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DAVID KEMBER AND DORIS Y. P. LEUNG

THE INFLUENCE OF THE TEACHING AND LEARNING ENVIRONMENT ON THE DEVELOPMENT OF GENERIC CAPABILITIES NEEDED FOR A KNOWLEDGE-BASED SOCIETY

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ABSTRACT. The effect of the teaching and learning environment on the development of generic capabilities was examined through a survey of 1756 undergraduate students at a university in Hong Kong. The survey assessed students' perceptions of the development of the six capabilities of critical thinking, self-managed learning, adaptability, problem solving, communication skills, and interpersonal skills and groupwork. Students were also asked to rate the quality of nine facets of the teaching and learning environment. Structural equation modelling was used to test a model of the influence of teaching on the nurturing of the six capabilities. The model grouped the nine facets of teaching and learning under the three higher-order latent variables of teaching, teacher–student relationship, and student–student relationship. The model showed a good fit to the data, indicating that the teaching and learning environment had a significant impact on the development of the generic capabilities while the students were taking their degree. The teaching latent variable had the strongest effect on the development of all six of the capabilities. A suitable teaching environment was characterised by a focus on understanding, the active participation of students in learning activities, a coherent curriculum, and assessment which focused on analytical skills and self-learning capability. Strong student–student relationships nurtured communication and interpersonal skills. There was a mutually reinforcing effect between the type of teaching, teacher–student relationships and student–student relationships.

KEY WORDS: active learning, assessment, curriculum, generic skills, graduate capabilities, structural equation modelling, teacher–student interaction, teaching and learning environment

1. INTRODUCTION

In recent years, there have been persistent calls from diverse sources for the higher education sector to produce graduates with the types of qualities needed in knowledge-based societies (Candy & Crebert, 1991; Leckey & McGuigan, 1997; Longworth & Davies, 1996; Tait & Godfrey, 1999). The range of attributes suggested as necessary tends to vary somewhat, but normally includes intellectual qualities such as the ability to pursue lifelong learning, critical thinking, creative thinking and the capability to deal with ill-defined problems. Recognising that future graduates will have to work and communicate with others leads to the inclusion of qualities such as interpersonal skills, communication ability and teamwork skills. The ability to cope with an uncertain future calls for flexibility, adaptability and information technology skills. An appropriate professional and disciplinary knowledge base remains important, as do literacy and numeracy.

While few have disagreed that these capabilities are important, there have been questions as to whether university graduates have sufficiently developed these capabilities. Over the years, there have been numerous claims from employers, governments and even academics that graduates have been ill-prepared for employment, let alone for the demanding requirements of work in the knowledge-based sector. Daly (1994) reviewed 20 major reports emanating from, or on behalf of, organisations representing the business sector in the USA. The over-riding issue was a decline in the competitive edge in the global economy. There was concern that the education system was not producing a suitable workforce to maintain the position of the USA as the leading economic power.

A number of governments with relatively unified higher education systems (e.g. Australia, Germany, New Zealand, Spain, Switzerland and the UK) have produced reports and plans calling for graduates to be equipped with appropriate higher-order thinking skills (for a review, see Longworth & Davies, 1996). The Hong Kong Education Commission's (1999) consultative document, *Learning for Life*, includes the claim that the education system is not appropriate for making the transformation to a knowledge-based economy to fill the void created by the shift of manufacturing into mainland China, where wages are significantly lower:

> However, our education system appears to have stagnated in the industrial age. The system still caters to a selected few, whilst disadvantaging the majority and creating a large number of losers. . . . Even in universities, students often have little experience outside their specialised areas of study. Many students stop learning after graduation. This runs counter to the expectations of a lifelong learning society and poses a serious challenge to Hong Kong. (p. 15)

Therefore, there is wide agreement that graduates need to possess a range of qualities that equip them to be productive members of a knowledge-based society. Where there is less agreement is whether higher education is nurturing appropriate capabilities and on how best to ensure that the qualities are developed.

