Understanding Personal Knowledge Development in Online Learning Environments: An Instrument for Measuring Externalisation, Combination and Internalisation

Markus Haag and Yanqing Duan
University of Bedfordshire, Luton, UK
markus.haag@beds.ac.uk
yanqing.duan@beds.ac.uk

Abstract: This paper investigates personal knowledge development in online learning environments using the perspective of a model adapted from Nonaka and colleagues' SECI model. To this end, the SECI model, which was originally designed to describe organisational knowledge creation and conversion, was adapted to conceptualise personal knowledge development in online learning at the individual level. As the SECI model was originally conceived at the organisational level, in order to measure personal knowledge development at the individual level in the context of online learning, a measurement instrument was created in order to measure the scores of individual online learners on Externalisation, Combination and Internalisation. It is argued that Socialisation is not a relevant mode in the context of online learning and is therefore not covered in the measurement instrument; this is explained further in the paper. This measurement instrument also examines the interrelationships between the three modes and a new model – the so-called EC-I model – is proposed to depict these interrelationships. The measurement instrument is based on data collected through an online survey, in which online learners report on their experiences of personal knowledge development in online learning environments. In other words, the instrument measures the magnitude of online learners' Externalisation and Combination activities as well as their level of Internalisation, i.e. the outcomes of their personal knowledge development in online learning. For Externalisation and Combination, formative indicators were used, whereas for Internalisation reflective indicators were used. The measurement instrument is one of the main foci of this paper and is therefore discussed in-depth. In sum, the paper proposes a modified version of the SECI model, extending the applicability of the original SECI model from the organisational to the individual level. It outlines a new measurement instrument which can be used to measure Externalisation and Combination, i.e. personal knowledge development processes, and Internalisation, i.e. personal knowledge development outcomes.

Keywords: personal knowledge development, SECI model, EC-I model, measurement instrument, measurement indicators, online learning

1. Introduction

The objective of this paper is to examine and understand personal knowledge development (PKD) in the context of online learning environments (OLEs). It is suggested that one should distinguish between PKD processes and PKD outcomes. For this context, no measurement instrument yet exists that could measure both the processes and the outcomes – the research presented here proposes such an instrument. The research also examines the relationships between PKD processes and PKD outcomes by proposing a new model called EC-I.

Knowledge creation at the organisational level has been researched and described intensively by using Nonaka and colleagues' SECI model (e.g. Nonaka and Takeuchi 1995). Gourlay (2006) claims that SECI has even achieved a paradigmatic status in the field of knowledge management. The model was first proposed in the early 1990s (Nonaka 1991) and has since been modified and extended by, for example, Nonaka (1994), Nonaka and Takeuchi (1995), Nonaka and Konno (1998), Nonaka, Toyama and Konno (2000), Nonaka, Toyama and Byosière (2001), Nonaka and Toyama (2003), Takeuchi and Nonaka (2004), Nonaka, von Krogh and Voelpel (2006), and Nonaka and von Krogh (2009).

However, actual measurement instruments and measurement indicators of the SECI model and/or its four modes are extremely rare. Therefore, this paper – which is based on a doctoral research project described in detail in Haag (2010) and in publications related to the research (Haag, Duan and Mathews 2007, 2008, 2009) – presents a measurement instrument for three of the four SECI modes, namely Externalisation, Combination and Internalisation – in the context of online learning. That means that the SECI model will be used as the basis for a new PKD model at the individual level of rather than at the level of organisational knowledge creation for which it has originally been conceived. This new model, called the EC-I model, describes the PKD of an individual learner in

Reference this paper as: Haag, M and Duan, Y. "Understanding Personal Knowledge Development in Online Learning Environments: An Instrument for Measuring Externalisation, Combination and Internalisation" *The Electronic Journal of Knowledge Management* Volume 10 Issue 1 (pp39-47, available online at www.ejkm.com

OLEs and extends the applicability of the original SECI model from a focus on the organisational level to a focus on the individual level.

