of technology as an aspect of information literacy. According to [6] both the relational and Seven Pillars framework are equally important. However, they do not focus on how information literate students structure and manage their own information resources [17].

Poor information literacy contributes to poor education [9]. For example, [19] argues that students often lack the skills necessary to succeed in this rapidly changing technological environment due to a lack of appropriate information literacy skills. The authors suggest that faculties need training and support to make use of new technologies for effective teaching and learning. Current information literacy practices have been criticised for a number of deficiencies. Information literacy still struggles from both an academic and a practical standpoint to gain a foothold in related fields, notably education, where its implications are particularly obvious [28] yet the role of information literacy in lifelong learning cannot be over emphasized. Regardless of a lot of research that shows the benefits of information literacy in higher education, its application seems not to amount to anything [19]; [12].

Information literacy has remained an expression that is unfamiliar to many teachers [28]. This impinges negatively on the information literacy of students. Secondly, research indicates that information literacy is not yet fully integrated with technological based literacies like computer literacy [19]. Information literacy leans towards certain types of technology and this causes it to lag behind technological development or be equated to existing computer literacy [15]. Where strategies of information literacy exist, these have confused information literacy with or reduced computer, digital or information and communication technology (ICT) literacy [12]. Although these literacies are inter-related, there are critical differences among them and they should be treated as such. According to [15] current standard definitions of information literacy are insufficient for the revolutionary social technologies currently prevalent online and suggest a reframing of these definitions to include meta-literacy.

Table 1: Relational model and Seven Pillars

Relational Model		**Seven Pillars**	
Category	**Skill**	**Pillar**	**Skill**
One	Ability to retrieve, use and communicate information using information technology	**Identify**	Ability to identify a personal need for information
Two	Ability to find information stored in information sources	**Scope**	Ability to assess current knowledge and identify gaps
Three	Ability to use processes to find and make decisions about information needs	**Plan**	Ability to construct strategies for locating information
Four	Ability to collect, manipulate, store and retrieve information	**Gather**	Ability to locate and access information one needs
Five	Ability to use information critically to build a knowledge base	**Evaluate**	Ability to compare and evaluate information obtained from different sources
Six	Ability to integrate	**Manage**	Ability to organize, apply,

	personal experience with new information		and communicate information to others in a professionally and ethically ways.
Seven	Ability to wisely use information to benefit self and others	**Present**	Ability to apply the knowledge gained: presenting the results of their research, synthesising new and old information and data to create new knowledge and disseminating it in a variety of ways

This stems from the fact that a number of other literacies share the same skills with information literacy. In view of this, in this information age, information literacy can no longer be treated in isolation of other literacies [15]. Researchers like [10] had earlier made efforts to establish connections of information literacy and visual literacy, media literacy, computer literacy, digital literacy and network literacy. This prompted [9] to advocate for the integration of information literacy and technologically based literacy into e-information while [15] propose metaliteracy. The following subsections briefly discuss various literacies that are connected to information literacy.

3.1 Metaliteracy

Metaliteracy is a new concept in information or library science cycles. The emergence of social media and collaborative online communities has led to the reframing of information literacy as meta-literacy [20]. Information online takes many forms and is produced and communicated through multiple modalities [20], therefore, the need for metaliteracy. The proponents of metaliteracy argue that students need rich print and media experiences to prepare them for their digitally enhanced world [20]. From this perspective, metaliteracy is an integrated framework of information literacy with other literacies that seek to foster multi-literacy skills in students at institutions of higher learning. Besides unifying multiple literacy types, metaliteracy emphasises particularly on information production and sharing in participatory digital environments [20]**.** Metaliterate students are expected to apply various literacy skills to enhance their studies anywhere at any time where they have access to social networking.

The purpose of metaliteracy is to provide a spectrum of skills that makes it possible to link information literacy to other related literacies. This broadens the scope of information literacy from a set of discrete skills to a literacy form that enables individuals to actively produce and distribute knowledge in collaborative online communities [20]. Metaliteracy plays a vital role in the reconceptualization of information literacy and the perspective of e-learning which is also vital for the academic and lifelong learning. The emergence of social media facilitates meta literacy preparing the students to be both users and co-creators of information.

3.2 E- Information Literacy

E-information is another contemporary literacy which has more relevance to the information age than the traditional information literacy and mainly discussed in relation to other literacies. According to [19], e-information literacy is the ability to locate, evaluate and effectively use needed information with a set of skills and attitudes for lifelong learning. E-information literacy seems to be an extension of traditional information literacy to the current information society by full utilisation of the capabilities of information and communication technologies [19]. This makes e-information more relevant and of major importance to learning in this new environment of continuous technological change. The use of the Internet among various individuals from different social strata has been found to be linked to e-information (e-literacy for short) skills [18]. E-information skills depend on computer or information technology skills [18],[19]. Therefore, individuals who lack e-information literacy can hardly benefit from the Internet to better their academic studies and their chances of being lifelong learners dwindle. The following subsection examines visual literacy and how it relates to information literacy.

3.3 Visual Literacy

Visual literacy skills are as important as the other literacy skills in students' academic life [4] and hence the need to develop this type of literacy in students in institutions of higher learning. Visual literacy results from a system for expressing, recognising, understanding, and learning visual messages that are negotiable by all people [1]. Visual literacy involves developing a set of skills an individual needs to be able to interpret the content of visual images, examine social impacts of those images and discuss purpose, evidence and ownership [2]. Students who are visually literate have abilities to interpret, negotiate and make meaning from information presented in the form of images. Visual literacy skills are typically important in research where symbols and pictures may be the primary source of information or means of communication. The use of visual literacy in particular, symbolism; understanding signs, symbols and signals to express many words or phrase in one image, can be used effectively in developing writing [2]. Academic research makes use of images and symbols, therefore, students

involved in academic research need to be acquainted with this form of visual literacy. Unlike verbal and oral communication, visual communication does not have a fixed vocabulary that students can use. This makes it imperative for students involved in academic research to have visual literacy skills. Visual stimuli are easily produced, pervasive, sophisticated and powerful in informing and persuasion [2]; [14]. Visual literacy is crucial in that it enables students to apply their visual senses in order to understand, create and use images for different but beneficial study purposes. Figure 1 shows the components of visual literacy. Visual literacy is also related to media literacy, which is outlined below.

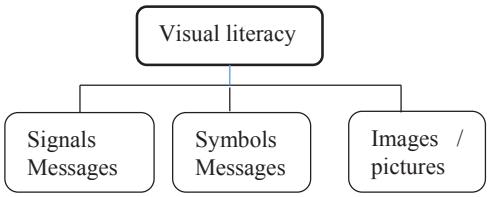

Figure 1: Visual literacy

3.4 Media Literacy

Media is the means through which all forms of information are made available to users or readers. This includes all media; television and film, radio and recorded music, print media, and Internet. Media literacy is the ability of an individual to access, analyse and evaluate the power of images, sounds and messages (of all types) and to communicate competently on a personal basis using the media available [12]. A media literate student has the ability to analyse, evaluate and create messages in a wide variety of media types and systems. Information technologies, like computers are commonly used to create and transmit messages in various forms. This means that students should be able to access and understand media in print, sound or digital format and also be to create or to express themselves using a variety of media. Media literacy promotes independent critical thinking and helps media recipients become active, conscientious consumers, rather than remaining passive and subservient to the images and values that dominate the media [18]. Students involved in academic research also need media literacy skills in order to face the challenges related to media communication. The following section is an outline of computer literacy.

4 Computer Literacy

The term computer literacy has many connotations. According to [29] computer literacy can be classified in three overlapping approaches: 1) programming skills and ability to do computing; 2) the critical competencies limited to general knowledge about, and awareness of computers and their uses; and 3) the ability to use computer applications and related technologies. These authors further identify four key computer literacy skills each of these approaches seek to develop. Table 2 illustrates the skills and indicators that a computer literate person should exhibit.

Table 2: [29]'s computer literacy

Computer skill	Indicators
Computer systems	Knowledgeable to use hardware and programs (software) necessary for computer applications
Computer application	Ability to responsibly evaluate, select, and implement a variety of practical computer application to do meaningful and efficient work based on an understanding of general types of applications, capabilities and limitations of types of applications, and social impact of specific applications
Computer attitudes	One's feeling about the personal and societal use of computers in appropriate ways – responsible use of computers.
Computer programming	Skilful use of programming languages to direct the operation of the computer. Problem solving strategies like algorithms, flowcharts, languages are required.

Hardware literacy is a set of basic operations one needs to know in order to use a computer to complete simple tasks. Software literacy refers to the invisible set of general-purpose procedures and instructions that the computer or telecommunications hardware required in order to perform its functions properly. Applications literacy refers to the knowledge of, and the skills necessary to efficiently use various special-purpose software packages that are on the market. This means that functional literacy should exist before the critical and rhetorical literacies are acquired 0; [27]. These computer literacy perspectives' main objective is to make all university undergraduate regardless of their programmes of study acquaint themselves with basic computer technology and related technologies. Although, functional computer skills are vital, a computer literacy programme whose intention does not go beyond this level is far from addressing the current computing challenges undergraduate students face. Institutions of higher learning spend considerable time developing functional literacy to majority of the students at the expense of critical literacy. This marginalises students who need these other computer literacy skills which are key to e-information literacy.

Critical computer literacy is meant to make a student aware of contextual elements of computer use, understand the institutional forces that shape technology use, and is capable of analytic reflection upon popular beliefs about the role of computers in society [27]; [23]. This addresses [29]'s computer application and attitudes skills that seek a long term goal of acquiring computer technology competencies. This

perspective looks at higher order computer literacy skills that a student should possess and this is most likely to be affected by the forms of usage of computers in the programme of study being pursued. This type of computer literacy is more likely to aid students in their information literacy. According to [27] computer literacy programmes that address critical literacy are expected to infuse information literacy skills.

Rhetorical computer literacy intends to develop students' higher order skills in computing such as computer programming, systems development and also the ability to evaluate existing interfaces [27]. This type of literacy tallies with [27]'s computer programming and problem solving skills that each computer literate person may need. Students who are rhetorically computer literate are expected to possess multiple skills that would help them to design user interfaces, reflect on their own work, evaluative and judge own and other students' work [27]. Students with these skills view interfaces as social actions as opposed to technical ones. The ultimate results of rhetorical computer literate student are both technical skills and knowledge that lead them to pursue information technology careers. From [28] and [12]'s arguments, a student who is computer literate is expected to have basic knowledge and skills in the efficient use of hardware, software and applications that would result in that particular student realising the benefits of using a computer.

From [29]'s perspective, computer literacy means an understanding of computer characteristics, capabilities, and applications as well as an ability to implement this knowledge in the skilful, productive use of computer applications suitable to individual roles in society. In this regard computer literacy becomes the knowledge and ability to use computers and related technology efficiently, with a range of skills covering levels from elementary use to programming and advanced problem solving [25]. In this paper, an individual who is computer literate is one who is able to use computer hardware, software, applications and the network technologies like the Internet, world-wide web, electronic mail and databases to meet information requirements for the programme of study.

4.1 Digital Literacy

The concept of literacy has evolved to include visual, electronic and digital forms of expression and communication [14]. Digital literacy now plays an important role in computer literacy and is relevant in the way information is accessed, processed and communicated. Digital literacy has become synonymous to computer literacy. This causes attention to be paid more to digital technology at the expense of how these could be used gainfully. However, in this research, digital literacy is regarded as an essential component of computer literacy.

Digital literacy represents a person's ability to perform tasks effectively in a digital environment, with digital information represented in numeric form and primarily for use by a computer [13]. A digital literate student has the ability to locate, organize, understand, evaluate, and analyze information using digital technology. Digital literacy is related to other literacies: network literacy, visual literacy and media literacy. Therefore, digital literacy plays a crucial role in connecting different available literacies.

In academic circles, the purpose of digital literacy is to enable students to acquire a working knowledge of current high-technology and an understanding of how it can be used in their field of study [13]; [12]. Digital literacy has an immediate application to academic research where students need to use baseline computer literate skills to access information highways using electronic tools. When applied in academic research, digital literacy skills enable students to constructively contribute to both societal culture and human behaviour. For example, contributing to academic social groups makes an individual student to be aware of the culture of that particular group and the required codes of conduct [35]; [34]. Implicitly, digital literacy helps students to communicate and keep abreast with societal trends through social networking services including Web 2.0 technologies. Digital literacy has become a central enabling agent in the educational enterprise as a result of a number of trends [34]; [16]. To develop meaningful digital literacy skills, an individual should possess base-line computer and information skills. The following section focuses on network literacy, a concept related to digital literacy and is vital in information literacy.

4.2 Network Literacy

Network literacy is a contemporary literacy which has so far received a lot of publicity with regard to library sciences [14] This arose from network technology (local area networks, Intranet, Internet and telecommunications) with multimedia, digital storage and digital delivery that makes information to be networked and tremendously extending the usefulness of information resources and services availability [19]; [14]. Information and communication technology networks have facilitated networking of information across the globe making it easier for its access at negligible costs. Network literacy is the ability to identify, access and use electronic information from the information network [19]. Network literacy is information literacy based on network technology in a network environment. This forms a crucial overlap between information literacy and ICT or computer literacy. According to [13] network literacy means linking to what other people have written and inviting comments from others; it means understanding a kind of writing that is a social, collaborative process rather than an act of solitary individual in solitary. This definition regards network literacy as learning how to write with awareness that anyone may read the information. In this sense, network literacy is a non-technical-computer skill that involves the understanding of the ways in which people read, write and participate actively

in the distributed, collaborative environment of the Internet in its current form [11]. Students' network literacy can be promoted through the e-mail, blackboards, Web 2.0 interactive platforms and social networking like Facebook, YouTube, twitter, iEARN (international education and resource networks), and other web-based discussion platforms. These allow information to be created and commented on by different people. For example, students involved in research can create academic writings then post them for editing by others. This gives theses students a chance to interact with professionals or experts. By developing network literacy individual students become more intelligent editors and contributors of information rather than being intelligent consumer of information [21]. Besides developing, the 3Rs, these tools give students more chances to interact through writing and reading. Furthermore, this literacy allows students to improve their ICT skills and research skills.

5 E-Learning

Academic and lifelong learning are now tied to e-literacy, e-learning or technological based access to and organisation of information for one's success. Students cannot retrieve and evaluate the information that will be required for problem solving and decision making in the workplace and in society despite the publicity given to technological advances and their potential to facilitate access to information [22]. The perennial problem is that students in institutions of higher learning seem to be information illiterate from a technological standpoint. At the core of e-learning are the issues that other literacies deal with and are normally treated independently. According to [26] e-learning can change education by making learning more flexible and more tailored to individual needs. However, to achieve this, students should possess the required capabilities. To be effective as both academic and lifelong learners, students should be well versed in information literacy, media literacy (including print and digital), visual literacy, computer or ICT literacy (including digital and network literacies). These literacies should be fostered in students in an organised way that gives all the literacies deserved attention to be as integrated as possible.

6 Layering of literacy for academic & lifelong learning

From the foregone discussions of different literacies, the diagram, in Figure 3, shows how these literacies could possibly be layered and then acquired by students in higher education. Figure 3 shows our conceived connection of different literacies into a layered hierarchy of literacy.

The layering of the literacies revolves around information literacy rooted in basic traditional literacy, computer literacy, media literacy and visual literacy. The literacy hierarchy increases from basic traditional literacy through information literacy, fused with relevant components of computer literacy, media literacy and visual literacy. Removal of redundancies that exist among different literacies indicates that the main literacies that lead to academic and lifelong learning should provide for e-learning. This could only be achieved by providing a balanced combination of the major literacies that are related to information literacy.

In this taxonomy, we regard traditional literacy as the basis for all literacies. This should be acquired through formal schooling supported other means. Traditional literacy can be enhanced through various means while an individual acquires other literacies. For example, computer literacy skills are influenced by one's basic literacy. At the same time when one attains proficiency in computer technology as medium, it translates to increased proficiency in traditional literacy. This applies to media and visual literacies that also depend on the basic literacy. Institutions of higher learning further basic literacy through a variety of activities like note taking and assignments.

Currently, different electronic devices have replaced paper and pen, while number crunching has quietly disappeared. A variety of literacy skills start to blossom as an individual starts to interact with technology that provides media for presenting information. Computer literacy skills required range from those addressing functional skills to those that develop critical thinking in students. Computer literacy plays an important role in information literacy; it is not just computer literacy. Functional literacy is primarily needed for students to use different types of computers to access networks for social networking, to create and share academic information with pears or tutors, research purposes. Digital literacy focuses on those aspects associated with learning how to effectively find, use, summarize, evaluate, create, and communicate information while using digital technologies. The digital technologies span traditional computers. Use of mobile electronic gadget and their use to support learning should not be left to chance but explicitly provide a classroom environment.