A number of universities have introduced courses specifically designed to develop certain generic capabilities (e.g. Chapman, 1999; Medlin, Graves & McGowan, 2003; Oliver & McLoughlin, 2001; Tait & Godfrey, 1999). The large majority of programmes have not gone down this track. Providing training with the specific goal of generic skill development has been seen as contrary to the traditional view of a university as providing an education through in-depth study of a particular discipline (e.g. Jackson, 2000). Integrating generic skill development with the disciplinary context has also been seen as important (de la Harpe, Radloff & Wyber, 2000; Hattie, Biggs

& Purdie, 1996). It is also unlikely that space could be found within timetables to incorporate specific programmes aiming to teach students each of the range of skills seen as necessary. Many curricula are already crowded, or even over-crowded, because of the inclusion of new material following the knowledge explosion.

The majority of universities seem to have adopted a traditional view, even if it is largely implicit, that generic capabilities are best developed in a manner integral to programmes of discipline-based study. Over the term of their enrolment, the students are expected to develop intellectually through exposure to a stimulating campus environment, in the company of intelligent peers, with good teaching, an interesting curriculum, and good facilities for taking advantage of this stimulating atmosphere. Pascarella and Terenzini (1991) summarised the conventional view on nurturing intellectual capabilities:

> The research on the net effects of college sheds little light on *why* college attendance fosters greater average growth in general cognitive skills than other post-high school experiences. One reasonable explanation, however, is that of all the experiences a student could have after secondary school, college is the one which most typically provides an overall environment where the potential for intellectual growth is maximised.... The advantage of college, however, is that salient intellectual, cultural, and interpersonal influences (for example, courses, libraries, laboratories, faculty and other similarly engaged peers) tend to be concentrated in one place. (Pascarella & Terenzini, 1991, p. 156)

It is notable that such a thorough review of the effects of college education was unable to find specific evidence of the mechanism by which capabilities are developed. The 'reasonable explanation' is certainly plausible, but it could also be interpreted as an act of faith that the traditional model of university education is capable of nurturing graduates with generic capabilities.

Therefore, there is justification for studies which aim to provide more detailed insights into the mechanism for the development of qualities needed for a knowledge-based society. The aim would be to show which factors are influential in the development of particular qualities. This would provide guidance on how a curriculum and learning environment might be configured to produce appropriate graduates for a knowledge-based society.

1.1. *Alternative to the Traditional View of Capability Development*

Research that we recently reported (Kember & Leung, 2005) started as an attempt to interpret some rather surprising data from graduate surveys of students who had completed discrete full-time and part-time programmes. Those surveyed were asked to report their perceptions of the development of nine graduate capabilities during their studies. We were surprised to find that the part-time graduates reported significantly greater development in eight of the nine capabilities. The differences were mostly quite substantial.

We had anticipated that the full-time graduates would have experienced higher levels of nurturing of the capabilities as they would have spent much more time on campus. The literature discussed above had suggested that the campus environment would provide the stimulation necessary for the nurturing of the capabilities. However, the part-time students would have spent very little time on campus beyond attending evening classes. Nearly all were in full-time employment; so, the majority also would have spent little time with their student peers outside class.

There were clearly other distinctions between the full-time and part-time samples which are fully discussed in Kember and Leung (2005). The differing demographic characteristics of the part-time sample, such as age and level of experience, could have explained differences in absolute levels of capabilities. The questionnaire, however, clearly asked for perceptions of capability development through the experience of university study.

While other influences could not be ruled out completely, it appeared worthwhile to explore whether a major influence on the perception of capability development had been the nature of teaching in the full-time and part-time courses. Most of the full-time programmes had quite traditional university teaching, with the majority of the classes being lectures. The part-time programmes were taught in the evening through three-hour classes. These involved more student activity and discussion than the full-time programmes because it would be unrealistic to expect students to sit through a three-hour lecture after a day's work. It would also have been easier to find discussion topics for the part-time students, as most were employed in professions relevant to the topic of their course.