First, this paper gives a brief overview of the SECI model and its four modes. Then, the methodology of designing and validating the measurement instrument will be presented. The paper then outlines newly proposed measurement indicators for three of the SECI modes, namely Externalisation, Combination and Internalisation. Finally, the EC-I model, a model of PKD in OLEs, is introduced.

2. The SECI model and its modes

The SECI model describes four modes of knowledge creation through a continuous interaction between explicit and tacit knowledge. The four modes are now explained one by one:

Socialisation is defined as the "process of sharing experiences and thereby creating tacit knowledge such as shared mental models and technical skills" (Nonaka and Takeuchi 1995, p 62). In this mode, knowledge is acquired mainly by observation, imitation and learning by doing, similar to an apprenticeship (Nickols 2000). Here, tacit knowledge is converted into tacit knowledge.

Externalisation is "typically seen in the process of concept creation and is triggered by dialogue or collective reflection" (Nonaka and Takeuchi 1995, p 64). Here, tacit knowledge is converted into explicit knowledge.

Combination "involves combining different bodies of explicit knowledge" (Nonaka & Takeuchi 1995, p 67). This is done by individuals exchanging and combining this knowledge in the form of documents, etc. Here, explicit knowledge is converted into explicit knowledge. This combining and processing of explicit knowledge is likely to lead to more complex and systematic knowledge (Nonaka and Toyama 2003).

Finally, Internalisation is the process by which knowledge becomes valuable when it "[knowledge] is internalized in individuals' tacit knowledge bases through shared mental models or technical know-how" (Nonaka, Toyama and Byosière 2001, p 497), and it is closely related to learning by doing (Nonaka and Takeuchi 1995). Here, explicit knowledge is converted into tacit knowledge. Figure 1 (based on Nonaka and Konno 1998, p 46) depicts the SECI model and its four modes.