Once students become digitally literate they could overcome the barriers of technology on communication. This is manifested through student communicating and collaborating efficiently with other students or those who possess the same knowledge and skills with them. Digital literacy depends on network literacy and vice versa. Network literacy will help students to link with appropriate people for ideas, help or sharing their academic work, accessing on-line learning material, digital libraries, simple web searches. This depends on students' ability to use digital tools, media like e-mail, social networks. These skills can be acquired through various means. However, this paper recommends that institutions of higher education actively provide a balanced curriculum in all literacies that are interacted with traditional information literacy.

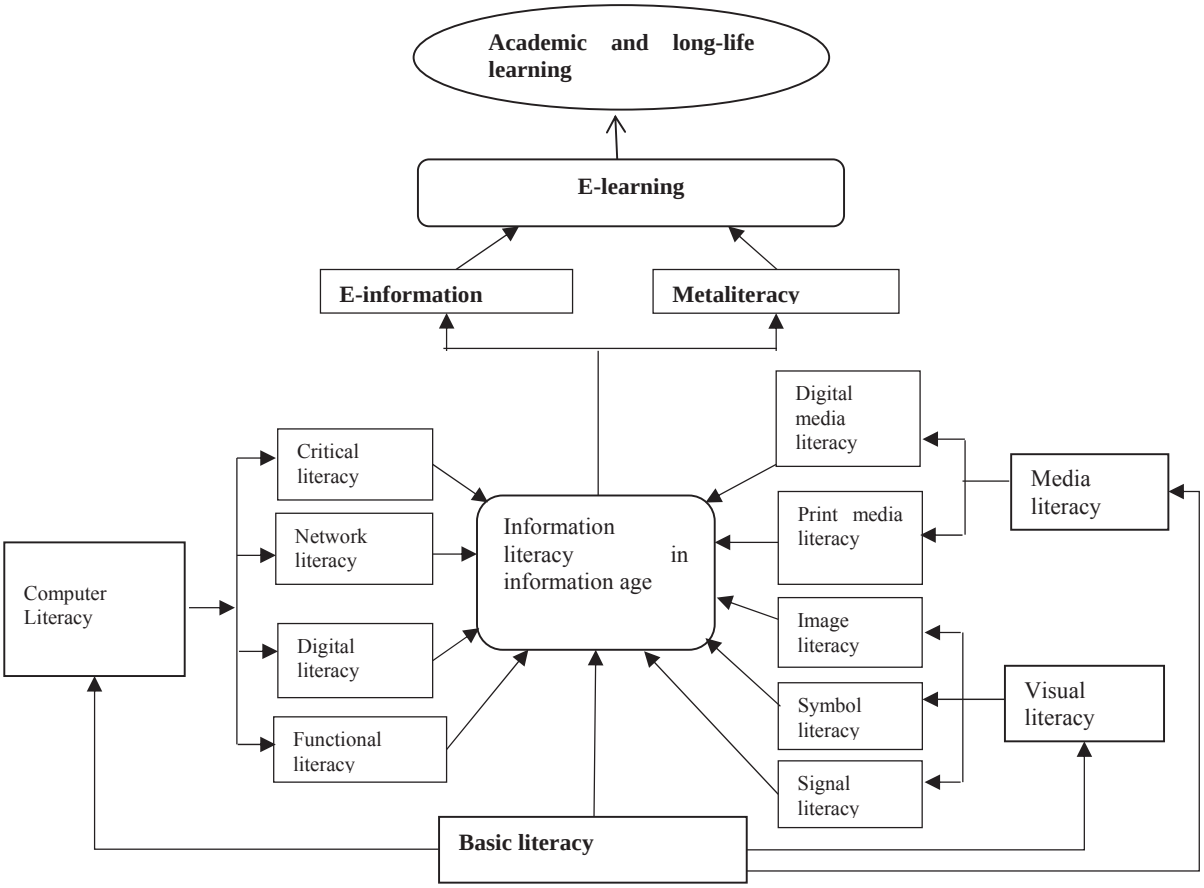

Figure 2: Taxonomy of literacy for academic and long-life learning

Computer literacy for information literacy is an area which requires students to have exposure to the relevant media used in this area. This important process should not be the job of the computer science personnel or the information services personnel for they tend to be biased towards their area of specialisation, but requires active participation of all individuals with integrative skills in these literacies.

According to [26] information literacy fused with relevant technology evolves into e-information literacy and is also a very important component of this taxonomy. E-information literacy raises the level of use of information technology resources to support students' academic life. The emphasis is to push information literacy skills of an individual to a level where one enjoys the benefits of using the internet and web to support research. E-information skills are not acquired by coincidence, but through teaching in a contextual way.

Information literacy can be fused with computer literacy, media literacy and visual literacy to form metaliteracy. This taxonomy adopts this perspectives and further indicate that e-learning rely much on both e-information and metaliteracy [15]. Unlike e-information, metaliteracy seeks to develop a multi-literate student proficient in the use of information skills, computer/ICT skills, media skills and visual skills. The ultimate goal of this taxonomy to provide academic and lifelong learning skills derived from basic interacting literacies. Information literacy enhances the mastery of content in learners and gives them the learning autonomy thus contributing to lifelong learning. Coupled with the abilities for ICT utilisation and fluency in technology, information literacy greatly extends the individual's competencies and skills needed for academic and lifelong learning.

However, care should be taken when imparting different types of literacies. An integrated approach should be adopted that will make students aware of the relationship between these various forms of literacy and their importance to their current and future studies. It should also be noted that some computer skills should be discouraged. For example piracy, hacking and data theft. Good information skills emphasise social responsibility in the use of technology. When sharing information, students should be aware of the negative effects brought by malware, exposure to offending materials found on the Internet.

7 Conclusions

This paper discussed the role played by different literacies in preparing students involved in academic studies. It focused on academic and lifelong learning starting with the traditional literacy (3Rs). Traditional literacy, although no longer sufficient to address modern students' academic requirements, is still a basic requirement for an individual to break into other literacies. In order for a student to be an effective information user and communicator there are basic information, computer, media and visual skills that must be provided in the right combination. Our literacy taxonomy shows how these important literacies interact with information literacy, through e-information and metaliteracy to e-learning, with the student emerging as an academic and lifelong learner.

8 References

[1]. Alberto, P. A., Fredrick, L., Hughes, M., Mclntosh, L and Cihak, D. 2007. "Components of Visual Literacy". http://facstaff.unca.edu/nruppert/2009/VisualLiteracy/DigitalLiteracy/componentsVL.pdf

[2]. Bamford, A. 2009. "The Visual Literacy White paper". http://wwwimages.adobe.com/www.adobe.com/content/dam/Adobe/en/education/pdfs/visual-literacy-wp.pdf.

[3]. Benson, J. & Reyman, J. 2009. "Learning to write publicly: Promises and Pitfalls of Using Weblogs in the Composition Classroom". www.bgsu.edu/cconline/LearningtoWritePublicly.pdf.

[4]. Blead, R. 2005. "Visual Literacy in Hihger Education." http://net.educause.edu/ir/library/pdf/eli4001.pdf

[5]. Bruce, C. 1997. "The relational approach: a new model for information literacy." The New Review of Information and Library Research, 3, 1–22.

[6]. Catts, R. 2005. "Confirming the relational model of information literacy." The International Information and Library Review (2005) 37, 19–24

[7]. Cheek, J. & Doskatsch, I. 1998. "Information literacy: a resource for nurses as lifelong learners." *Nurse Education Today* (1998) 18, 243-250. Harcourt Brace & Co. Ltd

[8]. Coughlin, J. W. & Kalodner, C. 2006. "Media literacy as a prevention intervention for college women at low- or high-risk for eating disorders." Body Image 3 (2006) 35–43. http://www.Sciencedirect.com.

[9]. Dorner, D. G. & Gorman, G.E. 2011. "Contextual factors affecting learning in Laos and the implications for information literacy education." Information Research. Volume 16. No. 2. June 2011.

[10]. Eisenberg, M. B., Lowe, C.A. & Spitzer, K.L. 2004 "Information literacy: essential skills for the information age." 2nd ed. Westport, Connecticut: Libraries Unlimited.

[11]. Ezeani, C. N. 2011. ""Network Literacy Skills of Academic Librarians for Effective Services Delivery: The Case of University of Nigeria Library System." (2011). Library Philosophy and Practice (e-journal). Paper 648. http://digitalcommons.unl.edu/libphilprac/648

[12]. Horton, F. W. 2007. "Understanding information literacy: A premier. United Nations Educational, Scientific and Cultural Organization, Paris"

[13]. Jones-Kavalier, B. R. & Flannigan S. L. 2006. "Connecting the Digital Dots: Literacy of the 21st Century." EDUCAUSE Quarterly Vol. 29 Number 2. http://www.educause.edu/EDUCAUSE+Quarterly/EDUCAUSEQuarterlyMagazineVolumeum/ConnectingtheDigitalDotsLitera/157395.

[14]. Koltay, T. 2011. "The media and the literacies: media literacy, information literacy, digital literacy." Media Culture and Society, Volume. 33, No. 2, 2011, 211-221. SAGE Publications. . http://mcs.sagepub.com/cgi/content/abstract/33/2/211.

[15]. Mackey, T. P. & Jacobson, T. E. 2010. "Reframing Information Literacy as a Metaliteracy." http://crl.acrl.org/content/72/1/62.full.pdf+html.

[16]. Martin, A. 2006. "A European framework for digital literacy". Nordic Journal of Digital Literacy, 2, 151–160. http://www.idunn.no/ts/dk/2006/02/a_european.framework_for_digital_literacy.

[17]. Mitchell, E. 2009. "Literacy, information, and learning - theoretical foundations." http://erikmitchell.info/uploaded_files/dissertation/1_information_literacy_mitchell.pdf

[18]. Morris, M. 2007. "E-literacy and the grey digital divide: a review with recommendations. Journal of Information Literacy." Volume 1, No 3 2007. abstract http://jil.lboro.ac.uk/ojs/index.php/JIL/article/view/RA-V1-I3-2007-2/0

[19]. Nayak, V. G., Nayak, R. R. & Murgod, S. G. 2006. "E-Information Literacy: An Over View." 4th International Convention Caliber-2006, Gulbarga, 2-4 February, 2006

[20]. O'Connell, J. 2012. "Learning without frontiers: School libraries and meta-literacy in action ACCESS." Volume 26, Issue 1, 2012, pp. 4-7. http://www.asla.org.au/pubs/access/commentary-26012012.htm.

[21]. Pearson, C 2012. "Removing the 'e' from 'e-learning'" http://richlambert.edublogs.org/2009/05/01/network-literacy-what-does-literacy-mean-in-the-web-20-age/

[22]. Pinto, M. 2010. "Design of the IL-HUMASS survey on information literacy in higher education: A self-assessment approach." Journal of Information Science 2010 36: 86. http://jis.sagepub.com/

[23]. Sacchanand, C. 2011. "Developing strategies to create information literate Thai Students." http://conference.ifla.org/ifla77.

[24]. Sasikala, C. & Dhanraju, V. 2010. "Assessment of Information Literacy skills among the Science students of Andhra University: A survey." Library Philosophy and Practice (e-journal) Libraries at University of Nebraska-Lincoln. 518. http://digitalcommons.unl.edu/libphilprac/518

[25]. Schneider, D. K. 2011. "Computer literacy" http://edutechwiki.unige.ch/en/Computer_literacy

[26]. Secker, J. 2004. "E-learning and information literacy." Oxford, Chandos.

[27]. Selber, S.2004. "Multiliteracies for a Digital Age." Carbondale: Southern Illinois UP http://prelimsandbeyond.wordpress.com/2009/01/31/selber/

[28]. Shenton, A. K. 2009. "Information Literacy and Scholarly Investigation: a British perspective." International Federation of Library Associations and Institutions IFLA Journal 2009 35: 226

[29]. Simonson, M.R., Maurer, M., Montag-torardi, M. & Whitaker, M. (1987). "Development of a standardised test of computer literacy and computer anxiety index." Journal of Educational Computing Research, 3(2), 231-247

[30]. Society of College, National and University Library (SCONUL). 2004. "The SCONUL seven pillars of information literacy core model for higher education." SCONUL Working Group on Information Literacy

[31]. Stern, C. 2002. "Information Literacy Unplugged: Teaching Information Literacy without Technology." http://www.nclis.gov/libinter/

[32]. Tilvawala, K. & Myers, M. D. 2009. "Information literacy in Kenya. The electronic journal on information systems in developing countries." Ejisdc (2009) 39, 1, 1-11

[33]. Timmers, C. & Veldkamp, B. 2010. "Attention paid to feedback provided by a computer-based assessment for learning on information literacy." Computers and Education 56 (2011) 923–930 Elsevier Ltd. www.elsevier.com/locate/compedu

[34]. Walker, J. R. 2005. "Weblogs: Learning in Public." On the Horizon Volume 13, Issue 2, 2005. 112-118. Abstract in journal

[35]. Walker, J. R.2003. "Network Literacy: Learning with Blogging and Web 2.0." On the Horizon Volume 11, Issue 2, 20053 142-158. Abstract in journal

[36]. Warschauer, M. 2004. "Technology and Social Inclusion: Rethinking the Digital Divide." London: The MIT Press

[37]. Webb, J. & Powis, C. 2005. "Start with the learner." Library and Information Update, 4 (1–2): 50–52.

[38]. Winter, S. J., Chudoba, K. M. & Gutek, B. A. 1997. "Misplaced resources? Factors associated with computer literacy among end-users." Information and Management 32 (1997) 29-42.

An investigation into the extent and limitations of the GROW model for coaching and mentoring online: Towards 'prosthetic learning'

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Abstract – *Coaching and mentoring have many commonalities, but can also be seen to be different. The aim of coaching is to help a person transform being where they are to where they want to go, which may be on a path that has not yet been trodden. Mentoring is a one-to-one communication between a mentor who has "been there and done that" and a mentee who wants 'learn the ropes.' This paper looks at how these practices can be enabled online – through Virtual Coaches – and the extent and limitations of the GROW model for online coaching and mentoring. It finds that the GROW model is limited in what it can do, and that it needs to be extended to consider factors beyond goals, realities, options and will. It is suggested that 'engage' and 'routinize' be added to create a new model called 'GROWER.' An extension of the M-MARS model making it M-REAMS (i.e. Methods, Rules, Enmities, Amities, Memes, Strategies) is proposed for an ethnomethodological approach to reflective learning. The paper concludes that Virtual Coaches can provide benefits in terms of enhanced mentoring and coaching relationships.*

1 Introduction

Defining coaching and mentoring in terms of their différence [1] is difficult (i.e. what the difference between the two words is). Coaching and mentoring are both forms of learning conversations, which require reflection during and after learning conversations [2]. Even more difficult is defining coaching and mentoring in terms of the différance [1] of the words (i.e. what words are used to explain the meaning of both words and how they are different). Some have proposed that the différance between coaching and mentoring are that whilst both similar interventions they can be differentiated primarily by the extent to which they are described as being directive or non-directive [3]. These, however, may not be seen as satisfactory expressions of the différance and difference of coaching and mentoring. Both the activities coaching and mentoring can be led by either the coach or coachee. A more appropriate différence might be that mentoring is done by those who have been there and done that and want to show someone else the ropes, whereas the aim of coaching is to help a person transform being where they are to where they want to go, which may be on a path that has not yet been trodden. The différance would therefore relate to the role of the coach or mentor – whether it is to share their experience in the case of mentoring or help the participant realise their own potential in the case of coaching.

2 Background

There are a number of important considerations when considering whether coaching and mentoring can be effectively enabled in an online space. The purpose of coaching and mentoring need to be considered, the different approaches to them and the impacts of the Internet on the practice.

2.1 The purpose of coaching and mentoring

Understanding the purpose of coaching and mentoring is therefore important. Within work, coaching and mentoring is associated with improving the level of performance, bearing responsibilities, planning and carrying out duties, following up on steps for better results, self-actualisation and creativity [4-7]. Regular coaching and mentoring, is highly significant in shaping leadership proficiency, but exerts less influence than real-time experience, providing testimony that formal and experiential learning form an important part of leadership capability, compatible with various different faiths [8]. In terms of emerging and troubled economies, such as Afghanistan, coaching and mentoring is a core component of governance reform [9]. It has been argued that working internationally can involve the use of a Virtual Coach who delivers training, coaching and mentoring online [10], something that will be explored in the rest of this article.