It was possible to examine the impact of teaching on the graduate capabilities because the survey also included scales relating to the teaching and learning environment. We used structural equation modelling (SEM) to test a model which postulated the influence of active learning experiences on the development of graduate capabilities. The model showed a good fit to the data. The greatest effect on capability development came from teaching which aimed for understanding and required active involvement from students. The nature of the relationships between teachers and students had a direct effect on the development of capabilities involving working together and a mutually reinforcing effect on development through the type of teaching. The model from Kember and Leung (2005) is shown in Figure 1.

The surveys had been conducted as a quality-assurance exercise to provide feedback to departments on the programmes that they taught. The instrument had not been specifically designed to investigate the mechanism

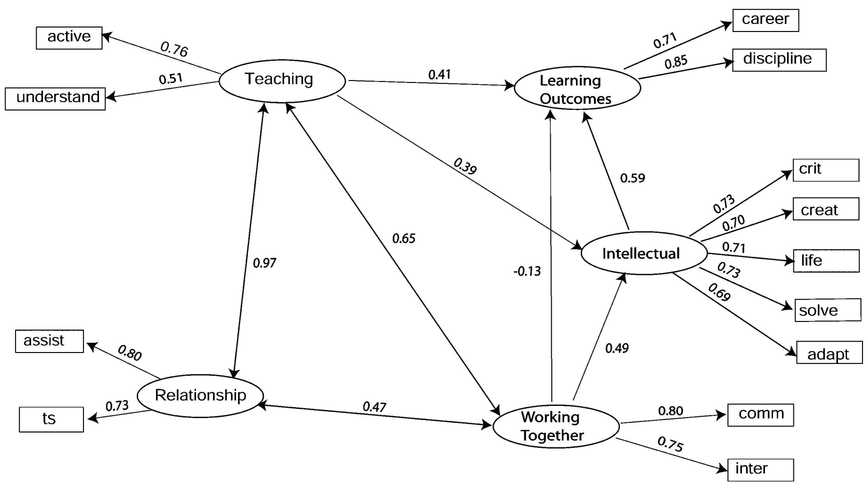

Figure 1. The model of capability development, adapted from Kember and Leung (2005).

for the development of graduate capabilities. There were sufficient scales relating to the teaching and learning environment to indicate important factors for nurturing capabilities, but not enough to characterise the mechanism fully.

This article reports a study which aimed to provide a better characterisation of aspects of the teaching and learning environment which play a part in nurturing capabilities. The teaching and learning environment in the model in Kember and Leung's study (2005) had two latent variables, each with two constituent scales. The study reported here builds upon this by adding extra constructs, in order to define a better learning environment conducive to capability development. The sample was taken from undergraduate students in full-time programmes in a comprehensive research-intensive university. The sample, therefore, is quite different from that in the previous study. Therefore, it is possible to see whether a similar model of influences would result from a different data set.

This seems to be a logical progression in attempting to build a plausible model of how universities can nurture the development of important graduate capabilities. There is at present little in the way of evidence-based theory on how this happens. There seems to be an assumption that capabilities develop through exposure to a stimulating campus environment. However, Kember and Leung (2005) suggested that the nature of the teaching and learning processes could have a stronger impact. This study provides a further test of this tentative finding and attempts to give more detailed insights into the type of teaching and learning environment most conducive to capability development.

1.2. *Structural Equation Modelling*

The main method of data analysis used in this study is structural equation modelling (SEM) (Bentler, 1980; Bollen, 1989; Byrne, 1994; Hayduk, 1987), which tests models that are specified mathematically by a series of structural or regression equations. The models can be represented diagrammatically for easy visualisation. The models consist of sets of latent variables representing theoretical constructs, their measurements or indicators, and the inter-relationships between these. The power of SEM is that it enables the researcher to examine authentic models of social science phenomena, involving multiple variables with complex patterns of interaction.

Latent variables are those representing theoretical constructs that cannot be observed directly. Latent variables are measured by a set of indicators, which are normally scales in a questionnaire. In the diagrams of models, latent variables are shown as ovals and the observed indicators as rectangles. Variables which are related are linked by lines, with the arrow heads indicating directionality. SEM is then used for specifying, estimating and testing the hypothesised inter-relationships among this set of meaningful observed indicators and latent variables in the model.