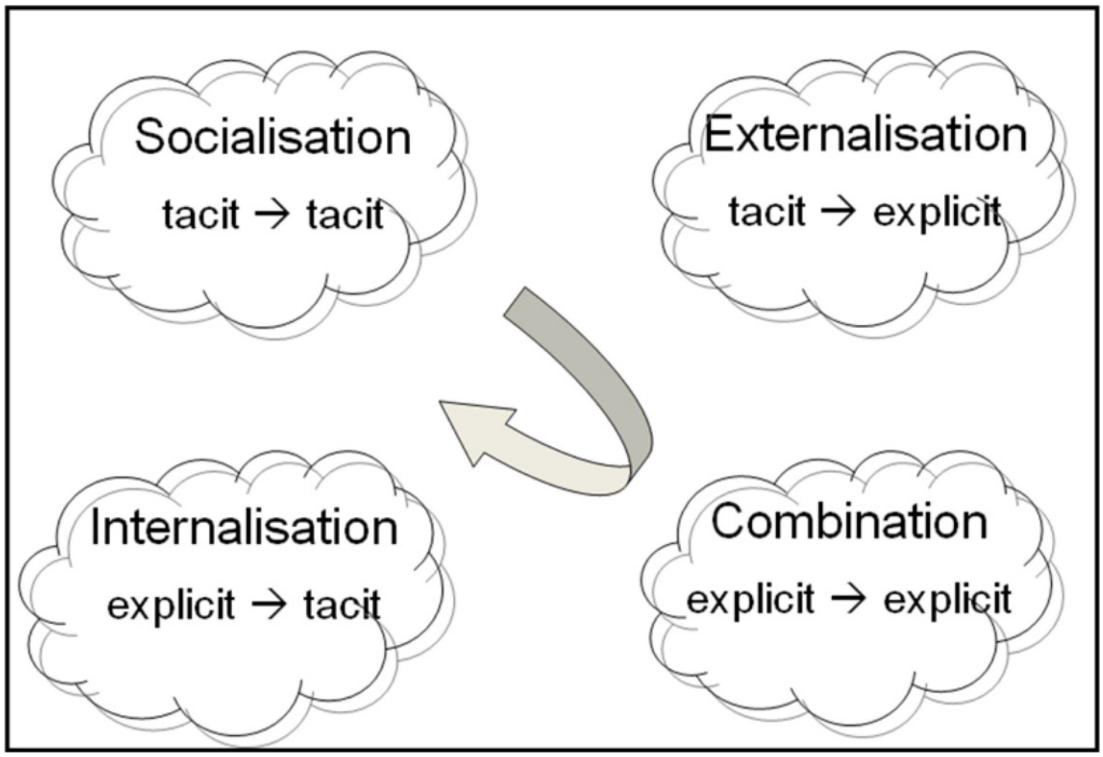

Figure 1: The SECI model and its four modes (based on Nonaka and Konno 1998, p 46)

3. Methodology of designing and validating the measurement instrument

The aim of the research presented here was to design measurement indicators that are valid in the context of high-level, more generic online learning. To this end, a maximally diverse and heterogeneous sample must be recruited; this results in a broad geographical dispersion of the sample.

First, the survey was piloted with students and academics at the University of Bedfordshire, UK. Both the content and the wording of the questions were checked and the questionnaire was modified accordingly. Thus, validity issues were addressed (Moser and Kalton 1971), and face validity could be established.

In order to get a highly diverse sample, three different ways of accessing participants were followed. This allows for triangulation of data (Denzin and Lincoln 2005) by different types of students (e.g. undergraduates versus postgraduates) and by different modes of instruction (e.g. fully online versus blended learning). It was decided to target a) the students of the eMBA course at the University of Bedfordshire, b) the members of three different Yahoo! Groups, called com-prac, interculturalinsights, and onlinefacilitation, respectively, and c) the members of dialogin The Delta Intercultural Academy, a knowledge community on culture and communication in international business. SurveyMonkey (www.surveymonkey.com) was used to host the survey. The data was then exported into SPSS (Field 2009) and analysed using this statistical analysis software. It is important to note that only some of the members of the three data sources are actual online learners; this means that the response rate could not be calculated. In total, 171 answers could be used in subsequent data analysis.

Table 1 shows the shorthand name of the measurement items, the SECI mode they refer to, and the respective questions asked in the survey. The two items for Internalisation shown in square brackets were not used in the final measurement instrument. The reasons for this are discussed in the analysis section below.

Table 1: Measurement items and respective SECI mode and question

Measurement items	SECI mode	Survey question
Discussion forums	Externalisation (PKD processes)	How often do you post in discussion forums?
Blog		How often do you contribute to a blog (e.g. adding, changing or deleting parts of it)?
Wiki		How often do you contribute to a wiki (e.g. adding, changing or deleting parts of it)?
Instant Messaging (IM)		How often do you take part in Instant Messaging (IM) with other learners or tutors?
Online chats		How often do you take part in online chats with other learners or tutors?
Search engines	Combination (PKD processes)	How often do you use search engines to find materials in addition to those provided by the online learning environment?
Different types of functions		How many different types of functions do you usually access when learning about one particular topic? Examples of these functions, among others, are: discussion forums, blogs, wikis, instant messaging, chats, listening to audio files, watching video files, self-assessment quizzes, downloading course documents, etc.
Getting to know other learners' opinions		How interested are you in getting to know other learners' opinions through reading their postings in discussion forums?
Sharing information		How often do you share information with other learners (e.g. posting links or other documents for them to read, using online communication tools to let them know about something, etc.)?
Working together with other learners		How often do you work together with other learners to create new materials (e.g. wikis, blogs, etc.)?
[Application of knowledge]	Internalisation (PKD outcomes)	How strongly do you agree or disagree with the following statements? (same for all five Internalisation items): [I can apply the knowledge that I have acquired in the online learning environment in other contexts.]

Measurement items	SECI mode	Survey question
[Functions for self-assessment]		[The functions for self-assessment (e.g. quizzes, tests, simulations) help me to learn.]
Acquiring new knowledge		The functions of the online learning environment contribute to me acquiring new knowledge.
Improving my skills		The functions of the online learning environment contribute to improving my skills.
I have learned a lot		Overall, I have learned a lot through the online learning environment.