Concepts such as peer coaching have been shown to be effective in helping workers and teachers improve their technique, such as questioning, without being evaluative [11]. It has been argued that introducing learning outcomes into coaching can improve its effectiveness for an individual, providing the process is clear [12, 13]. In some areas, peer coaching is seen as fundamental to professional development [14]. In teaching, peer coaching often takes the form of an educator giving a lesson and then having feedback and suggestions from their colleagues [15].

2.2 Different approaches to coaching and

mentoring

The model coach mentors choose to use depends on their own context, style and approach [16]. Grounded in partnership and focused on practice, most coaching and mentoring models are dialogical, non-evaluative, confidential and respectful [17]. Coaching and mentoring models can provide intensive, direct instruction in the conceptual and procedural foundations of effective classroom practices, as well as on-going support and individualized feedback [18].

There are a number of different approaches to coaching and mentoring, each often with their associated acronyms, such as GROW, CARE, ERR, OSCAR. The GROW model, which stands for Goal, Reality, Options, Will) is generally accepted to be the standard method for coaching and mentoring and the teaching of it [19]. In summary it reinforces a positive sense of identity by mapping a person's wishes according to their goals, the reality, their options and their will [20]. The CARE model, which stands for 'creating' comfort, raising 'awareness', 'reawakening' the flow of learning, and 'empowerment' is designed around a framework with a two-fold purpose. This is to provide a guidebook of techniques and behaviours to encourage learning, and to ensure beliefs and values that underpin the model are put into practice [21].

The ERR model, which stands for Emotion, Reality, Responsibility is intended to acknowledge one's 'emotions' and stay with them, explore the 'reality' of the situation and situation and separate facts from assumptions, as well as to be coached to get ownership and 'responsibility' for actions and decisions [22]. The OSCAR model, which stands for Outcome, Situation, Choices, Actions, and Review, builds on the GROW model, with Outcome reflecting Goals, Situation reflecting Reality, Choices and Consequences reflecting Options and Action and Review reflecting Will [23].

2.3 Extent and limitations of coaching and mentoring through digital technologies

Whilst in-person coaching is the most common method used, virtual coaching is becoming more prevalent [24]. Some critics have gone so far as to say coaching is only truly effective when done in person [25]. One might compare coaching and mentoring on the Internet as a form of online interviewing. Many people online prefer to observe and not to post as a result of problems feeling comfortable to participate might exist with a Virtual Coach [26-28]. Online interviewing can, it is argued, allow individuals to develop their own order, goals and interests [26, 27, 29], which is perfectly appropriate for coaching and mentoring. One-to-one coaching online may not have the problem of having to work through elders or other users [26, 27], and as many people have preferred ways of communicating online [26, 27], then Virtual Coaches may have to consider the preferred platform of communication for their coachee or mentee. This is known to be a factor in the effectiveness of virtual coaching, as selecting the most appropriate method of virtual coaching is the key to a successful relationship between coach and coachee [30].

Technology is known to be a core factor in ensuring effective virtual coaching, in terms of its development and execution [31]. Virtual coaching, by using technology, can allow for the provision of feedback, such as to learners, which can shape the learning process and the awareness of each party's strengths and weaknesses [32]. Indeed, it is possible for technology that is used for virtual coaching to be manufacture in order to encourage user acceptance [33].

The economic and business case for virtual coaching is also important. With education budgets falling, virtual coaching can save both time and money [34]. It is known to be very effective in ensuring the professional development of staff [35], as well as improve business management skill in education environments [36, 37].

Virtual coaching can help people with disabilities, such as social orientation impairments, especially those with special educational needs (SENs) also [38]. Virtual coaching can help people with SENs overcome problems, such as impairments in functional skills [39, 40]. Professional communication expertise is always helpful in virtual coaching, especially where disabilities and other protected characteristics are accommodated [41].

3 An investigation into the effectiveness of coaching and mentoring for the personal development of working persons

This investigation seeks to assess the efficacy of the GROW model for coaching and mentoring online. The method is not without criticisms, and some have critiqued the way it fails to consider where people are coming from before attempt to determine where they want to go [42]. This section looks at whether such a finding is replicated in online environments – where a lot of barriers are broken down.

3.1 Participant

The participant in the study was not a genuine coachee or mentee, as this would have involved significant ethical considerations, but as the person was experienced in coaching and mentoring, they would be able to provide an authentic context for assessment. Ethical considerations that were implemented however, included the right for the participant to exit taking part in the study if they felt they wanted to, for which they would face no penalty. Online participation posed fewer problems in this regard also.

3.2 Methodology

The GROW method was chosen for its wide use as a near standard method and paired with best practice, namely the do's and don'ts recommended in [43]. This formed the template visible in Annex I, which the researcher referred to when coaching to attempt to provide a systematic approach to what is otherwise a subjective process. This might compare with an emotionalist approach [44]. The session, on Skype, was

recorded with the permission of the participant and then evaluated using Gibb's reflective cycle [45]. This is applied both in terms of the researcher's thoughts and their reading of the participant's theory of mind. The conclusion 'and' action plan parts of this cycle, however, are applied in the conclusions section. The participant was given the name 'Terry' and it was taken that he was 'referred' to coaching because although he was a 'talented and innovative employee' he was beginning to feel 'stuck in a rut' and was demotivated at work so wanted to explore why that is and how to get 'back on track' again.

3.3 Results

In terms of the description of Gibb's cycle, the recording when analysed suggested that focussing on the goals of the mentee could actually assist with the building of a rapport between them and the mentor/coach. It was clear to identify using the GROW model that the person's difficult was with motivation, as they felt a lot of the autonomy they once hand that they lost, showing that by exploring goals the reality can be identified also. Using questions around 'options' appears quite key to understanding the situation, from which the intensions and way forward for the mentee/coachee can be identified and agreed, such as being part of an action plan.

Turning to the specific aspects of the session relating to the use of the online environment it was clear that the aspect of Gibb's cycle relation to emotion and evaluation were most applicable. One might see from the records that the use of online conferencing, such as Skype can actually break down many of the barriers to bonding and rapport. It was much more effective in terms of using a headset to pick up the different tones from the participant in order to judge how best to respond, such as framing the appropriate question. However it is easy to see how more traditional mentees/coachees might not warm to this in the same way, finding the loss of some affective information such as body language would reduce the trust building process rather than enhance it.

It is possible to conclude from this study that coaching and mentoring online can have lots of benefits for an organisation in terms of allowing coaching and mentoring to take part in an environment that the mentee/coachee feels comfortable with. Although the study used a synchronous approach through Skype, other forms of online coaching/mentoring are possible. Email would allow for a more reflective and experiential approach, that would bring out the 'been there and done that' experience of a mentor, as well as the more 'how do we get there' approach in coaching. The study did, however identify limitations in the GROW model that might be better reflected in future coaching and mentoring endeavours.

There are things to be learned from the other models available that could perhaps be used to enhance the GROW model. The addition of the 'Action' and 'Consequences' elements in the OSCAR model are somewhat helpful, but appear to do nothing more than reinforce the main aspects of GROW. The Empowerment component of the CARE model could be used to enhance what is proved through GROW, going beyond the CARE model, by focussing on the development of skills and not just the realisation of where one has been and where one wants to go. Figure 1 proposes adding two other elements to make the acronym GROWER, which are 'engage' and 'routinize.' In the case of the first, this refers to the need to understand what it is that motivates the mentee/coachee above all other things, so that the coach/mentor can devise options that most fit with the person's outlook.

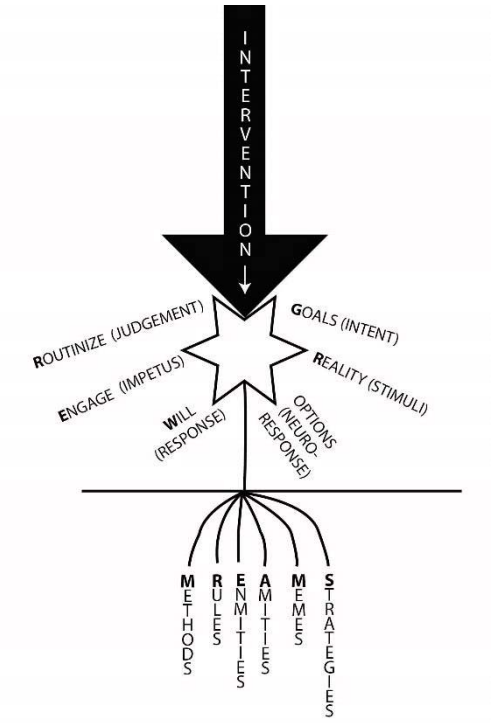

Figure 1 The GROWER model as an online alternative to the GROW model

An example in the study was the participant being identified as being motivated by autonomy and independence. In the case of the second, it is usually necessary as part of a coaching/mentoring session for certain skills or practices to be developed for long-term benefit. In the case of the participant in this study that was reflected in terms of them seeking out opportunities where they can make use of their self-managing abilities. In addition Figure 1 suggests the 'M-REAMS' approach, by extending the M-MARS approach in [46] to include 'enmities,' based on the newly identified 'bothered' cognitive bias. Enmities are people who inhibit one's goal. In the case of the participant in this study that was his line-manager. The model as a whole can be useful for reflecting on a coaching session, as an alternative to Gibb's model, which along with the 'GROWER' model provides an integrated approach to reflecting mentoring/coaching. With online approaches, it is possible for participants to record the conversation and play it back to enable reflection. Thinking in terms of the 'Methods' (e.g. what approaches they use or want), their Rules (what they feel they must do), their Amities (who they feel is on their side), their Memes (what they believe or want to believe) and their Strategies (what they want to

achieve) can complement the original GROW model as well as the proposed GROWER model.

4 The role of the Virtual Coach and GROWER model in transforming learning in traditional teaching contexts

It is known that an important part of knowledge transformation is the development of a personal relationship between an educator and a learner. When most think of education, this usually creates word pictures of a teacher at the front of a class, who might best be seen as a broadcaster of information [47]. As this paper has shown, personal relationships are not developed through isolationist practices like classroom-based teaching focused around the teacher as the fountain of all knowledge. They are based designing one's organisation around more personalised development, whether one-to-one contact, like Skype or email, or informal learning where learners pick up knowledge in non-formalised contexts where learning outcomes drive the direction of activity.

4.1 The role of Classroom 2.0 enhanced by prosthetic technology to aide Virtual Coaching

Classroom 2.0 is the name given to an approach to education, based on network learning, where students participate not only with their peers in a physical space (i.e. Organic communities), but also in a virtual space (i.e. virtual communities), such as through telepresence. The term Classroom 2.0 was coined by Spanish and Italian academics [48], but the concept has existed for much longer [49-51].

Table 1 Merging the GROWER model with Classroom 2.0 practice

Component	Description
The physical learning environment	The physical environment, represented by the arrow in the GROWER model, is the part of the model where the intervention towards the coachee occurs
The mediated environment	The mediated environment, represented by the star in the GROWER model, is the user interface through which stimuli is presented to evoke thoughts in the coachee.
The augmented environment	The augmented environment, represented by the shoots going into the ground in the GROWER model, is the interface between the human and the computer through which the user is subjected to and influenced by changes to their environment and their belief system.

Table 1 sets out the common elements of a typical networked learning environment based on Classroom 2.0 synthesised with the elements of the GROWER model.

4.2 The physical learning environment

The physical learning environment for the system is based around the AVEUGLE system devised as part of the Digital Classroom of Tomorrow Project [49, 52].

Using either PCs, tablets, smartphones, or similar, the learners can take part in a networked learning environment, where participants can be taking part at a distance or within the classroom. The physical environment is therefore very different for each learner, who may be using different hardware set-ups and may be in different sorrow dings if they are interacting at a distance.

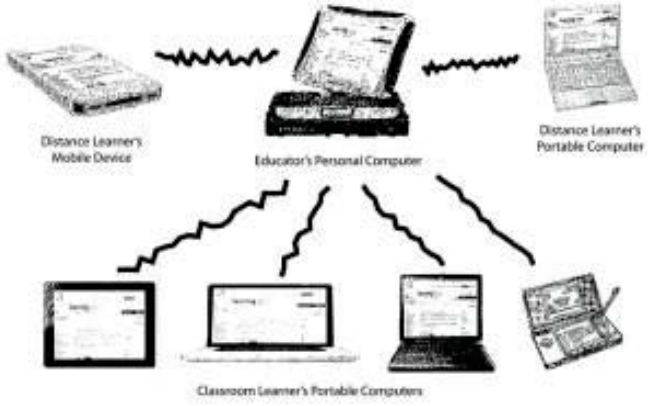

Figure 2 Conceptual framework for the AVEUGLE component

As can be seen from Table 2, the educator uses their PC as a facilitating device to suggest responses or actions to learners, who interact with each other either in person or remotely. This generally involves and instruction from the educator, which may involve responding to a request through an audience response plug-in.

The capturing of information from learners can take many forms, but generally it involves collecting data from the one learner, the network, and the learner or educator they are connected with in a networked learning environment.

The translator elements takes inputs, such as facial, dialogue or prosody effect [53], or user response data on their interests [49, 52] for instance. The translator does not attempt to persuade the users of the networked learning environment, only provide information on what the other person means.

This can be essential for ensuring any implementation of the GROWER model, as the system should be able to detect the existence of external representations in order to detect in the networked learning environment factors such as methods, rules, enmities, amities, memes and strategies, which are observable from detecting the goals (i.e. Intent), reality (i.e. stimuli), options (i.e. neuro-response), will (i.e., engage), and routinize (i.e. judgement).

Table 2 Functions of the AVEUGLE component

Function	Description
Sending User/Device	This can include the device of the educator or learner, from which information can be sent through a server, or bridge for instance.
Receiving User/Device	This includes the device used by the educator or teacher, through which information from the system, including educator instructions and learner feedback, is displayed.
Translator	Presents information to a learner in the language they understand, including based on ability and learning level
Facilitating Device	Used by the educator to fine tune the learning experience of learners' devices
Bridge	Allows users to connect over a virtual space sharing information
Server	Allows for the interaction of two or more users, such as in a classroom or remote from it
Receiving Device	Displays information, such as translation, to a user, such as in a classroom or remote from it
Bridge	Allows for users to interpret others via their Devices remotely using a Server
Sending User	The user that is sending information, such as audio and video captured through their device.
Receiving User	The user that makes use of the sent information that has been parsed through a translator
Sending Device	The device used by the sending user, such as a phone with front facing camera or video/Internet glasses with a camera facing another, in order to send information to another user through s server, bridge or similar.

4.3 The mediated environment

The mediated environment is based on an invention called PARLE [53]. As can be seen from Figure 3, PARLE is a system for receiving information from the device of one user, processing it over a server, translating it into a more suitable piece of information and then presenting that to the receiving user.

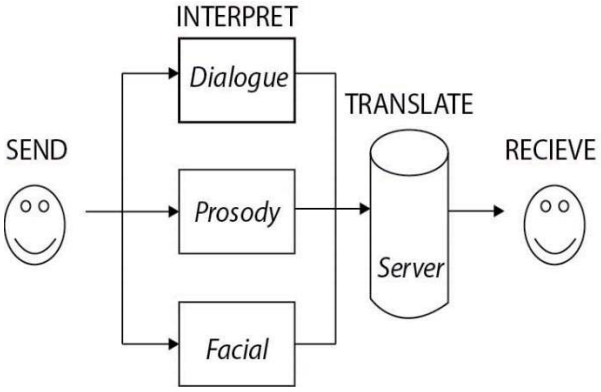

Figure 3 A conceptual framework of the PARLE component

Table 3 presents the functions of the PARLE component and describes how they work. As can be seen, the translator is a core component of the system. This receives information from one person, processes it to determine the meaning, and then tells another person of the meaning. This includes emotional information, as presented in Table 3, but can include cultural codes more generally. The problem with distance communication is that miscommunications can occur, which can affect the coach-coachee relationship.

Table 3 The functions of the PARLE component

Function	Description
Translator	Receives sent information, such as audio/video; interprets it into dialogue, prosody and facial affect; translates it into a meaning another user can understand

4.4 The augmented environment

The augmented learning environment, called PAIGE (Figure 4), is used to provide statements or instructions to users based on their response to previously presented information [54]. In terms of a Virtual Coach, this could include them being told what a user is meaning at a distance, and give a number of suggested responses for them to enhance the coach0coachee relationship.

