

Validation of SECI Model in Education

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Abstract

The use of Knowledge Management (KM) is increasingly relevant to education as our knowledge of factors influencing the effective managing of information and knowledge resources. It is important that educational organizations understand the application of strategies for managing the knowledge resources and providing appropriate access to this information within the University context. This article examines data collected from students doing the Software Engineering Program at UNSW. This data is used to analyse the industrial SECI model of KM as applied to the educational domain. We are looking at the validity of the empirical evidence. Results indicated that the data provided a valid study of KM in this context.

1. Introduction

The importance of knowledge management (KM) in education is becoming more evident, and as such, institutions around the world have implemented various KM systems to assist them. For example, Petrides and Nodine (2003) describe that Cuyahoga Community College in Cleveland, Ohio utilised money funded by the Ohio State Government, to hire a chief knowledge officer who was assigned to improve information sharing throughout the organisation (Petrides & Nodine, 2003). By adapting University procedures to fit the recommendations made the chief officer, Dean was able to capitalise on the corporate knowledge and experience of the chief officer (Petrides & Nodine, 2003). Similarly, the American Department of Education gave Jackson State University in Jackson, Mississippi a Title III Grant to hire a corporate KM expert to assist them in improving their knowledge management practices. The Vice President for knowledge management systems and support staff was the man hired to implement technologies to improve the University's knowledge flow (Petrides & Nodine, 2003). The methodologies used by these hired experts were adopted from well-known KM frameworks that detail different aspects of knowledge creation and storage.

This research uses the SECI model (Nonaka and Takeuchi, 1995) for assessing the KM practice of an educational institution. SECI is often used to assess the existing support for KM in an organisation, as this model can successfully explain the transition process of knowledge management for individuals in the organization. The study has two objectives. Firstly, it examines the components of the SECI model of KM, i.e. Socialisation, Externalisation, Combination and Internalisation. Then, it investigates how their implementation through technology impacts on the success of KM practices in an educational context. A case study was used to explore KM in education, in particularly for the Software Engineering (SE) program in University of New South Wales (UNSW). In this study a detailed questionnaire was developed and used to gain an understanding of the current KM uses of technology within the SE degree. The purpose of this investigation is to support the learning activity through the use of technology in the SE

program.

This paper is a brief summary of the data collected in a study of student's experiences of the SECI model as developed by Nonaka and Takeuchi (1995), within an educational context

2. Background on Knowledge Management in Education

KM is seen as integral to idea creation and improvement, executive decision-making and organisational improvement. It involves transforming information and intellectual assets into enduring value (Kidwell et al, 2000). It connects people with the knowledge they need to take action, when they need it. In the corporate sector, managing knowledge is considered key to achieving breakthrough competitive advantage. Effective knowledge management programs identify and leverage the know-how embedded in work processes, with a focus on how it will be applied.

The following benefits have been identified for KM in education. Firstly, faster and more enhanced communication between academic staff and students (Alavi & Leidner, 1999). Using knowledge enablers such as course websites allows academic staff to post information about the course and its assignments any time of the day, and students to view it at a convenient time (Lyman and Varian, 2003). This medium also allows additional information pertaining to the post to be included, for example, additional links to helpful references can be included for assignments.

Secondly, KM provides educational institutes financial benefits by shortening the length of time that academics are required to search for information pertaining to the subjects they teach. According to Lyman and Varian (2003), a dramatic amount of 1.5 Ebyte of information is produced worldwide each year, for example data repositories that store journal articles significantly reduce the amount of time that is required by course administrators to search for these materials.

A further potential benefit of KM in education is heightened efficiency. This includes increased efficiency in recording assignment and examination results, releasing these results to students, immediate access to journal articles, and in communication between academics and/or students through email or message boards.

Lastly, KM can also improve the performance of students. Having information stored in a central repository where students can continually refer to it allows for a more enlightened student as they can access new information easily, and re-visit information that can help build on their skills. Having a more enlightened student reaps benefits not just to the academic world, but also the corporate world. It enables the quality of students that graduate from a program to learn from each other's work, and become more and more qualified as time progresses. As graduating students move into employment, it is essential for them to be correctly trained and highly qualified beforehand, saving companies millions of dollars down the track (Petrides & Nodine, 2003). Well-captured knowledge, and knowledge that can be transferred easily from student to student deepens each student's perspective on their course work. It enriches their education and creates a spiral effect where each student after them obtains the existing knowledge and a little bit more, ensuring a more qualified workforce each year (Barrios et al, 2002). This highly qualified and trained workforce also ensures that Australian organisations are able to hold a significant place in the global market.