In terms of the Socialisation mode, it is suggested here that the direct physical proximity necessary in this mode is, by definition, not possible in an OLE. Nonaka and Toyama (2003) also stress that successful Socialisation is fostered by 'indwelling' and 'living in' the world, which in turn suggests that the context in which knowledge creation and PKD occurs has to be actively experienced and made sense of. However, in the vast majority of today's OLEs, particularly at the generic level of online learning, this in-dwelling is normally not possible. Therefore, in the context of this study, Socialisation was considered to be not relevant and was therefore not examined. Moreover, one could argue that some elements of Socialisation are also covered by either Externalisation and/or Combination. The role of Socialisation in online learning requires further clarification and further research.

The answer options were identical for all five items representing Externalisation and were based on a Likert-type ordinal scale: 'Never' was coded as 1, 'once or twice a month' as 2, 'once or twice a week' as 3, '3-5 times a week' as 4, and 'more than 5 times a week' as 5. The cases that answered 'Not applicable' for a particular item were not included in the calculations.

The coding for the five Combination items was similar to the Externalisation items, with a coding of 1 to 5 starting from the lowest intensity to the highest intensity. The wording of the five Combination items for the codes of 1 to 5 differs; the respective wordings are:

- 'Search engines': never, rarely, sometimes, often, very often, not applicable
- 'Different types of functions': only one, two, three, four, five or more, not applicable
- 'Getting to know other learners' opinions': very much interested, somewhat interested, neither interested nor disinterested, somewhat disinterested, not interested at all, not applicable
- 'Sharing information with other learners' and 'working together with other learners': never, once or twice a month, once or twice a week, 3-5 times a week, more than 5 times a week, not applicable

The answer options for all five Internalisation items were identical, namely: strongly agree, agree, neither agree nor disagree, disagree, strongly disagree, not applicable.

4. Analysis of measurement indicators for a model depicting personal knowledge development in online learning environments

4.1 Scale development: Formative versus reflective indicators

The nature of the ECI modes in the context of online learning will now be discussed. It is suggested here that constructs of Externalisation and Combination differ from the Internalisation construct in terms of their characteristics of measurement and that one should distinguish between formative and reflective indicators. This distinction will now be discussed.

The main approach to the development of measures centres on "scale development, whereby items (i.e., observed variables) composing a scale are perceived as reflective (effect) indicators of an underlying construct (i.e., latent variable)" (Diamantopoulos and Winklhofer 2001, p 269). An alternative to scale development (Hinkin 1995) is the creation of formative or causal indicators and requires the creation of an index rather than a scale (Bollen and Lennox 1991). Formative indicators are observed variables, i.e. items that make up an index, and that cause a latent variable. Contrary to that, reflective indicators, i.e. effect indicators, are observed variables or indicators that are caused by a latent variable (Diamantopoulos and Winklhofer 2001).

It is argued here that Externalisation and Combination are latent variables that can be measured by measurement items which are the cause of either the Externalisation or Combination construct. One can say, therefore, that Externalisation and Combination are the dependent variables that are determined by a linear combination of measures of independent variables, namely their respective

formative indicators (Bagozzi 1994). In other words, it is not the objective of the items to represent the same uni-dimensional construct but to give a relevant representation of a range of Externalisation processes or Combination processes, respectively. Contrary to that, it is suggested here that Internalisation should be measured by reflective indicators, because the scale for Internalisation consists of *reflective* scale items. A more detailed discussion of formative and reflective indicators and their role in this study can be found in Haag (2010).

4.2 Intercorrelations between the measurement items

The intercorrelations between the measurement items for Externalisation, Combination, and Internalisation (ECI items) and their respective aggregates will now be examined. Rather than using the widespread Pearson's correlation coefficient, Kendall's tau (τ) was used instead. This is because the distribution of the data in this study was considerably non-normal. In such a case, it is often suggested that non-parametric statistics should be used as they do not require normality (Field 2009). In addition to that, it has been suggested that Kendall's tau is a better estimate of the correlation in the population (Howell 2009).