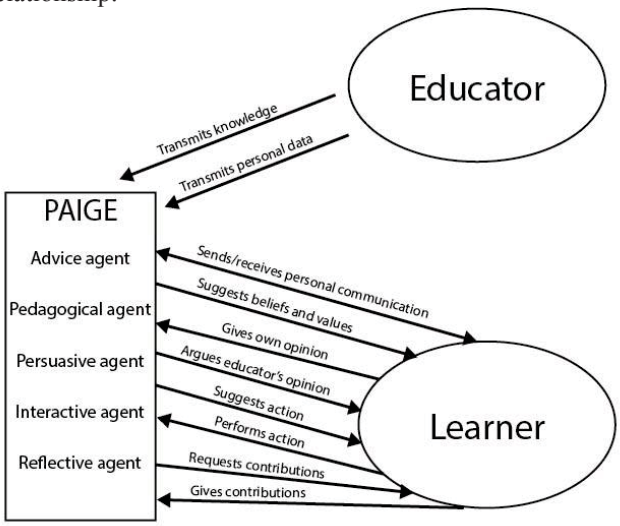

Figure 4 A conceptual framework of the PAIGE component

Table 4 presents the functions of PAIGE, which as can be seen are very similar in structure to PARLE, making developing a system to enhance the coach-coachee relationship that much easier.

Table 4 The Functions of the PAIGE component

Component	Description
Sending User	The sending user can be the educator populates the database or the user who interrogates it
Receiving User	The receiving user can be the learner who is being persuaded by the

	system, or the educator who can modify the database
Sending/Receiving Device	The learner's device will receive instructions and be used to reply to those
Intelligent Agent	The intelligent agents identify the most effective means to advise, persuade and assist the user in interaction, learning and reflecting.
Translator	Translates educator's knowledge instructions into ones learner can understand and be persuaded by

5 Towards AVEUGLE – The Audiovisual Enhanced UI for a GROWER Learning Experience

This section presents the amalgamation of the AVEUGLE, PARLE and PAIGE components as set out above into a system called the Audiovisual Enhanced UI for a GROWER Learning Experience (AVEUGLE).

As can be seen from **Erreur ! Source du renvoi introuvable.**, AVEUGLE involves at least two people, sending and receiving information, who can either interact in person within an organic community or remotely through a virtual community. Whilst devices, servers and routers are referred to in the Bridge component in the middle of **Erreur ! Source du renvoi introuvable.**, it is quite possible other technologies could be used, such as an educator's laptop as shown in Figure 2 au-dessus.

The key element of AVEUGLE is that it has sending and receiving users using some form of device, this is interfaced with a bridge or facilitating human, through which a translator and artificially intelligent agents enhance the communication of the coach and coachee.

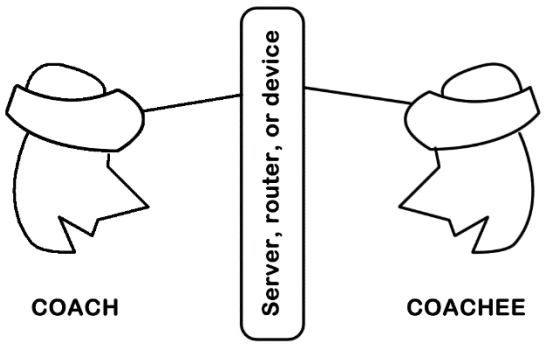

Figure 5 The AVEUGLE prosthetic learning environment for Virtual Coaching

5.1 Sending/Receiving User/Device

The sending and receiving component of AVEUGLE can include the one that a coachee is most familiar with, or in the case of sessions in organic communities it could be used by the Virtual Coach in person, and could take the form of a Google Glass, or Microsoft HoloLens.

The purpose of the technology would be to allow the Virtual Coach and coachee to send and receive information that is accessible to both, such as to overcome cultural or other differences that might make a relationship difficult. Figure 6 presents an example interface AVEUGLE could use.

Figure 6 A possible interface for AVEUGLE augmenting information with a live video input

5.2 Facilitator/Bridge

In most cases the information from the sending and receiving devices will have to be parsed through some form of device, which can include the Virtual Coach's computer, or a Cloud-based device such as a server. Using a server can mean a lot of the processing power needed for AVEUGLE would be away from the client device, and would improve the user experience. Ensuring the interoperability of bridges is known to affect the extent to which a technology functions and is used in domestic environments [55]. It is know that with e-learning systems in particular that using bridges for interoperability is essential [56].

5.3 Translator

The translator component of the system receives information, processes it and then provides a statement or recommendation [53, 54, 57]. As can be seen below, it involves working with language use and behaviour detection; language translation; an intelligent agent and recommender system; as well as fluid and dynamic text.

5.3.1 Language use and behaviour detection

The system has been designed to be able to identify representations of social norms in virtual communities, which may be different from those in organic communities. Understanding behaviour and the use of language is known to be important in online learning environments designed to promote user interaction [58].

Understanding language use in online environments is important in helping avoid unwanted behaviours such as flaming or trolling [59].

Table 5 Example language use and behaviour detection for Empathics

Organic community want	Virtual Community want
Give an empathic twenty minutes of unsolicited, quality attention each day	Calculating the length of time two people chat for
Bring an empathic flowers as a surprise as well as on special occasions	Calculate number of virtual gifts sent
Compliment an empathic on how they look	Identify compliments in chat text
Give an empathic four hugs a day	The number of times a 'send a hug' card is sent, posts liked, etc.
Tell an empathic: "I love you at least a couple of times every day"	Count the number of times a person says "I love you"
Take her side when she is upset with someone.	Difficult, although phrases such as "I believe you" could be searched for
Display affection in public.	Check whether symbols of love are said in public chat room other than a private one.
Pay more attention to her than others in public.	Check that the number of chat messages to someone's partner is greater than to other community members.
Buy her little presents, like a small box of chocolates or perfume.	Calculate the number of greetings someone send their partner
Write a note or make a sign on special occasions such as anniversaries and birthdays.	Calculate the number of greetings sent or classifieds placed to someone's partner near their birthday or specified event.
Surprise her with a love note or poem	Calculate the number of 'Love' greetings sent.
When listening to her, reassure her that you are interested by making little noises.	Check for words of agreement in chat text.
Ask her how she is feeling	Check for phrases such as "how are you" in chat text.
If she has been sick in some way, ask for an update and ask how she is doing or feeling	Check number of "Get Well Soon" greetings are sent.
Let her know that you missed her when you went away.	Calculate number of "I missed you" or "welcome back" greetings.

As can be seen from Table 5 and Table 6, there are differences in language behaviour online compared to offline [60].

Table 6 Examples of language use and behaviour detection by Autistics

Organic community want	Virtual community want
He makes a mistake and she doesn't say "I told you so"	Check that chat text does not include "I told you so"
He disappoints her and she doesn't punish him	Check that chat text does not include certain negative words
When she has hurt him and she understand his hurt, she apologises and gives him the love he needs	Check for words of apology in chat text, such as "I'm Sorry". Calculate the number of "I'm Sorry" cards that are sent.
When he apologises for a mistake, she receives it with loving acceptance and forgiveness.	Check for keywords in chat text, such as "that's okay"
She asks for his support rather than dwelling on what he has done wrong	Check for keywords such as "can you" or "would you" in chat text.

5.3.2 Language translation

The device and/or bridge could detect cultural cues as well as other information, in order provide a recommendation based on this [54]. This can include updating a person's reputation value (i.e. kudos score) so people know they are likely to be treated more favourably [60].

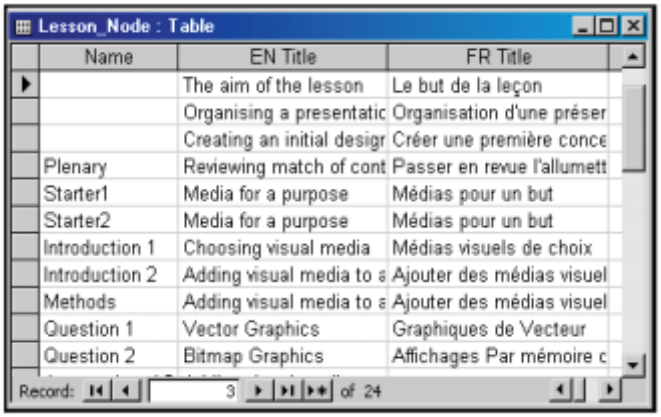

Figure 7 Cultural translations from AVEUGLE

The system could track what someone says in a discussion group and then translates this according to its merits (i.e. whether it is positive or negative) and then display that translation through increasing or decreasing someone's reputation, affecting how others perceive them in the online space they are present within [60]. Language translation that takes account of cultural cues is known to be important in promoting equality and diversity [61]. Difficulties with translating language and cultural cues is known to be a problem assisting the integration of minorities into communities [62], so

having this functionality in a virtual coaching environment is essential.

5.4 Intelligent agent and recommender system

The intelligent agent and recommender system can be implanted through sending statements to the AIML file and the possible response back to the user. This can be used initiate culturally aware instructions.

Recommender systems have played a big part in e-commerce for decades [63], and there is no reason for to not be introduced into education. Such systems can be introduced into the education system through animated pedagogical agents, which are virtual characters that augment the learning process [64].

An example of how the animated pedagogical agent that could be user facing in order to gather information is presented in Figure 8. Furthermore, as the interests of secondary school learners are likely to change frequently [65], educational material will always appear current and relevant if the learner is encouraged to update their profile [49].

Figure 8 An intelligent animated pedagogical agent for use with AVEUGLE

Through the APA, educators have the option to embed parameters into learning material to personalise it with textual artefacts that have been defined by the individual learner. This is achieved through placing the parameter into a specific part of the text and surrounding it with parentheses.

For example, if the learner's favourite actor was Tom Cruise, the text, "*Write about a movie starring {User_Char_FavActor} that you enjoyed*" would be converted into "*Write about a movie starring Tom Cruise that you enjoyed*", which should create a positive attitude towards the activity as it is about something the learner is interested in.

Furthermore, as the interests of secondary school learners are likely to change frequently, educational material will always appear current and relevant if the learner is encouraged to update their profile.

5.4.1 Dynamic and Fluid Text

Dynamic text, which involves the personalising of an interface to the learner, has been used significantly in systems based around Adobe Flash [66]. Educators have the option to embed parameters into learning material to personalise it with textual artefacts that have been defined by the individual learner. This is achieved through placing the parameter into a specific part of the text and surrounding it with parentheses [49]. For example, if the learner's favourite actor was Tom Cruise, the text, "*Write about a movie starring {User_Char_FavActor} that you enjoyed*" would be converted into "*Write about a movie starring Tom Cruise that you enjoyed*", which should create a positive attitude towards the activity as it is about something the learner is interested in. Table 7 shows how they system adapts the language depending on the ability of the learner using it.

Table 7 Adaptive learning levels in AVEUGLE

NC Level	Bloom Level	Personalisation
1	1	Knowledge: Restructures content and rewords questions to encourage observation and recall of artefacts and subject matter
2	1	As NC level 1
3	2	Comprehension: Restructures content and rewords questions to encourage learners to develop a social context of artefacts and understand their meaning.
4	2	As NC level 3
5	3	Application: Restructures content and rewords questions to encourage learners to apply knowledge to other social context and situations.
6	4	Analysis: Restructures content and rewords questions to encourage learners to make relationships between artefacts and recognise patterns and hidden meanings
7	5	Synthesis: Restructures content and rewords questions to encourage learners to use artefacts in different contexts and situations and develop new concepts and ideas.
8	6	Evaluation: Restructures content and rewords questions to encourage learners to compare uses of artefacts and develop theories and select artefacts based on reasoned argument.

Figure 9 presents an example of the way a system can provide additional information to users to make using the system more suited to their ability or other differences [49].

In this case the "longdesc" attribute, which is used to provide longer and more detailed descriptions (No Reference Selected) is modified so that by looking at the bottom of a browser, the user can see the purpose of the link they are hovering over.

Using a prosthetic system like Google Glass, it would be possible for this to be implemented using menu selection and stroke input [67].

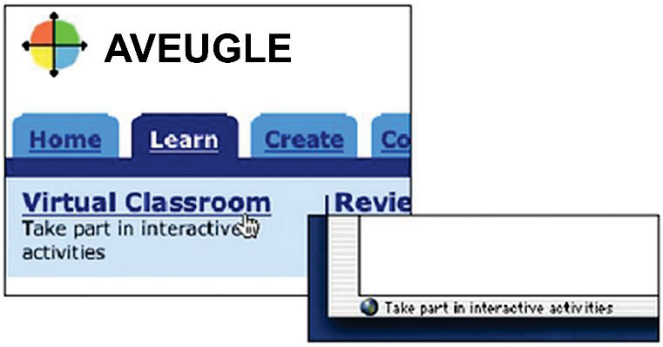

Figure 9 An example of how links can be made fluid through adaptive technology

6 Discussion

This study has sought to look at the purpose, benefits and appropriate situations for coaching and mentoring in the workplace. In particular it has look at the roles Virtual Coaches can play by using techniques such as synchronous interviewing on Skype. Such an approach makes managing issues to do with ethics much simpler and also break down some barriers to communication in many different mentees. The study has identified that there are many different models for coaching and mentoring, including long established one's like GROW. But even these are limited in application to the internet, where factors like intrinsic motivation and the development of specific and targeted skills are an issue.

Through carrying out a test of an online coaching session using Skype, which was based on the scenario of an employee named Terry, who was 'stuck in a rut,' it was clearly to see that a Virtual Coach can be as effective as an offline one. It was also found that coaching and mentoring online can actually enhance the ability to pick up on tone of voice for a more systematic and empathetic approach to assisting a coachee or mentee. It is clear from this study that there are a lot of benefits to being coached or mentored by a Virtual Coach, but the methods used may need to be revised, and greater focus is needed on the coachee/mentee in order to build rapport.

This study then fed into the design of a system that could enhance the coach-coachee relationship, including through the use of prosthetic technology. The system proposed using devices to send and receive information through a server or an educator's device as a facilitator, which can then be translated into something more appropriate for users. This could for instance break down any language barriers caused by differences in culture.

6.1 Implications and Future Research Directions

This paper has established that a Virtual Coach can be as effective as one where communications take place in person. By carrying out a recorded coaching and mentoring session online, it was possible to see the implications of the practice. The existence of Virtual Coaches can therefore offer benefits to workers, especially as they can be in any place when taking part in a coaching or mentoring session. Future research will have to look at the effectiveness of coaching and mentoring online in more detail, such as through observing many more participants than in this study.

Coaching and mentoring can be effectively carried out online and have the same benefits as in-person mentoring, but without many of the social barriers that online participation filters out. Changes are needed however to take account of the differences between online and offline coaching, and as this study has shown, the GROW model can be effective in providing structure, but its absence of encouraging the understanding of what motivates a particular individual being coached or mentored means it might not provide the easy opportunity to build rapport through the coach being able to convey empathy and understanding. Thus future research will be necessary to extend the findings of this study – that to improve engagement understanding intrinsic motivations is necessary – will have to be explored further. The study also found that it is important in any coaching setting, but especially online, for the coachee/mentee to routinize what they have learned so that it is possible to take more from the session than it being a simple chat or conversation. Future research will need to look at the specific approaches that can be used to facilitate this.

The paper has proposed a system, called AVEUGLE, for assisting the interaction between a Virtual Coach and their coachee, which can be implemented through existing devises as well as newly emerging prosthetic technologies. Further research will have to implement the system design of AVEUGLE and test whether it can actually improve the coach-coachee experience. The embodiments of AVEUGLE in this paper have focussed mainly on online coaching and mentoring. Future research should consider its wider implications for increasing access to information more generally. For instance, those who find it difficult to watch films and know what is going on due to a lack of awareness of the affective states of characters could be given real-time information about this, and recommended options. Other research could look at using the chat-functions of AVEUGLE to make literature more accessible to those who would otherwise be unable to access it.

7 References

[1] J. Derrida. "Writing and difference". Psychology Press, 2001.

[2] JE Maritz & L. Roets. "A virtual appreciative coaching and mentoring programme to support novice nurse researchers in Africa"; 2013.

[3] Christian van Nieuwerburgh & Chloé Tong. "Exploring the benefits of being a student coach in educational settings: a mixed-method study"; *Coaching: An International Journal of Theory, Research and Practice,* 6., 1, 5-24, 2013.

[4] Fadila Grine. "Empowering Muslim Women Though Executive Coaching & Mentoring"; *International Journal of Nusantara Islam,* 2., 1, 54-68, 2014.

[5] Gary N. McLean, Baiyin Yang, Min-Hsun Christine Kuo, Amy S. Tolbert & Carolyn Larkin. "Development and initial validation of an instrument measuring managerial coaching skill"; *Human Resource Development Quarterly,* 16., 2, 157-178, 2005.

[6] Richard Phillips. "Coaching for higher performance"; *Management Development Review,* 7., 5, 19-22, 1994.

[7] Terry R. Bacon. "Helping people change"; *Industrial and Commercial Training,* 35., 2, 73-77, 2003.