As graduating students move into employment, it is essential for them to be correctly

trained and highly qualified which would benefit those companies for whom they work. Skills that students receive at University assist them in being more efficient and effective employees and will save companies thousands of dollars per employee in training in the long run. Efficient knowledge management systems operating in the public sector that can assist in this would clearly benefit to those in the private sector. This forms that main basis behind this thesis. It will explore KM in education, analysing existing KM frameworks, and how they relate to a scholastic environment.

3. Methodology and Research Question

In this study we used the SECI model to investigate knowledge management in an educational context. This is an empirical research which aims to discover how applicable this model is in an educational context whilst also testing the theory behind the SECI Model.

A survey was conducted on students and was analysed in light of the following research questions:

RQ1. Does the level of use of each type of transformation of knowledge, i.e. Socialisation, Externalisation, Combination and Internalisation, have any effect on the level of knowledge management? Is the SECI model applicable in an educational context and does the significance of the model components vary between years or across gender?

RQ2. What are the current knowledge management practises within educational organisations? Which procedures are being utilised effectively by students and which can be improved?

4 Analysis of Validity of Data

The analysis conducted on the data included correlation analysis and regression analysis. However these operations include some assumptions of the data. This section discussed these assumptions, and how close the data fitted the desired format.

4.1 Outliers

When running the regression analysis we need to verify that the results are not affected by univariate outliers. This was carried out for each test in the previous section. In this section we discuss how the outliers were selected. Also we require that the regression standardised residual for the level of KM form a normal distribution, which is discussed later.

Outliers were identified using the boxplot graph shown in User Field REF _Ref111536024 \h = Figure 1 and removed from each analysis, which was then redone. The results before and after removal are compared to verify the stability of the analysis against outliers. When parametric tests were used, the effect of removing the outliers was significant, so non-parametric tests were adopted.

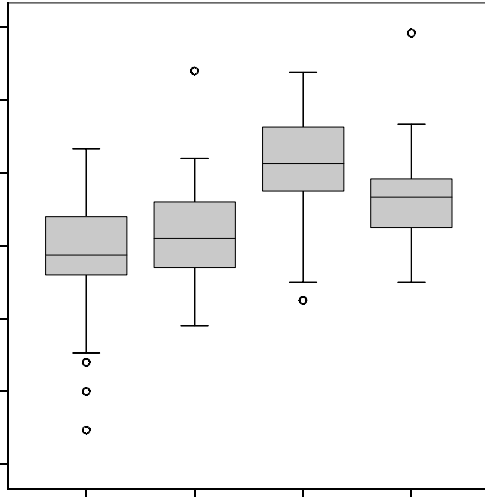


Figure User Field SEQ Figure * ARABIC = 4 Boxplot of Predictors showing outliers

The outliers were further analysed as follows. These results of the initial parametric regression were compared with the resultant regression predictions. The high influence points were not the outliers selected in the boxplot graph User Field REF _Ref111536024 \h = Figure 1 as being more than 1.5 time the inter-quartile range from the median. However some high leverage points were also boxplot outliers.

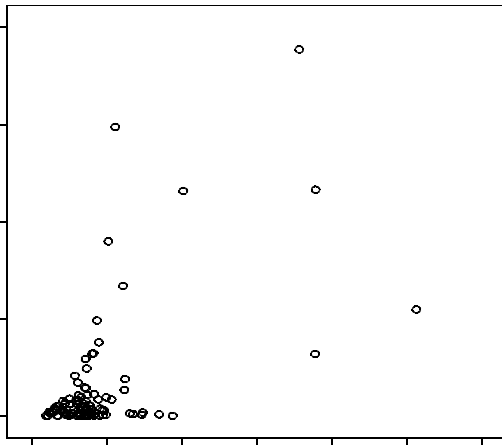


Figure User Field SEQ Figure * ARABIC = 4 Showing high leverage and high influence points

After the initial regression analysis we also looked at the high influence points. The plot of high leverage and high influence points in User Field REF _Ref117356444 \h = Figure 2 suggests that the cases 91, 81, 47 and 1 have high influence. A high leverage gives a point extra weight in the computation of the regression line, and the high influence indicates that it did affect the slope of the regression line. However these were not identified as outliers, so not removed, although they could be weighted in future analysis. As an alternative method of identifying outliers for the regression analysis, three points had a studentized error less than two in absolute value (15, 78, 82) and two

had studentized error greater than two (47, 81).

Given the large number of outliers, non-parametric tests were used in the final analysis. Also when comparing the relative level of the population for each independent variable or predictor, this was estimated from the median not the mean.

4.2 Correlation between dependent variable and its predictors.

When conducting a correlation analysis we are assuming the dependant variable has a linear relation to the independent variables. While there is an underlying constant value for the residual Knowledge Management effect of the institution, there is a generally linear trend between each of the predictors and the Knowledge Management value as shown in User Field REF_Ref116947080 \h = Figure 3.