4.2.1 Intercorrelations between Externalisation items

Table 2 shows the interrelationships, i.e. the correlation coefficients, between the items for Externalisation and the aggregate value for the Externalisation index. All correlations are positive and significant at the p<.001 level (2-tailed), with n=171 as the number of cases. In the tables that follow, one asterisk denotes that the correlation is significant at the 0.05 level (2-tailed), whereas two asterisks denote that the correlation is significant at the 0.01 level (2-tailed).

Table 2: Interrelationships between Externalisation items and their aggregate

	Discussion forum	Blog	Wiki	Instant Messaging	Online chats	Externalisation
Discussion forum	–	.508**	.271**	.292**	.278**	.586**
Blog	.508**	–	.318**	.397**	.406**	.609**
Wiki	.271**	.318**	–	.302**	.313**	.437**
Instant Messaging	.292**	.397**	.302**	–	.580**	.692**
Online chats	.278**	.406**	.313**	.580**	–	.672**

The lowest inter-item correlation is τ=.271 for the discussion forum – wiki relationship, whereas the highest is τ=.580 for the instant messaging – online chats relationship. The wiki item has the lowest inter-item correlations throughout, suggesting that a wiki is a somewhat distinct feature that stands slightly apart from the other four Externalisation items. However, the wiki item must not be seen as separate from the Externalisation index as the inter-item correlation is still significant. The item-to-total, i.e. item-to-Externalisation aggregate correlation is also very high, ranging from τ=.437 for the wiki item to τ=.692 for the instant messaging item. Given the very high item-to-aggregate correlations, the chosen items are very likely to represent a similar phenomenon.

4.2.2 Intercorrelations between Combination items

Table 3 shows the interrelationships between the items for Combination and the aggregate value for the Combination index. The significance levels (2-tailed) are also displayed.

The spread of the inter-item correlations for the Combination items is larger than for the Externalisation items. Only one was negative, albeit only very marginally, namely the correlation between 'search engines' and 'interest in other learners' opinions' with τ=-.019. The strongest correlation was found between 'working together with other learners' and 'sharing information with other learners' with τ=.414.

All items are significantly positively correlated with the Combination aggregate, with coefficients ranging from τ=.309 for 'search engines' and τ=.624 for 'types of functions'. It has to be stated again here that all items for both Externalisation and Combination should be kept as indicators for the Externalisation index and Combination index, respectively. This is because the individual items represent separate PKD processes that all add to the aggregate value of either Externalisation or Combination.

4.2.3 Intercorrelations between Internalisation items

Table 4 shows the interrelationships between the items for Internalisation and the aggregate value for the Internalisation index. All correlations are significant at the p<.001 level (2-tailed).

Table 3: Interrelationships between Combination items and their aggregate

		Search engines	Types of functions	Interest in other learners' opinions	Sharing information with other learners	Working together with other learners	Combination
Search engines	Corr. Coeff.	–	.168*	-.019	.041	.057	.309**
	Sig.	.	.011	.773	.537	.414	.000
Types of functions	Corr. Coeff.	.168*	–	.230**	.321**	.277**	.624**
	Sig.	.011	.	.000	.000	.000	.000
Interest in other learners' opinions	Corr. Coeff.	-.019	.230**	–	.149*	.215**	.429**
	Sig.	.773	.000	.	.022	.001	.000
Sharing information with other learners	Corr. Coeff.	.041	.321**	.149*	–	.414**	.550**
	Sig.	.537	.000	.022	.	.000	.000
Working together with other learners	Corr. Coeff.	.057	.277**	.215**	.414**	–	.560**
	Sig.	.414	.000	.001	.000	.	.000

Table 4: Interrelationships between Internalisation items and their aggregate

	Applying knowledge	Functions for self-assessment	Acquiring new knowledge	Improving skills	Having learned a lot	Internalisation
Applying knowledge	–	.278**	.425**	.409**	.469**	.458**
Functions for self-assessment	.278**	–	.352**	.304**	.298**	.329**
Acquiring new knowledge	.425**	.352**	–	.710**	.599**	.782**
Improving skills	.409**	.304**	.710**	–	.662**	.828**
Having learned a lot	.469**	.298**	.599**	.662**	–	.824**