[8] Tom Stehlik, Tom Short AND Janene Piip. "The challenges of leadership in the twenty-first century"; *Workforce Development* (Springer) Anonymous 193-2112014.

[9] Frederik Ferdinand Rosén. "No words will deliver anything: coaching and mentoring as neoliberal governance strategy in the Afghan state administration"; *Journal of Intervention and Statebuilding,* 5., 2, 151-173, 2011.

[10] Bob Little. "Virtual value soars for sales-related skills"; *Industrial and Commercial Training,* 46., 5, 5-5, 2014.

[11] Michael E. Skinner & Frances C. Welch. "Peer coaching for better teaching"; *College Teaching,* 44., 4, 153-156, 1996.

[12] Anne Brockbank. "Is the coaching fit for purpose? A typology of coaching and learning approaches"; *Coaching: An International Journal of Theory, Research and Practice,* 1., 2, 132-144, 2008.

[13] George H. Stevens & Gary W. Frazer. "Coaching: The missing ingredient in blended learning strategy"; *Performance Improvement,* 44., 8, 8-13, 2005.

[14] D. L. Waddell & N. Dunn. "Peer coaching: the next step in staff development"; *Journal of continuing education in nursing,* 36., 2, 84-9; quiz 90-1, 2005.

[15] Connie L. Bowman & Sandra McCormick. "Comparison of peer coaching versus traditional supervision effects"; *The Journal of Educational Research,* 93., 4, 256-261, 2000.

[16] Fran Deans & Louise Oakley. "Coaching and mentoring for leadership development in civil society". INTRAC, 2007.

[17] S. Spezzini, JS Austin, G. Abbott & R. Littleton. "Role reversal within the mentoring dyad: Collaborative mentoring on the effective instruction of English language learners"; *Mentoring & Tutoring: Partnership in Learning,* 17., 4, 297-315, 2009.

[18] Barbara A. Wasik & Annemarie H. Hindman. "Improving vocabulary and pre-literacy skills of at-risk preschoolers through teacher professional development."; *Journal of educational psychology,* 103., 2, 455, 2011.

[19] Diana Martinez. "The Mentor Program for Undergraduate Students at Stamford International University". The National Conference on Management and Higher Education, 2014. , 64.

[20] Catherine Dixon. "Empowering life choices"; *Intervention in Mental Health-Substance Use,* 225, 2011.

[21] Jacquie Turnbull. "Coaching for learning: a practical guide for encouraging learning". Continuum International Publishing Group, 2009.

[22] Jackie Arnold. "Coaching Supervision at its B.E.S.T". 2014. .

[23] Jenny Rogers, Karen Whittleworth & Andrew Gilbert. "Manager As Coach: The New Way To Get Results: The New Way to Get Results". McGraw-Hill International, 2012.

[24] Niloofar Ghods & Camala Boyce. "Virtual coaching and mentoring"; *The Wiley-Blackwell Handbook of the Psychology of coaching and Mentoring.Chichester: Wiley-Blackwell.S,* 501-523, 2013.

[25] Grace McCarthy. "Approaches to the postgraduate education of business coaches"; *Australian Journal of Adult Learning,* 50., 2, 323, 2010.

[26] N. James & H. Busher. "Online Interviewing". Sage Publications, 2009.

[27] Jonathan Bishop. "Increasing participation in online communities: A framework for human–computer interaction"; *Computers in Human Behavior,* 23., 4, 1881-1893, 2007.

[28] Blair Nonnecke & Jennifer Preece. "Lurker demographics: Counting the silent". Proceedings of the SIGCHI conference on Human factors in computing systems, ACM, 2000. , 73-80.

[29] G. Mantovani. "New Communication Environments: From Everyday to Virtual". Taylor & Francis, 1996.

[30] Amit Mitra & Aditi Kalia. "Role of virtual coaching to develop human capacity among organisations"; *ACM Transactions on Computer-Human Interaction (TOCHI),* 2010.

[31] Narissra Maria Punyanunt-Carter & Emilio S. Hernandez. "Virtual Mentoring"; *Communication, Relationships and Practices in Virtual Work,* 177, 2010.

[32] Marcia L. Rock, Naomi P. Zigmond, Madeleine Gregg & Robert A. Gable. "The Power of Virtual Coaching."; *Educational Leadership,* 69., 2, 42-48, 2011.

[33] Anja Leist & Dieter Ferring. "Technology and aging: Inhibiting and facilitating factors in ICT use"; *Constructing Ambient Intelligence* (Springer) Anonymous 166-1692012.

[34] Megan Allen. "Catching the Bug: How Virtual Coaching Improves Teaching"; *Educational Horizons,* 92., 4, 25-27, 2014.

[35] Kay Cantwell. "Virtual Coaching: The Cure Professional Development Blues?"; 2007.

[36] Tina Salter. "Equality of mentoring and coaching opportunity: making both available to pre-service teachers"; *International Journal of Mentoring and Coaching in Education,* 4., 1, 69-82, 2015.

[37] Marcia L. Rock, Madeleine Gregg, Pamela W. Howard, Donna M. Ploessl, Sharron Maughn, Robert A. Gable & Naomi P. Zigmond. "See Me, Hear Me, Coach Me."; *Journal of Staff Development,* 30., 3, 24, 2009.

[38] Robert A. Gable. "Teaching Students with Emotional Disabilities: Challenges and Opportunities"; *Special Education Past, Present, and Future: Perspectives from the Field (Advances in Learning and Behavioral Disabilities, Volume 27) Emerald Group Publishing Limited,* 27., 117-140, 2014.

[39] Maya Israel, Christina R. Carnahan, Kathleen K. Snyder & Pamela Williamson. "Supporting new teachers of students with significant disabilities through virtual coaching: A proposed model"; *Remedial and Special Education,* 0741932512450517, 2012.

[40] Arjen Brandenburgh, Ward van Breda, Wim van der Ham, Michel Klein, Lisette Moeskops AND Peter Roelofsma. "Increasing Physical and Social Activity through Virtual Coaching in an Ambient Environment"; *Active Media Technology* (Springer) Anonymous 487-5002014.

[41] David Clutterbuck. "Making the Virtual Development Program Work"; *Virtual Coach, Virtual Mentor* (Information Age Publishing, Inc.) David Clutterbuck & Zulfi Hussain (Eds.), 312010.

[42] Anthony M. Grant. "Is it time to REGROW the GROW model? Issues related to teaching coaching session structures"; *The Coaching Psychologist,* 7., 2, 118-126, 2011.

[43] Andrew Jones. "Workplace Mentoring Guide". Interactive Publications, 2012.

[44] D. Silverman. "Interpreting qualitative data: Methods for analyzing talk, text and interaction". Sage Publications, 2006.

[45] G. Gibbs. "The reflective cycle"; 1988.

[46] Jonathan Bishop. "The Equatrics of Intergenerational Knowledge Transformation in Techno-cultures: Towards a Model for Enhancing Information Management in Virtual Worlds". 2011. .

[47] D. Tapscott. "Growing Up Digital: The Rise of the Net Generation". McGraw-Hill, 1998.

[48] Gabriella Taddeo & Simona Tirocchi. "Learning in a "Classi 2.0" Classroom: First Results from an Empirical Research in the Italian Context"; *Didactic Strategies and Technologies for Education: Incorporating Advancements* (IGI Global) Paolo M. Pumilia-Gnarini, Elena Favaron, Elena Pacetti, Jonathan Bishop & Luigi Guerra (Eds.), 57-672012.

[49] Jonathan Bishop. "The potential of persuasive technology for educating heterogeneous user groups". 2004. .

[50] Mike Reddy. "Using CU-Seeme Video Conferening via the Information Superhighway to support distance learning of the ACE Initiative at Level 12". 1997. .

[51] Mike Reddy. "Using the Information Superhighway to support the ACE Initiative at Level 12". The 2nd BP International Conference on Students as Tutors and Mentors, London, GB. 2-5 April 2007, Sinclair Goodlad, Ed. 1997. .

[52] Jonathan Bishop. "Co-operative e-learning in the multilingual and multicultural school: The role of 'Classroom 2.0' for increasing participation in education"; *Didactic Strategies and Technologies for Education: Incorporating Advancements* (IGI Global) P. M. Pumilia-Gnarini, E. Favaron, E. Pacetti, J. Bishop & L. Guerra (Eds.), 137-1502012.

[53] Jonathan Bishop. "The Internet for educating individuals with social impairments"; *Journal of Computer Assisted Learning,* 19., 4, 546-556, 2003.

[54] Jonathan Bishop. "The Role of Multi-Agent Social Networking Systems in Ubiquitous Education: Enhancing Peer-Supported Reflective Learning"; *Multiplatform E-Learning Systems and Technologies: Mobile Devices for Ubiquitous ICT-Based Education* (IGI Global) T. T. Goh (Ed.), 72-882009.

[55] Kyeong-Deok Moon, Young-Hee Lee, Chang-Eun Lee & Young-Sung Son. "Design of a universal middleware bridge

for device interoperability in heterogeneous home network middleware"; *Consumer Electronics, IEEE Transactions on,* 51., 1, 314-318, 2005.

[56] Georg Weichhart. "Supporting the evolution and interoperability of organisational models with e-learning technologies"; *Annual Reviews in Control,* 2015.

[57] Jonathan Bishop. "The Role of Augmented E-Learning Systems for Enhancing Pro-social Behaviour in Socially Impaired Individuals"; *Assistive and Augmentive Communication for the Disabled: Intelligent Technologies for Communication, Learning and Teaching* (IGI Global) Lau Bee Theng (Ed.), 248-2722011.

[58] Jeff Orkin & Deb Roy. "The restaurant game: Learning social behavior and language from thousands of players online"; *Journal of Game Development,* 3., 1, 39-60, 2007.

[59] E. Eugene Schultz. "A framework for understanding and predicting insider attacks"; *Computers & Security,* 21., 6, 526-531, 2002.

[60] Jonathan Bishop. "Development and Evaluation of a Virtual Community". 2002. .

[61] Barbara Hayes-Roth, Heidy Maldonado & Marcia Moraes. "Designing for diversity: Multi-cultural characters for a multi-cultural world". Proceedings of IMAGINA, 2002. , 207-225.

[62] Qingwen Xu, Venera Bekteshi & Thanh Tran. "Family, school, country of birth and adolescents' psychological well-being"; *Journal of Immigrant & Refugee Studies,* 8., 1, 91-110, 2010.

[63] J. Ben Schafer, Joseph Konstan & John Riedl. "Recommender systems in e-commerce". Proceedings of the 1st ACM conference on Electronic commerce, ACM, 1999. , 158-166.

[64] Hanju Lee, Yasuhiro Kanakogi & Kazuo Hiraki. "Building a responsive teacher: how temporal contingency of gaze interaction influences word learning with virtual tutors"; *Royal Society Open Science,* 2., 1, 140361, 2015.

[65] Carol Ann Tomlinson. "Differentiated classroom: Responding to the needs of all learners". Ascd, 2014.

[66] Madeleine Sorapure. "Text, image, code, comment: Writing in Flash"; *Computers and Composition,* 23., 4, 412-429, 2006.

[67] Liwei Chan, Rong-Hao Liang, Ming-Chang Tsai, Kai-Yin Cheng, Chao-Huai Su, Mike Y. Chen, Wen-Huang Cheng & Bing-Yu Chen. "Fingerpad: private and subtle interaction using fingertips". Proceedings of the 26th annual ACM symposium on User interface software and technology, ACM, 2013. , 255-260.

Assessment Issues for MOOCs and Large Scale Examinations and Robust, Objective Testing with Reverse Multiple-choice

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Abstract. *For the examinations taken by very large numbers of students, such as the SAT or the ACT, multiple-choice form of questions has traditionally been used. These tests are machine-gradable, uniform, scalable, low-cost, and allow for testing of greater segment of the subject matter and eliminate grader's bias. But the format lacks incisive and probative information for instructors/ examiners or reliable feedback for students. Massive Open Online Courses have fueled renewed quest for assessment alternatives, which are discussed. The current approaches leave ample room for improvement, however, especially when students' achievement has to be measured for college credit or certification. The Reverse Multiple-choice Method can provide computerized testing and an elegant answer to assessment concerns for MOOCs, that may be combined with the other approaches and peer grading.*

Keywords: Assessment, MOOC, multiple-choice, on-line education

1. Introduction:

Educational assessment on large scale

Educational assessment on a very large scale has seen renewed interest in the recent years with the advent of Massive Open Online Courses (MOOCs), since by design, MOOCs may have hundreds of thousands of students or more. This unprecedented spread of internet-mediated education has given rise to new problems of scale. Assessment for MOOCs remains an open problem and an active area of research at major universities, e.g., Stanford, Harvard, MIT and Princeton

Reliable assessment and feedback have always been an integral component of education. Whereas the feedback came instantly for an ancient student learning at the feet of a guru, the immediacy between learning and assessment has been eroding with the education of the masses. Assessment on a massive scale is still a key educational activity, but it needs to be managed remotely, and online for a MOOC.

Standardized tests, mainly in multiple-choice format, have traditionally been used on very large scale, for instance for Scholastic Aptitude Test (SAT) or American College Testing (ACT), in order to compare achievement levels of college bound high school seniors from diverse institutions. But, the testing methods of SAT/ACT cannot simply be extrapolated to MOOCs, and novel assessment approaches have been tried for them in addition including portfolios, blogs, wikis, forum discussions and peer grading. Especially when college credit or certification of achievement hinges on the assessment, these new testing approaches raise concerns for MOOCs and other massive courses, such as governmental or corporate training.

In this paper, we review assessment issues relating to scale, consider the solutions in vogue, and propose how Reverse Multiple-choice Method (RMCM), a scalable, computerized method may be used, to have a cost effective and reliable assessment component however large the number of test-takers.

2. Assessment options for large scale

2.1 Multiple-choice tests for high school

Multiple-choice tests have been used for high school students for one hundred years. There is considerable collective experience and a wealth of test items for multiple-choice tests. SAT and ACT were conducted exclusively via multiple-choice until 2005, and the format is employed extensively, e.g., as part of admission tests for higher education or licensing tests. Examples include Graduate Record Examination, Graduate Management Admission Test, and Law School Admission Test. Multiple-choice format has many advantages: It is objective, machine-gradable, uniform, scalable, and it allows for a greater cross section of the subject matter to be tested and a wider swath of feedback. Multiple-choice tests are also less

expensive to conduct and grade than open-format essays, and provide grades untainted by grader bias.

For significant, milestone examinations, such as the SAT and the ACT, the appropriate passing bar is statistically determined. Substantial research and resources have gone into these exams to interpret the "raw" scores into appropriate "scaled" scores, so that the students can be meaningfully compared to their peers' percentiles and no group gains an unfair advantage. In theory, such comparison enables colleges to make admission decisions for a student with some assurance of future success in college.

Contrarily, some studies have also shown a lack of strong correlation between the results of these large examination and success in college. Therefore experimentation with test formats continues at the examining bodies and college administrations about the weight to be given to such "standardized" testing.

In 2006, for example, Educational Testing Service (ETS), which administers SAT, added the requirement of an open format essay to be written by the test-takers during the examination. This addition of a new component to the test of English and basic Mathematics raised the total number of points from 1600 to 2400. In March 2015, however, ETS eliminated the essay and returned to old scheme of test and 1600 points. There are many reasons for these changes, several of which are not relevant to our present discussion.

Two points are noteworthy, however: The cost of conducting SATs rose by more than 30% with the introduction of the essay portion; and, the enormous logistical and cost burdens of open format alternatives are at least partly responsible for the popularity of multiple-choice tests for large scale academic exams.

2.2 Assessment options for MOOCs

Assessment remains a tenuous link in the delivery of knowledge and learning via the MOOCs. Unlike the milestone exams like the SAT/ACT which command significant fees, because of the cost burden, using physical testing centers for many thousands of geographically spread out examinees is out of the question for a MOOC. So is centralized grading of open format long or short essays. For MOOC-scale even the use of multiple-choice exams, where a test-taker merely marks correct answers, is fraught with challenges of proctoring and control of plagiary and cheating.

Assessment for MOOCs, therefore, often relies on novel approaches. These include many forms of students' term portfolios, projects, blogs, wikis and forum discussions, and new ways of feedback and grading, particularly in the humanities. The enormous logistical challenge of grading/evaluating these submissions is handled by recruiting the legions of students themselves through "peer grading."

2.3 Peer grading

Peer grading has emerged as one of the most promising and studied answers to grading dilemma for MOOCs. In broad terms, the mechanism of peer grading works as follows: Each student grades, and has his or her submission likewise graded by a number (about half dozen) of other students under instructor-specified "rubrics" or guidelines, thus freeing up the instructor from the task of actively reading and grading the multitudes of student submissions. The instructor may additionally provide a few graded assignments as samples.