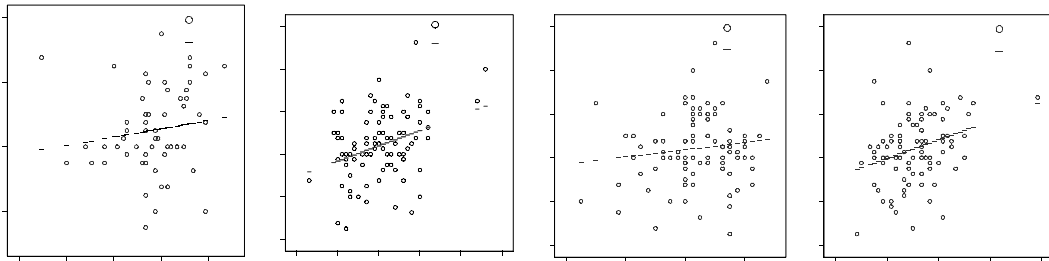


Figure User Field SEQ Figure * ARABIC = 4 Scatterplots of Socialisation, Externalisation, Combination and Internalisation predictors against KM showing Individual regression lines

The underlying residual constant in the Knowledge Management value arises from the study being carried out on one program in one University. Hence some common KM effect would be expected, especially within a culture of learning. However as the table above showed, the variations in KM is still closely correlated to at least some of the predictors.

4.3 Normality of Predictors

Also assumed in regression analysis is the normality of the predicting factors. The normality of the predictor and KM distributions were verified using normal probability plots as shown in the graphs below.

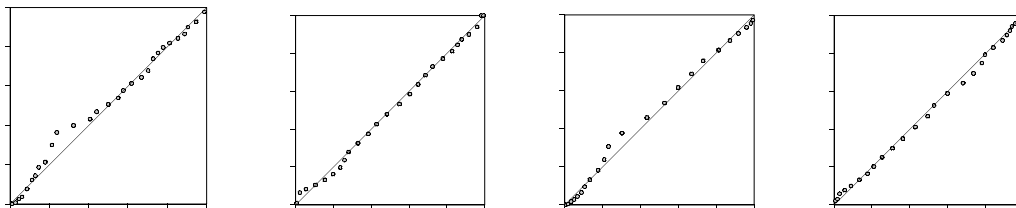


Figure User Field SEQ Figure * ARABIC = 4 P-P Plots of each Attribute Socialisation, Externalisation, Combination and Internalisation.

The data gathered for each predictor has near normal distribution, which is a necessary assumption for performing the regression analysis. Furthermore the dependant variable

Knowledge Management has near normal distribution. However, as there were many different outliers found in the data a more robust analysis method was used. Also some categories of data were small in number so hard to claim normal behaviour in the sub-population, for instance when looking at the effect of year on the data.

Therefore robust tests were used in all cases. The correlation between each predictor and the overall KM was estimated using Spearman Correlation. Two predictors were found to be correlated, so this was analysed further for the effect of these significant predictors on KM variation using robust multiple regression. Finally only Externalisation was found to be a significant predictor.

5. Further Analysis of sub-categories

Once the correlation between the dependent variable and its independent predictors is analysed, we looked at the possible effect of other variables on the data, including year of study, gender and country of origin. This analysis uses a level analysis based on the median, taking into account the large number of outliers and non-normality of the small data sets.

5.1 Level analysis for year

The aim of this analysis is to verify if the effect of different years has confounded the data and reduced the correlation between Internalisation, Socialisation and Combination in terms of overall KM.

The median value for each variable was assessed for the groups by year and these were found insignificant for nearly all predictors and Knowledge Management. Externalisation showed greatly reduced level and range in year 2. The variation between year groups was not significant for any other predictors.

Table User Field SEQ Table * ARABIC = 4 Median by year

Year	1		2		3		4	
	Median	Inter-Quartile Range	Median	Inter-Quartile Range	Median	Inter-Quartile Range	Median	Inter-Quartile Range
Social	2.67	0.73	2.94	0.98	3.13	0.90	2.70	0.96
External	3.15	1.13	2.75	0.35	3.30	1.00	3.15	0.90
Comb.	4.07	1.63	4.00	1.00	4.13	0.37	4.38	1.09
Internal	3.71	0.84	3.25	0.89	3.67	0.75	3.50	0.63
KM	2.75	0.97	3.13	1.13	3.50	1.19	3.07	0.47

The most significant difference in levels is Externalisation from year 2 to 3. Also Socialisation increases most from year 1 to 3 but drops back down year 3 to 4. Combination steadily increases most years. Internalisation and Externalisation decrease by nearly the same amount from year 1 to 2 but return to the year 1 level in year 3.