For Internalisation, the inter-item correlations range from τ=.278 for 'applying knowledge' and 'functions for self-assessment' to τ=.710 for 'improving skills' and 'acquiring new knowledge'. The item-to-aggregate correlations were also high, ranging from τ=.329 to τ=.828. It has to be noted that the aggregate for Internalisation is calculated on the basis of taking into account only the following three items: 'acquiring new knowledge', 'improving skills', and 'having learned a lot'. This is because the Internalisation scale is regarded as the dependent variable of Externalisation and Combination and a mean scale was used for Internalisation with the aim of improving Cronbach alpha, something which was achieved by deleting two of the items, namely 'applying knowledge' and 'functions for self-assessment'. Thus, Cronbach alpha for Internalisation rose from .823 to .878. On the other hand, as Externalisation and Combination are *multidimensional* constructs representing conceptually broad definitions rather than overlapping constructs, Cronbach alpha is not a particularly relevant concept (cf. Rojas-Méndez, Davies, Omer, Chetthamrongchai and Madran 2002).

5. The EC-I model: personal knowledge development in online learning environments

It was argued before that Socialisation in its definition by Nonaka and colleagues is not relevant in the context examined in this paper. The proposed model of PKD in online learning therefore includes only three of the SECI modes: Externalisation/Combination – Internalisation (EC-I model). The structural relationships of the model are based on the interrelationships of the ECI modes as shown in Table 5. All correlations are highly significant at the $p<.001$ level. The strongest correlation is between Externalisation and Combination with $\tau=.533$. The effect size of 'Externalisation as a PKD process' on 'Internalisation as a PKD outcome' is lower than the effect size of 'Combination as a PKD process' on 'Internalisation as a PKD outcome' ($\tau=.226$ versus $\tau=.309$). This suggests that Combination processes have a stronger impact on Internalisation, i.e. PKD outcomes, than Externalisation processes have on Internalisation. However, the difference in effect size is not substantial.

Table 5: Interrelationships of the ECI modes: Correlation coefficients

	Externalisation	Combination	Internalisation
Externalisation	–	.533**	.226**
Combination	.533**	–	.309**
Internalisation	.226**	.309**	–

Moreover, the strong correlation between Externalisation and Combination ($\tau=.533$) suggests that Externalisation and Combination could be interpreted as the two constituents of one latent factor that shares some characteristics with both Externalisation and Combination. It is argued here that the main shared characteristic is that both modes deal with 'PKD processes' as opposed to 'PKD outcomes' which are represented by Internalisation. Figure 2 depicts the EC-I model. It has to be pointed out that the EC-I model is only applicable in the context of PKD in online learning and not in other contexts. The model contains the following two main elements: Externalisation and Combination (i.e. PKD processes), and Internalisation (i.e. PKD outcomes). A more detailed discussion of EC-I can be found in Haag (2010).