Peer grading process can be a powerful learning activity in its own right, and has been used in some form for decades, e.g. as evaluative component for seminar courses in higher education. It works particularly well for interdisciplinary or exploratory courses, numbers of students notwithstanding. Historically, however, peer grading has largely been used for small, advanced, in-person classes and its extrapolation to massive online courses is not straightforward. In an influential paper, the Stanford team led by C. Piech et al. [5], advocated sophisticated, statistically "tuned" models to enhance peer grading for MOOCs.

Briefly, in a common version of this approach, the scores assigned by the students for a submission are processed statistically to estimate an unknown "true" score with an acceptable degree of confidence. In another version, the statistical processing estimates the grade that the *instructor would have assigned*, given the raw score data and a few instructor graded sample submissions. In these and other variations of tuned peer grading, the computer relieves the instructor from the drudgery of grading large number of papers.

While the advantages of peer evaluation are oft-mentioned, a major driver for its increasing popularity is the benefit of *cost containment*. By farming out assessment tasks to the students substantial cost savings can be realized.

However, the jury is still out on the validity and reliability of peer grading as an assessment tool, and controversy and difficulties remain. Studies indicate that it is possible to craft reliable peer assessment strategies through careful articulation of the rubrics. *Cf. Heng Luo et al. [6].* But contradictory studies also exist. In particular, the issue of conflict is a real concern with any grading option, including blogs and forum discussions, which includes a peer grading component: There may be inherent conflict in co-opting for grading the very students being graded.

2.4 Multiple-choice assessment and MOOCs

As noted above, there are many advantages of multiple-choice format: It is objective, machine-gradable, uniform, scalable and low-cost, and it covers a greater cross section of the subject matter for testing, and feedback. Also, significantly, it largely eliminates grader bias.

However, the use of multiple-choice tests for MOOCs presents unique challenges, including the twin imperatives to eliminate plagiary and cheating while keeping the cost of testing low.

A *key additional issue* is that traditional multiple-choice format has limited inherent value as a *probative* tool for testing of "summative" or critical skills. The still developing taxonomy of testing for MOOCs recognizes disparate needs of "xMOOC" testing, i.e., the testing of "formative" knowledge based on material previously presented, and "cMOOC" testing, i.e., testing of "summative" knowledge and application skills to new situations. The consensus so far points to the following: Since multiple-choice format generally lacks incisive and probative information for the instructors/ examiners or reliable feedback for students, it can be effective for xMOOC but *not* for cMOOC testing. But, cMOOC testing to assess and give feedback to the learners about critical thinking and application skills is important, especially in case of MOOCs that include a high proportion of non-traditional students.

Thus, at the present time, there remains a need for scalable, *objective* method of grading that can probe learners' grasp of the subject matter and provide timely feedback. The Reverse Multiple-choice Method (RMCM), an objective, scalable method presented in the next section is designed to address this limitation of multiple-choice format. We propose the use of RMCM for reliable feedback and/or as a check for validity and reliability of the grades generated by other methodologies.

3. An advantageous alternative to multiple-choice: RMCM

3.1 Structure of RMCM questions

An assessment strategy incorporating the Reverse Multiple-choice Method (RMCM) holds a unique promise for MOOCs, since it offers the objectivity, efficiency and scalability similar to traditional multiple-choice tests, along with a test of knowledge and understanding generally associated with open format. Grading of RMCM questions is possible on computer, thus making it suitable for online courses in most subject areas at several academic levels, *regardless* of the number of students. Furthermore, the method is compatible with other approaches proposed, pursued and discussed in the literature, and it may be used in addition.

RMCM is based on the observation that it is possible to use a multiple-choice question, with its perspective *reversed*, and task an examinee to reveal their reasons for the answer selection in a *brief, succinct* manner thus: Given the answer choices, task the student to modify the "query" so as to make an incorrect answer *correct* for modified question. This basic logic of RMCM is shown in Figure 1.

The typical and distinguishing steps of a typical RMCM approach are as follows:

- prompt examinee to select an answer choice as the correct answer; record the examinee's selection, assign credit for it;
- prompt the examinee to select at least one answer *not* selected as correct, then ask for a follow-up query to which *this incorrect* answer is a *correct* answer;
- match the follow up query against the database of queries for which the selected incorrect answer would be correct
- provide examinee's score for the question according to examiner's or administrative policy based on the result: Full credit for perfect matching, zero or negative credit for a total miss and partial credit for a partial match.

3.2 Example 1

Q: The common intelligence quotient (IQ) scale is Normally distributed with mean 100 and standard deviation 15. What proportion of population has IQ scores between 115 and 130?

A. 68%. B. 95% (C) 13.5% (D) 34%

Since in this case the stem has the accepted and unmodifiable information, the system would look for the queries for answer selections and changed interrogatives as shown in Table 2.

Table 1. Structure of a Multiple-choice Question illustrated for Example 1

Query → Putative Answers

Set of presumed facts (Stem of the question, narrative/equation etc.)	Interrogative Sentence (Call of the Question)	Set of Answer Choices (One correct, others incorrect)
The common intelligence quotient (IQ) scale is Normally distributed with mean 100 and standard deviation 15.	What proportion of population has IQ scores between 115 and 130?	(A) 68%. (B) 95% (C) 13.5% (D) 34%

Table 2. Structure of RMCM question for Example 1

Answer Choice	For given query	Changed query (Provided by the Examinee)	For changed query
(A)	Incorrect	What proportion of population has IQ scores between 85 and 115?	Correct
(B)	Incorrect	What proportion of the population has IQ scores between 70 and 130?	Correct
(C)	Correct	--	--
(D)	Incorrect	What proportion of population has IQ scores between 100 and 115?	Correct

3.3 A unique advantage of RMCM: Capturing context for query interpretation

A notable merit of multiple-choice question format is that it captures context of the query *more concisely* than other formats, since it is possible to view each answer choice as adding *contextual* information for the interpretation of the query.

Furthermore, the selection of one answer choice as "correct" over the other choices generally turns on a few syntactic elements, such as, words, phrases, operations, numbers and symbols etc. which contain the key facts. In RMCM terminology, the syntactic elements that make an answer choice correct are called Fact Objects (FOs). The value of a fact object for which an answer choice is *correct* is called Fact Value (FV) of the FO, a concept akin to assigning a constant value to a variable in algebra. These concepts are elaborated further by examples below.

In Example 1, for instance, there are *two* fact objects, namely the two end points of the interval of IQ scores, since the selection of an answer depends *only* on the values of those end points.

When creating a RMCM question, the examiner specifies fact objects and fact values for *all* the answer choices. The system provides the platform and editorial support for question creation, then uses examiner's specifications to *automatically* evaluate student answers or flag unexpected student answers

for human evaluation. If a RMCM question is appropriate to the students' academic level and constructed well with plausible confounders rather than irrelevant incorrect answers, the proportion of answers flagged for human evaluation would be relatively small, even for tests taken by massive numbers, such as the MOOCs.

4. Considerations for Using RMCM

4.1 Question creation

Depending on the subject matter being tested, a RMCM question can be framed and the "task" of modifying the query specified in many ways. For each answer choice that the test-taker regards as an incorrect answer to original query, such tasks may include one or more of the following paradigms:

(i) Identify the fact objects that need to be changed;

(ii) identify the fact objects to change from a given list;

(iii) write in the fact objects that need to be changed;

(iv) write in the fact objects to change from a given list;

(v) identify the fact values of a fact object that need to be changed;

(vi) identify the fact values to change from a given list;

(vii) write in the fact values of a fact object which need to be changed; or

(viii) write in the fact values to change from a given list.

A task may be specified in simple terms without using fact object/ fact value terminology. For example:

> Find the words /phrases/ symbols or other segments of the query which, if they are changed, will make your selected incorrect answer be the correct answer for the changed question.
> Or,
> Your selected answer is incorrect because at least one query segment has the wrong value; identify which value(s) from the given list should be assigned to the query segment(s) so that your selected incorrect answer becomes the correct answer for the changed question.

Similar language may be devised for write-in answers for fact objects or fact values.

4.2 Question Answering

For a student who has learnt the subject matter, RMCM questions may be unfamiliar at first but not much harder than answering traditional multiple-choice questions, and possibly easier than answering long or short essay type questions. The RMCM approach strongly encourages the students to:

(i) focus on closely reading the fact pattern, (ii) critically evaluate the answer choices, and (iii) recognize the critical pieces of information in the given fact pattern on which the answers turn.

The students also must acquire the skill to deconstruct and reassemble a question. But this is precisely the probative or summative information about a learner that an assessment regime seeks for cMOOC testing, and one often desirable for xMOOC testing.

5. Implementation strategies for RMCM

5.1 Machine implementation schemes

When creating the RMCM question, the examiner provides tables such as Tables 2-3 for query matching by the system; the system provides editorial support and intelligent help with question creation in more complex version.

The inputs from students and examiners are received by the system in appropriate fields by any of the known methods in the art. An interesting and useful method is to allow user to highlight a query segment and insert the highlighted character string into the required fact object/fact value/answer fields. For certain subjects or questions, e.g., in the STEM fields, the fact object/fact value tables can be complex, needing much support from the system.

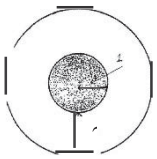
TABLE 3. Answer choice/Fact Object/Fact Value/Scoring for Example 1 of section 2.1

Answer Choice	Fact Object	FO selection score	Fact Value	FV selection score	comments
(A)	**[First end point of interval]** **[Second end point of interval]**	50% 50%	85 115	50% 50%	The two fact objects carry equal weights
(B)	**[First end point of interval]** **[Second end point of interval]**	50% 50%	70 130	50% 50%	The two fact objects carry equal weights
(D)	**[First end point of interval]** **[Second end point of interval]**	50% 50%	100 130	50% 50%	The two fact objects carry equal weights

5.2 Example 2

Julie designed a target computer game. On her computer screen, the circular targets look like the circular areas shown in the accompanying figure, where the radius of the shaded circle is 1 and the vertical length of handle shown in the middle of target is 2. If the computer randomly generates a dot that lands within the circular area, what is the approximate probability that the dot will land in the shaded area?

A.1/9 B. 2/9 C. 1/3 D. 2/3

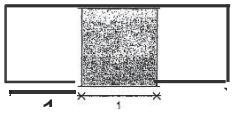


The correct answer is A.

A *Reverse Multiple-choice Question* based on this question would give the following task to the students: Select an *incorrect* answer from the choices A – D. Next**,** *identify and change* any words, data or other segments of the question, so that your selected answer becomes a correct answer to the changed question.

To automatically score this question, the system would look for the following query changes (possibly on a suitable form):

A. (No change, but the answer choice should not be selected as an incorrect answer by a student!)
B. Change vertical length of handle shown in the middle of the target from "2" to length "1.1213".
C. Use rectangular figure shown and change every instance of the word "circular" to "rectangular".
D. Use rectangular figure shown, change every instance of "circular" to "rectangular" and change "shaded" to "white".



Example 2 illustrates that the specification of Fact Objects and Fact Values can be made quite robust, even where graphics, or annotated parameters in graphics, may be included within the narrative or stem of an RMCM question. Further a utility to allow highlighting a character string and copying/ inserting it into an appropriate field offers a versatile and flexible way of specifying FOs and FVs for both examiners and students.

In the case here, the RMCM version is not straightforward; there are several ways to change "words, data or other segments" in order to make the incorrect answer become correct for changed question.

In general, the examiner must decide on which answer choices, fact objects and fact values to ask to change based on a given student body, course and target analytical skills to be measured. It may be necessary to provide special answer sheets for graphics.

5. RMCM implementation notes for MOOCs

With the editorial support of the system, the burden of creating RMCM questions may be significantly reduced for an examiner, who can focus instead on creating questions with forethought and deciding what the question will be designed to measure. Since incorrect answers are used to give assessment information, an examiner should use them strategically. An Examiner's initial expense of time can lead to significant savings of time by automating grading, and substantial cost reduction for MOOCs.

To answer RMCM questions successfully, the students *must* learn to focus on closely reading the facts and paying special attention to incorrect answers in relation to the query. Such learning is useful for both xMOOC and cMOOC evaluations.

6. Using RMCM with peer assessment

We note that for MOOCs, RMCM with its well-articulated test tasks may be provided as part of the "rubrics" for evaluation or as topics of discussion among students in a forum or team. Suitable language of the stem or query, or the nature or purpose of confounding answer choices can serve to focus the students on concrete points of discussion.

A big advantage of using RMCM for peer assessment is that student teams can be *recruited* to help create suitable question items for Reverse Multiple-choice. The resulting RMCM questions may be submitted to a central "library" or database of queries which the procuring instructor, as well as other instructors/trainers can access. Student teams can help create the questions for many disciplines, including the STEM fields.

A system of appropriate *rewards* may also be instituted to motivate the students to create test items of lasting value from their experience, and answer questions submitted by other teams/groups. Since a good RMCM question must be answered with critical thought, such a library can be useful for a long time, though an entire test made up of RMCM questions may be not be practical to administer in many courses.

In our exploratory classroom experience the introduction of some RMCM questions proved useful as a window into the students' minds despite automated grading. This provided partial credit where due and a more accurate and meaningful feedback to the student.

7. Conclusion

Reverse Multiple-choice Method incorporates an enhanced and enriched version of multiple-choice format from which it inherits the advantages of machine grading and scalability. The RMCM examiners can draw upon the vast existing resource of multiple-choice questions in all fields.

Our platform for assisting an examiner to create a RMCM *ab initio* or to modify an imported multiple-choice question can provide significant support. As part of further work, we are assembling databases of RMCM questions with suitable query and answer options, which can be useful to teach and evaluate human students, as well as for machine learning. For related research we expect to compare the results obtained by RMCM versus other approaches, and to study the degree to which RMCM can be used to enhance the validity of an approach such as peer grading.

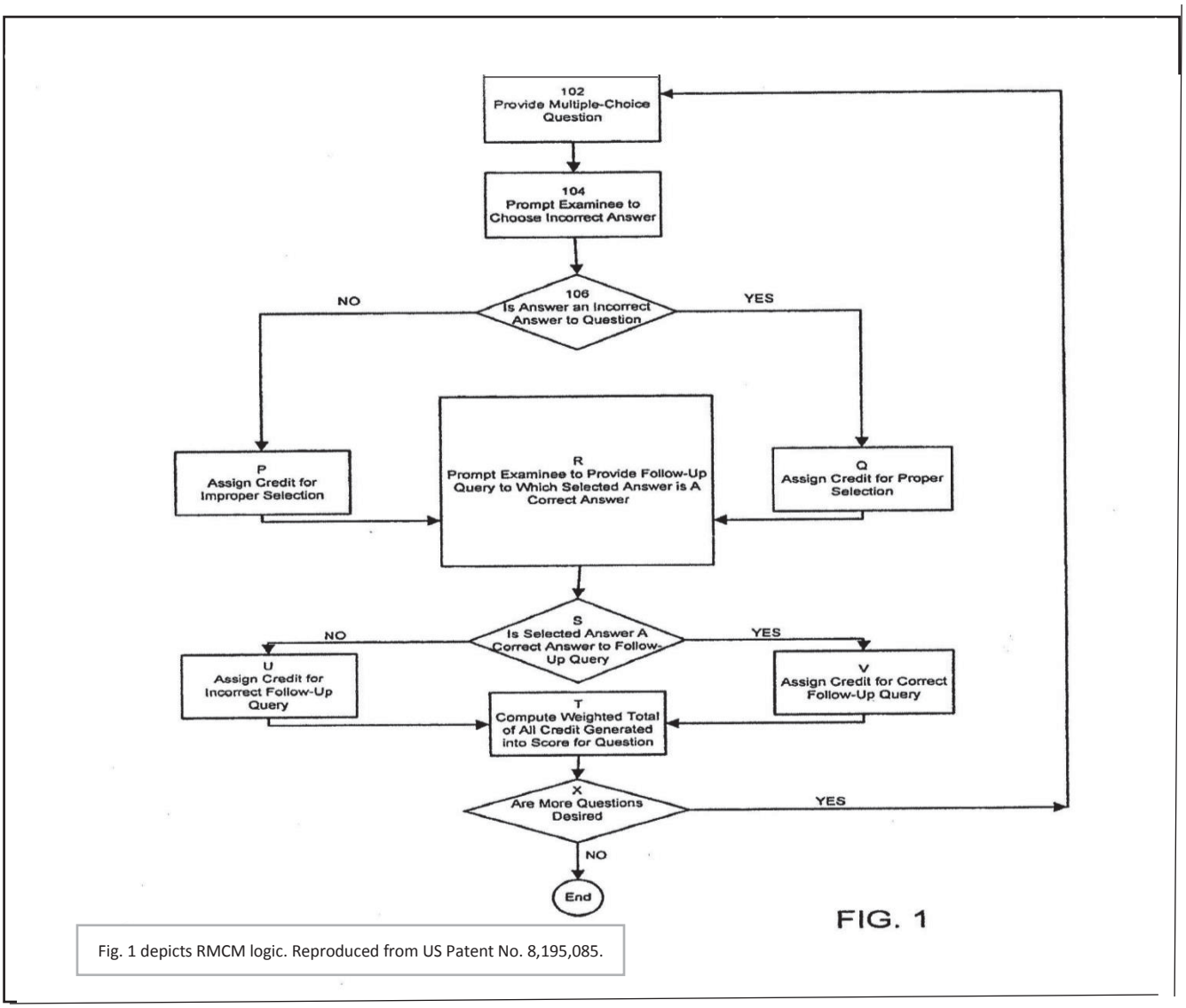


Fig. 1 depicts RMCM logic. Reproduced from US Patent No. 8,195,085.