The greatest variation in perception of the level of KM existing in the program was found to be between first years and third year students. By third year the students are apparently looking to external sources for their knowledge, such as textbooks, readings and websites. It is already of concern in Universities the lack of 'independent' learning

carried out by students.

Table User Field SEQ Table * ARABIC = 4 Greatest variation across years for each predictor, and Knowledge Management

Analysis by Year	Socialisation	Externalisation	Combination	Internalisation	Knowledge Management
Greatest Var.	Year 1 cf. 3 (reversed 4 cf. 3)	Year 2 cf. 3	Year 2 cf. 4	Year 2 cf. 1	Year 1 cf. 3

From this analysis it would not appear that variation across years was effecting the correlation of Socialisation and Combination with KM. Assuming the KM facilities are equal across years, it is worth noting that only Socialisation and Combination predictors and Knowledge Management effects are less in year 1 compared to later years. This would suggest that Universities do impart skills in this area, although in varying amounts across the years. Combination effects show a steady rise in mean and variation across each year. This would suggest that Combination was learnt steadily throughout the degree.

Internalisation is reduced over the early years, and is again reduced between year 3 and 4. While this suggests universities are not supporting this method of knowledge management, it may be an area which could be better supported in educational organisations.

While knowledge management had a lower median in year 4, there was also a greatly reduced variation, which suggests the students going on to the fourth year are generally more clear about how to manage their knowledge, although may not always find the University supplied resources ideal for this.

5.2 Level analysis by gender and birth country

The data was also analysed for the effect of gender and country of birth on the level of each separate predictor. This was to investigate if these variables were a confounding effect on the model.

These attributes were not found to be significant in explaining any variation in the predictor effects. However there was some difference between the perceptions of Externalisation and Internalisation according to gender. Males gave higher values to the existence of all predictors and to Knowledge Management. However the low number of female respondents suggests the power of this analysis is not high. See User Field REF _Ref120981150 \h = Table 3.

Since the questions were framed in terms of both the use of, and the value attached to the predictors, it is possible that males respond better to Externalisation and Internalisation as they perceived these as novel and hence significant ways of learning. The greater emphasis in Universities for both the use of alternative sources of information (Externalisation) and social apprenticeship (Internalisation) may be less common in boys experience than girls at school.

In the analysis by country the only large difference was in the experience of Combination factors, where Australian born students rated higher than non-Australian born as shown in User Field REF _Ref120980882 \h = Table 4.

Table User Field SEQ Table * ARABIC = 4 Analysis of Effect of Gender on Outcomes

	Gender	N of cases	Median	Inter-Quartile Range
Socialisation	Female	10.00	2.77	1.13
	Male	48.00	2.90	0.80
Externalisation	Female	20.00	2.80	0.40
	Male	70.00	3.10	1.00
Combination	Female	20.00	4.00	0.34
	Male	71.00	4.25	1.00
Internalisation	Female	20.00	3.17	0.65
	Male	71.00	3.67	0.75
Knowledge Management	Female	20.00	3.19	0.78
	Male	71.00	3.25	0.87

Table User Field SEQ Table * ARABIC = 4 Analysis by Country of Birth of Combination

Country of Birth	Number	Median Combination	Inter-Q Range
Australia	27	4.38	1.15
Non-Australian	61	4.00	0.63

6. Conclusion

The aim of this research was twofold: to examine existing knowledge management frameworks in an educational context to provide an analysis of how they can be, or have been, applied to an education institution. In doing so, to investigate Nonaka's SECI model, how it applies to education and how the model suggests improvement to KM in education.

This technical report is a brief overview of the strategy used to analysed the data from a survey of students experience of different aspects of Knowledge Management as described by the SECI model.

References

Alavi M, Leidner DE (1999) "Knowledge Management Systems: Issues, Challenges and Benefits", Communications of the Association for Information Systems (CAIS), Vol. 1, Article 7.

Barrios V. B., Gütl Ch., and Pivec M.: Semantic Knowledge Factory: A New Way of Cognition Improvement for the Knowledge Management Process; Proceedings of SITE 2002, March, Nashville, Tennessee, USA, 168-172.

Kidwell J.J., Vander Linder K.M., Johnson S.L. (2000). Applying Corporate Knowledge Management Practices in Higher Education, Educause, Quarterly 4, 28-33.

Lyman P. and Varian H. R. (2003). How Much Storage is Enough? ACM Queue vol. 1, no. 4 – June.

Nonaka I, Takeuchi H (1995). The Knowledge-Creating Company: How Japanese

Companies Create the Dynamics of Innovation, Oxford Univ. Press, New York, USA.

Petrides L, Nodine T (2003). Knowledge Management In Education: Defining the Landscape. The Institute for the Study of Knowledge Management in Education, March 2003