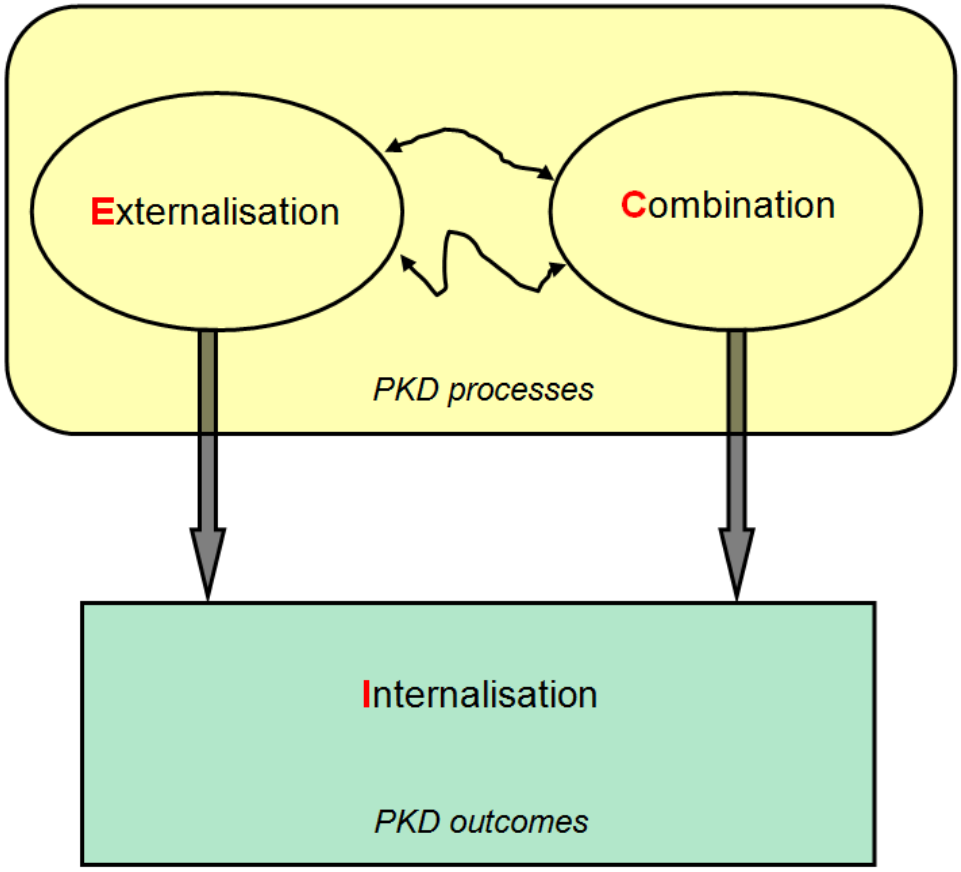

Figure 2: The EC-I model: A model of PKD in online learning

6. Conclusion

In this paper, a new measurement instrument was discussed which measures the scores of a learner on Externalisation and Combination, representing PKD processes in OLEs, and on Internalisation, representing PKD outcomes in OLEs. This instrument can only be applied in the context of online learning and must be modified to make it suitable and relevant to a different context. Therefore, the items dealing with Externalisation and Combination must be revised in such a way so that they adequately represent the PKD processes of the PKD context under investigation. The measurement items for Internalisation do not necessarily need to be modified because they measure PKD outcomes, a concept that does not differ across PKD contexts.

It was also shown that the SECI model can act as a useful starting point to investigate PKD in online learning. A new model, named the EC-I model, was presented in this paper. EC-I is based on the original SECI model and modified in such a way so that it is relevant in the context of PKD in OLEs at the individual level. In order to create further models of PKD in contexts other than online learning, more research is needed to address this shortage of empirical measurement instruments that can measure the magnitude of Socialisation, Externalisation and Combination activities as well as the level of Internalisation, i.e. the end-results of such activities. This will make the SECI model or models based on SECI more useful for both researchers and practitioners in the field of knowledge management.

References

Bagozzi, R. P. (1994) Structural equation models in marketing research: Basic principles, in R. P. Bagozzi (ed) *Principles of Marketing Research*, pp 317-385, Blackwell, Oxford.

Bollen, K. and Lennox, R. (1991) Conventional wisdom on measurement: A structural equation perspective, *Psychological Bulletin*, Vol. 110, No. 2, pp 305-314.

Denzin, N. K. and Lincoln, Y. S. (eds) (2005) *The SAGE Handbook of Qualitative Research*, 3rd edition, Sage, Thousand Oaks, CA.

Diamantopoulos, A. and Winklhofer, H. M. (2001) Index construction with formative indicators: An alternative to scale development, *Journal of Marketing Research*, Vol. 38, No. 2, pp 269-277.

Field, A. (2009) *Discovering Statistics Using SPSS: (And Sex and Drugs and Rock'n'Roll)*, 3rd edition, Sage, London.