8. References

[1] I. M. Anand, "Method of developing educational materials based on multiple-choice questions," United States Patent No. 7033182, 2006.

[2] I. M. Anand, "Method of developing educational materials based on multiple-choice questions," United States Patent No. 8195085, 2012.

[3] P. A. Kirschner, et al., "Do learners really know best? Urban legends in education" *Educational Psychologist, 48*(3), 169-183 (2013).

[4] Heng Luo, et al., "Is Peer Grading a Valid Assessment Method for Massive Open Online Courses (MOOCs)?" Sloan Consortium 7th Annual International Symposium on Emerging Technologies Online Learning (2014).

[5] C. Piech, et al., "Tuned Models of Peer Assessment in MOOCs," Stanford University, web.stanford.edu (2013).

[6] J. A. Reynolds, et al., "Calibrated Peer Review™ assignments in science courses: Are they designed to promote critical thinking and writing skills?" *Journal of College Science Teaching, 38*(2), 60-66 (2008).

[7] del Sanchez-Vera, et al., "Beyond objective testing and peer assessment: alternative ways of assessment in MOOCs," RUSC, Universities and Knowledge Societies Journal (2015)

[8] Daniel Thomas Seaton, et al., "Enrollment in MITx MOOCs: Are We Educating Educators?" Educause Review (February 2015).

[9] Hoi K. Suen, "Peer Assessment for Massive Open Online Courses (MOOCs)" The International Review of Research in Open and Distributed Learning,15(3),(2014).

Teaching Mathematics at Different School Levels in Developing Countries

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Abstract: In this paper we discuss several aspects of teaching mathematics at different school levels in developing countries. The situation in the three levels, namely elementary, primary, and secondary schools is illustrated stressing the negative aspects in each level. A proposal for measures to remedy the negative aspects of teaching mathematics at all three school levels in developing countries is then given.

Key-Words: Teaching Mathematics– *School Levels* – *Developing Countries* – Negative Aspects – Remedy Proposal

1 Introduction

Some negative aspects of teaching mathematic at elementary, primary, and secondary schools in several developing countries are briefly discussed. A proposal for future measures is accordingly given.

In Section 2 the current situation of teaching at the three school levels in several developing countries is given.

The negative aspects of teaching mathematics at all three school levels in developing countries are illustrated in section 3.

A proposal to remedy the negative aspects is discussed in section 4.

In section 5 our recommendations for the future are given.

Finally the conclusion is then briefed in section 6.

2 Current Situation in Developing Countries

To study the current situation of teaching in general in developing countries we have to consider following differences:

Governing systems,. economic situation, total population, area, and geographical location, differ largely between several developing countries.

Standards of teaching in schools, ratio of number of schools to total population, percentage of non-alphabetical people also differ in many developing countries.

Technical and financial support of developed countries depend mainly on political aspects (see [1], [2]).

3 Negative Aspects of teaching mathematics at the three School Levels in Developing Countries

The main negative aspects of teaching mathematics in elementary, primary, and secondary schools are as follows:

3.1 General Aspects

Governing systems are trying to keep low standard education to avoid raising free thinking young students. Also not to decrease the numbers of non-alphabetic people especially in developing countries with high population.

The curricula and textbook in the departments of education are not up-to-date. Also the students

joining those departments are usually among the weakest graduates from the secondary schools as working as a teacher does not include good financial income and high social status.

Many poor people do not send their children to school and send them to work and earn extra money to help their parents.

Economically weak developing countries usually do not give education high priority in their budget planning.

Financial and technical support of developed countries is usually quite limited to effectively help the sector of education in developing countries (see [3], [4]).

3.2 At School Levels

Differentiating between different school levels is necessary:

3.2.1 Elementary Schools

In this extremely important level of elementary school one of the main problems is the limited interest of some of the governments at this level and the ignorance of many uneducated parents.

The teachers appointed are the weakest compared to those appointed in primary and secondary school levels who are also weak.

Many teachers are graduating from universities have out of date education departments in terms of curriculum and textbooks used.

The classes are usually over-populated with limited facilities.

Many young students pend long time on games and internet.

3.2.2 Primary Schools

Not recognizing the problems created in the elementary school.

Many teachers are graduating from universities having out-of-date education departments in terms of curriculum and textbooks used.

Several teachers use unrevised strategies and emphasizing memorization rather than thinking.

3.2.3 Secondary Schools

Not recognizing the problems created in the primary school.

Many teachers do not prepare the students for their continuing studying at higher education.

Not stressing visualization and imagination skills as well the important critical thinking.

4 A Proposal to Remedy the Negative Aspects

4.1 Generally

The governments of developing countries must give highest priority to education at all levels.

States and private universities must invest more money and intensify the process of raising the standards of education in their countries.

The curricula and textbooks at departments of education at state and private universities should be periodically updated.

The percentage of non-alphabetical population should be drastically decreased, if not completely eliminated.

4.2 At Different School Levels

The profile of the three school levels differs. Each of the elementary, primary, and secondary levels is to be considered separately as follows:

4.2.1 Elementary Schools

The teachers for elementary schools must be chosen very carefully as they are responsible of giving the students a successful start in their educational road.

The decrease of the number of students in each class is a necessity to be able of following the students' development individually.

Special tutoring for socially needed students and parents should be held.

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4.2.1 Primary Schools

Teachers must recognizing the problems created at elementary school level.

Updating the currecula and textbooks is a necessity.

Stressing critical thinking and avoiding memorization.

Motivating the young students at this level to have good attitude towards learning.

4.2.1 Secondary Schools

Recognizing the problems created at elementary and primary schools is necessary by all teachers.

Educating the teachers to have updated teaching methods and strategies.

Emphasizing critical thinking and stressing visualization and imagination.

Teachers must prepare the students for the study at universities and/or beginning a professional career.

5 Recommendations

Due to the extremely important role of education in the development of developing countries, the governments must system which enhance high standards of education through updating the curricula and textbooks, as well as considering more financial support in their budget in education.

Highly recommended is decreasing the percentage of non-alphabetic population.

Training all school teachers at all school levels, especially in elementary schools.

The curriculum and textbooks at departments of education at state and private universities should be periodically updated.

The number of students in all classes must be decreased through providing more schools and appointing more educated teachers.

In the primary and the secondary levels teacher must recognize the negative aspects of teaching at the lower school level respectively

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In all school levels critical thinking and visualization should be stressed by all teachers..

Textbooks should be written by scientists in developing countries which take into consideration the political, sociological, economic, social and cultural aspects in their countries

6 Conclusion

More support of the governments in developing countries to education in all school levels is highly recommended.

Training teachers in all school levels is very essential achieve high standards of education in developing countries.

Updating the curricula and textbooks at all departments of education at state and private universities.

Teachers must stress critical thinking and visualization.

References:

[1] Moussa, N., "Teaching Mathematics to Engineering Students in Developing Countries", European Scientific Journal, May 2014, pp. 168-

[2] Nabil Moussa „Quality od Education in Developing Countries", Higher Education in the Twenty-First Century: Issues and Chalenges, Taylor & Francis Group, London, 2008, ISBN: 978-0-415-48000-0, pp. 109-112.

[3] http://www.accc.edu.au, Curriculum Corporation Technology, 1994, Report, "A Curriculum Profile for Australian Schools

[4] Krantz, S. "How to Teach Mathematics: A Personal Prospective", Providence, RI;AMS, 1993

[5] Moussa, N., „Knowledge Delivery Methods of Mathematics to Engineering Students in Developing Countries", WSEAS International Conference (AIKED'09), Cambridge, U.K., 2009, pp. 266-270

[6] Nabil Moussa, "Calculus I-Differential Calculus", ISBN: 977-304-109-3 (2005), "Calculus II- Integral Calculus", ISBN: 977-304-110-7 (2005), "Calculus III- Intermediate Calculus", ISBN: 977-304-307-X (2008)

[7] Moussa, N, "Theoretical and Applied Approaches for Teaching Mathematics to Engineering Students", WSEAS Transactions on Advanced in Engineering Education, Issue 1, Volume 1, 2004, pp 6-10

[8] Moussa, N., "Teaching Mathematical Analysis to Engineering Freshman and Sophomors", Proceedings of the Symposium on Sciences and Engineering Education in the 21st Century, AUC, 1995, pp. 202-209

SESSION

LATE BREAKING PAPERS: CORPORATE ISSUES, STANDARDS AND POLICIES

Chair(s)

TBA

Funding Enabling Technologies

Dr. Steve Richfield
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Abstract - *Investors have foregone enabling technology investments despite their potentials for astronomical profits. This is because they have cost more and taken longer to become profitable than innovations based on already-available technology.*

Learn how to repackage enabling technologies to compete against innovations, including the following how-to methods:

1. *Secure the services of a good patent attorney by paying them a significant piece of the action.*
2. *Secure U.S. patents in one year, instead of the usual decade, using senior co-developers (ala Patent 8,788,263).*
3. *Find an interim CEO.*
4. *Plan to develop more than one product.*
5. *Identify and mitigate both perceived and actual risks without resorting to development.*
6. *Develop different novel components and products within different corporate shells.*
7. *Reward key personnel with stock without incurring tax liabilities.*
8. *Collapse development using parallel efforts and just-in-time scheduling methods.*
9. *Multiply the return on investment using staged committed financing.*
10. *Plan on selling off some corporate shells to fund others.*
11. *Avoid exclusive licensing deals.*
12. *Look for an early buy-out.*
13. *Make your Venture Capitalist a full member of your team.*

Keywords: CEO, corporate shells, founders stock, funding, just in time development, parallel development, patent attorney, venture capital,

1 Introduction

Enabling technologies are new and patentable methods of producing new classes of products, rather than just a single new product. Much of our world is built on enabling technologies, like internal combustion engines, networking, satellites, atomic fission, etc. Nearly every WORLDCOMP conference has people presenting what should be world-changing enabling technologies that never make it to market.

Here the author (on the left) is demonstrating his game theory computer at the 1962 WESCON convention. This special purpose computer was then the fastest computer in the world for solving 5x5 non-zero-sum game theory (war strategy) problems, until the RAND Corporation adopted the author's algorithm. Earlier awards included 1st Place at the King County Science Fair, and the Space Medicine award presented by U.S.A.F. General Curtis LeMay. Wouldn't it be nice if computers could now solve our own personal strategy problems?

On the author's right in space 24 was an incredible walk-around 3-D display device that would still be amazing even if seen today – a half century later.

Enabling technology is in abundance, but there are solid dysfunctional reasons why enabling technologies go unfunded, despite being the potential basis for whole new future industries. What seemed to be needed was research into methods to circumvent the usual failures to fund.

Investors have foregone enabling technology investments despite their potentials for astronomical profits. This is because, in the past, enabling technologies have cost more and taken longer to become profitable than innovations based on already-available technology.

The author recently founded Savant AI Holdings, to apply the various financial methods being presented. Savant's technology is a method of parsing natural language that is extremely fast, coupled with a method to utilize fast parsing to better promote products on the Internet than can be done with conventional advertising.

2 Methods

Enabling technologies can be repackaged to successfully compete for investment money by using the following methods:

2.1 Secure the services of a good patent attorney by paying them a significant piece of the action

This sounds easy enough, but patent attorneys all understand that only about one in fifty patents turns out to be worth anything at all, so it becomes a MAJOR challenge to get them to bet a lot of their time and energy on both you AND your idea. If you think venture capitalists (VCs) are skeptics – then you haven't yet had a heart-to-heart talk with a good patent attorney. To show you aren't naive, tell your prospective patent attorney what he already knows - the awful truths regarding success rates, and assure him that you have a way around such hazards. To overcome some of the obvious objections, point out that most patents are never intended to be sold, so the one-in-fifty figure is misleading. Further, give the attorney a big enough piece of the action that if it works out, they will never again have any reason to write more patent applications.

Some things a patent attorney may look for include

1. The solution to a long-felt and unsolved problem in a critical and burgeoning technical field;
2. A very creative algorithm, e.g. instead of merely throwing raw processing power through hardware at a problem;
3. Your motivation and participation in the process; and
4. Potential return on investment (ROI) considered in view of all of the other factors. Of course this last one is where the magic is.

There is no formula for selling yourself and your idea to a patent attorney, because this is all about how it feels to the patent attorney. If it doesn't feel good to him, he won't do it for a piece of the action.

I am now working with counsel in Northern California, with whom I worked when we had a mutual client.

Our deal was for a percentage of whatever I got, in return for pushing the application through the 2nd office action. Another percentage was for the attorney to still be onboard when the "big money" arrived (the technology got funded, sold, etc.). A 3rd percentage applied if I would ever fire him. I have assured my attorney that he will never see a dime of this last percentage, because I trust his judgment on patent matters over my own judgment. In addition, we agreed to share all patent-related expenses, so that neither of us would work in a way to unreasonably increase expenses for the other.

2.2 Secure U.S. patents in one year, instead of the usual decade, using senior co-developers (ala U.S. Patent 8,788,263)

The U.S. patent office is the first, and only, U.S. government office to ever show a profit. To accomplish this minor miracle they have increased fees, reduced services, and instituted all sorts of "gotcha" procedures and fees. In this hyper-complex environment, designed to trip up veteran patent attorneys, you wouldn't stand a chance doing it yourself.

One result of reduced services is that it often takes several years (sometimes 5-7 years, or even a decade) to secure a U.S. patent; by which time whatever technology is being patented has probably become obsolete.

There is a provision in U.S. patent law to process certain patents before all others. For example, if you can show that your invention is being infringed upon, you can pay a substantial fee and receive this acceleration.

To expedite the process somewhat, you can also petition the U.S. Patent Office to treat the application as a "special" application, if one of the named inventors is over 65 years of age. This does not necessarily provide for a swift examination, but it may speed things up simply by getting your application to the front of the line.

An assured way to expedite the entire process is to seek an accelerated examination through a petition filed under 37 CFR 1.102. There are some pretty stiff requirements for a pre-filing search and the filing of a support document (and these can be time consuming and costly themselves), as well as the payment of a higher filing fee, but the application is guaranteed a final disposition within one year. As an alternative, a prioritized examination can be sought, and while the filing fee is a bit higher, a pre-filing search and a support document are not required, and this, too, will result in a final disposition within one year.

One common source of needless delay is arguing for disallowed claims, when some claims have already been allowed. A better strategy is to accept your patent with just the allowed claims, and file a Continuation In Part (CIP) to argue the disallowed claims. This costs more in fees, but it gives you a patent months (or sometimes years) earlier than would have otherwise been possible.

2.3 Find an interim CEO

The Chief Executive Officer's (CEO's) primary responsibility is to produce the business plan and find the money needed to make the company successful.

VCs who will fund your company will probably want to install their own CEO to watch over their investment. Hence, hiring a CEO before you have found funding probably won't work. This leaves you with a chicken-or-egg dilemma, because you need a CEO to put together the deal with the VC, yet the VC will probably want to replace your CEO.

The solution here is to "hire" (for a promise of stock) an interim CEO, with the understanding that when the company gets funded he will probably have to change jobs within the company, e.g. to become its new Vice President or Marketing Manager.

Finding an interim CEO can sometimes be a challenge. Past employers might be interested. You can also advertise, or even post on State job bulletin boards.

2.4 Plan to develop more than one product

The usual problem with enabling technologies is that several mini-developments are needed to assemble the desired product. However, those mini-developments can probably be combined in other ways to make other products, and/or be sold as separate products.