Gourlay, S. (2006) Conceptualizing knowledge creation: A critique of Nonaka's theory, *Journal of Management Studies*, Vol. 43, No. 7, pp 1415-1436.

Haag, M. (2010) *Personal Knowledge Development in Online Learning Environments: A Personal Value Perspective*. PhD thesis, University of Bedfordshire, UK.

Haag, M., Duan, Y. and Mathews, B. (2007) Knowledge Development in e-Learning Environments: A Cross-Cultural Perspective, Proceedings of the 8th European Conference on Knowledge Management (ECKM 2007), Barcelona, Spain, 6th-7th September 2007, Vol. 1, pp 391-397.

Haag, M., Duan, Y. and Mathews, B. (2008) Trial Application of the Schwartz Value Survey on Personal Knowledge Development through e-Learning. Proceedings of the 9th European Conference on Knowledge Management (ECKM 2008), Southampton, UK, 4th-5th September 2008, Vol. 1, pp 257-266.

Haag, M., Duan, Y. and Mathews, B. (2009) Which Personal Values are Most Relevant to Knowledge Development through E-Learning? Insights from a Delphi Study. Proceedings of the 10th European Conference on Knowledge Management (ECKM 2009), Vicenza, Italy, 3rd-4th September 2009, pp 356-363.

Hinkin, T. R. (1995) A review of scale development practices in the study of organizations, Journal of *Management*, Vol. 21, No. 5, pp 967-988.

Howell, D. C. (2009) *Statistical Methods for Psychology*, 7th edition, Wadsworth, Belmont, CA.

Moser, C. A. and Kalton, G. (1971) *Survey Methods in Social Investigation*, 2nd edition, Ashgate, Aldershot.

Nickols, F. W. (2000) The knowledge in knowledge management, in J. W. Cortada and J. A. Woods (eds) *The Knowledge Management Yearbook 2000-2001*, pp 12-21, Butterworth-Heinemann, Boston, MA.

Nonaka, I. (1991) The knowledge-creating company, *Harvard Business Review*, Vol. 69, No. 3, pp 96-104.

Nonaka, I. (1994) A dynamic theory of organizational knowledge creation, *Organization Science*, Vol. 5, No, 1, pp 14-37.

Nonaka, I. and Konno, N. (1998) The concept of "ba": building a foundation for knowledge creation, *California Management Review*, Vol. 40, No. 3, pp 40-54.

Nonaka, I. and Takeuchi, H. (1995) *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, Oxford.

Nonaka, I. and Toyama, R. (2003) The knowledge-creating theory revisited: knowledge creation as a synthesizing process, *Knowledge Management Research & Practice*, Vol. 1, No. 1, pp 2-10.

Nonaka, I., Toyama, R. and Byosière, P. (2001) A theory of organizational knowledge creation: understanding the dynamic process of creating knowledge, in M. Dierkes, A. Berthoin Antal, J. Child, and I. Nonaka (eds) *Handbook of Organizational Learning and Knowledge*, pp 491-517, Oxford University Press, Oxford.

Nonaka, I., Toyama, R. and Konno, N. (2000) SECI, ba and leadership: A unified model of dynamic knowledge creation, *Long Range Planning*, Vol. 33, No. 1, pp 5-34.
Nonaka, I. and von Krogh, G. (2009) Tacit knowledge and knowledge conversion: Controversy and advancement in organizational knowledge creation theory, *Organization Science*, Vol. 20, No. 3, pp 635-652.
Nonaka, I., von Krogh, G. and Voelpel, S. (2006) Organizational knowledge creation theory: Evolutionary paths and future advances, *Organization Studies*, Vol. 27, No. 8, pp 1179-1208.
Rojas-Méndez, J. I., Davies, G., Omer, O., Chetthamrongchai, P. and Madran, C. (2002) A time attitude scale for cross cultural research, *Journal of Global Marketing*, Vol. 15, No. 3/4, pp 117-147.
Takeuchi, H. and Nonaka, I. (eds) (2004) *Hitotsubashi on Knowledge Management*, John Wiley & Sons, Singapore.