While your business plan will show most of the potential income in the target product, with careful planning you can show enough other income in allied products to make the company a good investment, even if the target product should fail for some reason.

An additional advantage is that developers have a closer product horizon and are more motivated to achieve it. They can be given stock in the piece they are developing, instead of the whole company.

Also, investors like having some insurance against a possible marketing failure, because this mitigates one of the major unknowns

2.5 Identify and mitigate both perceived and actual risks without resorting to development

The first problem you encounter with enabling technologies is that investors want to see it work before they invest, when most of the desired investment is to make it work. Having made the mistake of playing this game, trust me, there is NO end to this. Whatever you demonstrate, they will want to see MORE before they will invest. Eventually they will lose interest, or they will have invested their money elsewhere before you give up on demonstrations.

This simply doesn't happen when there is an independent expert involved, so the key here is to find a way to involve a suitable expert, e.g.:

- Obtain fixed-price quotations for developments that VCs want to see demonstrated.
- Find a super-expert, like a former president of a respected research establishment, to carefully review the project and proclaim it to be no problem.
- Ask the VC to provide an expert they trust.

2.6 Develop different novel components and products within different corporate shells

There are many reasons to chop major startups up into separate stand-alone pieces, ranging from litigation protection, to being able to grant stock at a later time, to being able to sell some pieces to fund other pieces, etc. However, you simply can NOT decide to do this later. You must arrange for this before accepting your first dollar of investment money.

2.7 Reward key personnel with stock without incurring tax liabilities

Chuck, a consultant friend, once provided consulting to a company headed by a good friend of his, for which they paid Chuck in stock, which wasn't trading at that time because of the problems Chuck was called in to solve. Then next year, when he turned his finances over to his accountant to prepare his tax return, the accountant informed Chuck that he owed part of a million dollars in taxes on the stock!!! Chuck went to unload the stock, but its price had fallen to nearly zero, and besides, it was now the next year and too late to mitigate his astronomical tax liability. When it was all over, the IRS ended up seizing Chuck's home.

Granting stock, without incurring such liabilities, requires that it be granted before the company has been funded, so the stock has no per-share value. Unfortunately, this is too late for key personnel you hire after you have been funded. However, if your VC funds a holding company that later forms other companies to develop a technology, then you can wait until those companies are formed to distribute stock in them.

2.8 Collapse development using parallel efforts and just-in-time scheduling methods

Most high-tech projects involve a long sequence of tasks, each of which is dependant upon the previous task. For enabling technologies, these critical paths can be quite long, sometimes involving years of work. From an investor's point of view, if you take twice as long to make the same amount of money, you have cut your yearly rate of return in half. Hence, planning to do enabling technology products in this manner is economically suicidal – you will NEVER get funded.

However, for a tiny amount of additional effort you can create stubs for all of the major components needing development. Stubs are nonfunctional placeholders to put into other components as they are being designed, built, and tested. In software, stubs are typically empty subroutines that do nothing, and they are extensively used during top-down development.

Once the stubs have been created, the many separate developments can all be done in parallel, with one final step of replacing the stubs with the components for which they have been placeholding, and debugging any remaining problems.

2.9 Multiply the return on investment using staged committed financing

In most startups, small teams of people each take responsibility for their part of the company. They then approach investors and give them NO responsibility, other than seeing that their checks clear the bank. In the process, they rob investors of an opportunity to take care of the company's needs with FAR less money (by finding other early investors or buyers), and tie up that money for FAR less time (by waiting until the money is needed before putting it into the company).

Consider a different relationship. An investor is charged with raising money as needed (or wanted) by the company in return for their piece of the action. An astute investor might know someone, who knows someone else, who would simply purchase the company. With such deals in place, investors could potentially earn their pieces of the action while expending NO money.

Failing this, an investor might elect to operate the company as a "doomsday project", within which a skeleton crew gradually creates the new technology, while investors spread the word about how it will destroy entrenched industry players. New technologies are often worth a lot, but not nearly as much as the existing technologies they usurp.

For example, Savant's technology to displace much/most present-day advertising is probably more economical for major advertisers than present-day advertising. As a result, Savant's technology may be worth more to Google, Yahoo, Facebook, Amazon, etc. to upgrade their present products, than it would ever be worth as a new product.

Failing this, an investor might elect to execute a rear-end-loaded development, delaying major expenses for as long as possible to shorten the time the money is tied up, and therefore increasing the yearly rate of return.

An astute investment team can utilize staged committed financing to achieve FAR greater rates of return than can ever be achieved using classical funding, where the money is given in one large lump sum and held until it is needed.

2.10 Plan on selling off some corporate shells to fund others

In an ideal world, everything would be in place for a simple change that would make a lot of money – which is what innovations are all about. Enabling technologies usually require that some additional supporting components of an ideal world be created. While these supporting components may not be a part of the technology being developed, they are, nonetheless, needed to make the technology marketable.

While not worth astronomical sums, companies that produce these supporting components may still have substantial worth. Once created, they become separate mini-startups assuming their own value. Rather than hanging onto these mini-startups while the primary product is being brought to market, it may be possible to sell these mini-startups to raise additional capital to fund development of the primary product.

2.11 Avoid exclusive licensing deals

Exclusive licensing sounds so attractive, but it is a trap. If your enabling technology is disruptive, and it probably is, than other players in the same industry will be forced to decide whether or not to infringe on your patent. When they absolutely MUST infringe on your technology to stay in business, you have a problem. They will infringe and you will end up in court, costing ~$2M per litigant. Your patent will be challenged in every conceivable way, and since nothing is perfect, there is a good chance that they will find some tiny chink on which to invalidate your patent. ***The Impossible Lens*** is an excellent video about how an exclusive licensing deal destroyed an excellent patent, and did so without even finding flaws in the patent.

2.12 Look for an early buy-out

Disruptive technologies can often assume values far beyond their worth as a product, especially when they threaten the cash flow of large companies, or have a synergistic ability to transform something of little worth into something of great value. Rather than toiling for years, wouldn't it be better to be paid more right now than you would eventually earn? Your investors would also prefer this, so make sure they have a path to make this happen.

2.13 Make your Venture Capitalist a full member of your team

With most pre-funding startup teams, everyone has a job, and everyone does their job, or else they walk away with nothing. "Employing" your VC on this same basis, somewhat like a combination of investor and CEO, gives your VC an opportunity to try many ways of marketing your stock and company, and/or waiting until the last minute to pay your company's expenses as described in section 2.9. You can grant your VC a sizeable chunk of stock, because you know

you won't be granting the next VC another chunk of stock, unless your present VC has walked away without his stock.

Most VCs would welcome the opportunity to simply cut and run should the company veer off of its success trajectory, over having such companies continuing to spend the VC's money in honor of the VC's "right" to collect a drawer full of worthless stock certificates.

This approach is a "win" for everyone. The VCs get more control and more stock by taking some responsibility to keep a company running so the rest of the team can concentrate on product development, instead of finances.

Astute VCs will then use their connections even more than their money, to make companies successful.

3 Conclusions

Enabling technologies are often worth far more than innovations. However, classical exchanges of stock for investment money are simply not up to the task of funding enabling technologies. Here, the angel is in the details, to chart a success path from idea to startup to riches.

The key to charting that path is to make your investors full members of your team, with responsibility for all monetary concerns. Like other members of your team, if they fail to deliver what they agreed to deliver, they walk away with nothing.

4 Annotated References

[1] David and Laura Gladstone. "Venture Capital Handbook". Prentice Hall, 2002. This industry "Bible" is all about investing in innovations, but it is completely oblivious to much more valuable disruptive enabling technology investments.

[2] David Pressman, Thomas Tuytschaevers. "Patent It Yourself: Your Step-by-Step Guide to Filing at the U.S. Patent Office". NOLO, 2014. This book guides you through the intricate process of drafting a patent, which you should then have refined by a competent patent attorney.

[3] Pure Science Specials "The Impossible Lens" http://www.hulu.com/watch/646797#i0,p16,d2 This show should convince you of the folly of exclusive licensing deals.

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Re-certification of enterprises in Russia

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Abstract - *The article covers the main problems of standardization and certification of Russian enterprises towards accession to the World Trade Organization (WTO). The international standardization and certification practices adopted in WTO Member States are fundamentally different from standardization systems, which are derived from the USSR State Standard. The problem of harmonization of the Russian legislation and WTO standardization and certification rules and activity norms is rather relevant. The article will be interesting for specialists involved in implementation of information systems at enterprises engaged in foreign economic activity, post-graduate students and students of IT professions.*

Keywords: The World Trade Organization (WTO), re-certification, standards, certificates, information systems, certification centers.

The consequences of long-term isolation of the Soviet Union from western economies, the myths and the realities of "mysterious Russian soul" create substantial difficulties in business.

Corruption, a distinct feature of all economies in transition, and the period of original capital accumulation created a parallel world with its laws, standards and tariffs.

According to "The Izvestiya", "Various contests of quality in Russia turned into informal fees – the one, who pays more, gets a higher position. "The Izvestiya", №7 (12) 2011.

Such "certificate of quality" does not imply any obligations for the structures that issued it. This is not more than a receipt certifying the payment of fees for receiving this document. On 24.08.2012 the Russian Federation ratified the Agreement on WTO Accession. The country should be ready for new conditions of work in the global market.

Andrei Sharonov, the head of "Troika-Dialog" OJSC expressed his opinion on the RF accession to the WTO: "Today we seemed to have entered the area of global business, but we have not joined any group yet. That is why our attempts "to push" serious decisions are opposed by a wall made by a team of 158 people."

The problems of Russia's WTO accession and the impact on the national financial market were addressed in the studies of L. Krasavina, V. Krasheninnikova, I. Platonova, I Noskova, D. Mikhailova, etc.

The issues of Russian foreign economic activity and the country's accession to the World Trade Organization were considered in the works of A. Daineko, A. Krylov, S. Borisov, V. Dmitriyev, I. Kozhakova, L. Razumnova, V. Obolensky, S. Anisimov, V. Mekhryakov, I. Rozinsky, A. Kryuger, F. Kimur, M. Ando, T. Fudziya, T. Rezerford, D. Tarr, O. Shepotilo.

Nevertheless, the researches, especially the ones related to financial and economic system of the country cannot be called complete, reliable and accurate.

"The system regulating financial markets should be really comprehensible, transparent for all the participants and stable. That is what they ask us, when we meet the representatives of foreign firms with clear delimitation of competencies and responsibility. It should correspond to the international standards and rules," said PM Medvedev at the session of the RF government on Russia's WTO accession on 14.02.2012.

He stressed that in its development, the country should follow global laws, flexibly respond to global impacts, "feel the nerve of the international financial system development. And, of course it should diminish the risks of global financial instability, which are rather high at the moment," added the Prime Minister.

At the moment the WTO unites 159 countries. Over 60 international organizations including IMF and the World Bank have the status of observers in it. WTO agreements and legal documents regulate over 90% of global trade in goods and services.

The "game rules" established by WTO for practically all aspects of foreign trade activity exclude discrimination in trade.

The main consequences of Russia's WTO accession will be sharp competition, mainly scrupulous in its foundation, based on price/quality correlation of products/services.

"The most important thing is not direct financial profit from trade, but quality institutional changes, which will bring about economic transformations," believes the editorial board of "The Vedomosti".

As a conclusion of this preliminary analysis, it should be noted that in short-term period Russia's accession to WTO will lead to loss of some market share, may be a significant one, by Russian enterprises with mass invasion of international corporations with higher quality of goods and low costs.

It is very important to understand that WTO accession is not` oriented on mining industries as the most stable ones in their development, but also on segments of high processing.

While joining the WTO, our country has sufficient amount of potential opportunities to protect its economic interests from discrimination.

An example of such discrimination that everybody remembers is limitation measures towards Russian metallurgy companies in the USA. The results of anti-dumping investigations in respect of rolled steel producers clearly demonstrated the advantage of Russia as a WTO Member State.

One of the abiding documents by all WTO Member States is Agreement on Technical Barriers to Trade (TBT).

In 1994 the government of the RF set out Russian State Standard (currently Federal Technical Regulation and Metrology Agency) its principal authority on preparing the accession to this agreement.

Technical barriers in WTO trade are obstacles emerging as a result of differences between legislations of different countries in respect of the products ("technical regulations" under WTO terminology), standards and procedures of assessing the correspondence of products to technical regulations and standards.

In order to eliminate these barriers the TBT Agreement urges the countries to come together as much as possible or in other words to harmonize the national legislations, standards and procedures for assessing the correspondence of products and management systems.

The short formula for this goes like this: "Common standard - common method - general recognition".

Thus, the issues of standardization and certification will be an engine that will allow Russian enterprises having international legitimate certificates not to lose, but to win upon Russia's accession to WTO.

All international organizations, in the first place ISO technical committees, collect detailed information about the situation at the certified market in Russia.

In August 2008 ISO 17021 standard took effect. It will abolish close to 90%-95% of illegitimate certification bodies, which operate in Russia today.

This is confirmed by sad experience of the countries of Eastern Europe and Asia, which have already acceded the WTO. The economic and social consequences were rather serious for them. For instance India's membership in WTO resulted in bankruptcy of over 40% of small and medium businesses of the country.

While serious joint efforts of business and the state are undertaken in the field of quality management, the environment and life safety are practically on zero level. At the same time it is necessary to remember that Russia will inevitably see the arrival of companies offering goods and services at lower prices, environment friendly and produced at enterprises with the certified system of life safety and social responsibility.

There was a time, when in order to enter the EU all enterprises of the candidate states passed certification for compliance with OHSAS 18 000 standard. We should really be ready that sooner or latter big international associations will propose the same requirements to Russia.

We can be sure that:

- Up to 90% of certificates currently available in Russia may become illegitimate under WTO requirements;

- Receiving orders, contractual obligations with budget (state) structures will be possible only under condition of legitimate certification with the 3rd generation ISO 9001:2000, ISO 14001, OHSAS 18 000 and other socially important international standards;

- For real competition under WTO conditions it is necessary to have a certified system of management under the industry standards: ISO 22000 for the food industry, TL 9000 for the communication services, QS 9000 for the automobile industry, Q1/ISO9001 + API Standard 1512/ISO900 for O&G complex, etc. The international industry standards are relevant for each region and each district.

Re-certification. The situation in the country, where there are many certification bodies that have issued dozens of thousands of certificates, will be subject to serious revision.

The Russian Research Institute for Certification collects real statistics from all over Russia and submits it to the corresponding ISO committees. ISO is getting ready for thorough analysis of every certificate.

Preliminary re-certification, effective and quality sanction of the management system can spare the enterprise of the domestic producer from serious and inevitable problems. The statistics of Federal Technical Regulation and Metrology Agency and Russian Research Institute for Certification available today suggests rather disappointing data. The percentage of safety certificates in Russia ranges from 10% to 20%. After initial receipt of the certificate there are no audit controls. The

of managers, authorized persons, internal auditors expired long time ago.

Problems also emerge after certification bodies change their accreditation, and the Code you need is not fully represented. This problem is even more dangerous, when the certification body did not have the necessary accreditation code during initial certification. In such a situation urgent re-certification is required and the certification body has to be replaced by a legitimate authority. In August 2008 ISO 17021 standard took effect and has remained in force since that time. It exhibits very tough requirements to certification bodies.

According to the forecasts of world business analysts, 90-95% of the "players" of certification business in Russia will have to leave the field.

Bibliography

[1] WTO: 2012 PRESS RELEASES PRESS/668 23 July 2012 PRESS RELEASE:`

[2] WTO.ru: Targets and objectives of accession

[3] I. Shuvalov: Russia's WTO accession is a key step on the way to entering — the OECD. — New of the Day — RosBusinessConsulting, 2012

[4] Agreement Establishing the World Trade Organization

[5] Position of Georgia on Russia's WTO accession remains unchanged //

Civil Georgia, Tbilisi / October 5, 10

[6] Russia is as never close to reaching one of its most objectives in foreign policy and economy// echo.msk.ru, 31.10.2011.

[7] Ukraine demands withdrawing its consent on Russia's WTO accession // izvestia.com.ua, 5.11.2011

[8] Report of the Working Party on Russia's Accession to the World Trade Organization dated November 16, 2011, № WT/ACC/ RUS/70,

WT/MIN(11)/2

[9] Report of the Working Party on the Accession of the Russian Federation to the World Trade Organization (English). The Ministry of Economic Development of Russia (November 1, 72011). Examined on February 22, 2012.

[10] Short review of the obligations of Russia to the WTO in the field of insurance services.

[11] Short review of the obligations of Russia to the WTO in the field of bank services, services and the securities market and other financial services (but for the insurance services)

[12] WTO legal texts — The WTO Agreement