The hypothesised model, specifying the *a priori* relationship among the constructs and the observed variables, can be tested in a simultaneous analysis of the entire system of variables to determine the extent to which it is consistent with the data. The degree of fit and the adequacy of the model are indicated by goodness-of-fit test statistics and indices. SEM indicates changes to the goodness-of-fit statistics if paths are added or deleted from the model with the Lagrange Multiplier and the Wald tests. So, it is possible to examine whether closely related models would provide a better fit. In addition, it is also possible to compare alternative models and to contrast models for subsets of the data, to see whether the same hypothesised relationships are applicable.

SEM can be a superior approach to other multivariate exploratory analysis as it incorporates both observed and latent variables simultaneously, provides explicit estimates of measurement errors, and allows hypothesis testing for inferential purposes. The three main advantages in the application of SEM are:

1. It is possible to determine the goodness-of-fit between the proposed model and the data observed.
2. Given an adequate fitted model, we can further test the plausibility of another postulated relationship among the variables by adding or deleting the corresponding paths in the model.
3. Based on an adequate model, we can compare the goodness-of-fit of competing nested models.

2. Method

2.1. *Development of the Instrument*

The questionnaire in this study was a revised version of the one used in the previous study (Kember & Leung, 2005). In turn, this had been developed through a number of iterations. The generic capabilities included in the original graduate survey instruments were determined by faculty panels as being appropriate to the needs of graduates from their faculties (Kember et al., 2001). Scales for the facets of the teaching and learning environment included in the instrument have been modified as tentative evidence emerged that the nature of teaching and learning appeared to play a greater part in capability development than the campus environment (Kember & Leung, 2005). The original instruments featured few scales relating directly to teaching and had more scales focusing on the student experience (Kember et al., 2001; Leung & Kember, 2005). The instrument used in Kember and Leung's (2005) study focused more on teaching and learning and the section below indicates that this trend has continued for the instrument used in this study. The original instrument (Kember et al., 2001) included scales assessing the following capabilities:

- Critical Thinking;
- Creative Thinking;
- Ability to Pursue Lifelong Learning;
- Adaptability;
- Problem Solving;
- Career Relevance;
- Discipline Knowledge;
- Communication Skills;
- Interpersonal Skills and Groupwork.

Throughout this article, we adopt the convention of using upper case for the first letter in each word of each scale's name. The titles for latent variables in structural models are shown bolded.

The previous study had surveyed graduates (Kember & Leung, 2005). The present study had easier access to undergraduates, and it was felt that the conclusions would be more robust if similar results were found with both graduate and undergraduate surveys. To make the capabilities more applicable to undergraduates, the following scale changes were made.

Because Ability To Pursue Lifelong Learning is an ability which undergraduate students would find hard to determine, it was replaced by a scale named Self-Managed Learning. Creative Thinking was left out, partly on the grounds of parsimony and partly because it can be hard to demonstrate creative thinking in some undergraduate courses. Because Career Relevance and Discipline Knowledge asked about the applicability of the degree to the current profession of the graduate, they were deleted.

The scales in the teaching and learning environment domain were expanded in order to better characterise the nature of the type of teaching and learning environment capable of nurturing capabilities. The instrument in the previous study (Kember & Leung, 2005) included the following scales in the teaching and learning environment domain:

- Active Learning;
- Teaching for Understanding;
- Teacher–Student Interaction;
- Assistance from Teaching Staff.

To these were added the following scales:

- Feedback to Assist Learning;
- Relationship with Other Students;
- Cooperative Learning;
- Assessment;
- Coherence of Curriculum.

The revised questionnaire was then field tested. New scales had been formulated with four to five items. The testing process was used to reduce the number of items in each scale while still maintaining coherence and reliability. All items were scored on a 5-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree. The Appendix displays the final version of the questionnaire which has 33 items measuring the development of the six capabilities and the nine elements in the teaching and learning environment. The wording of the items is likely to help readers to understand the constructs measured by the scales. The questionnaire also had other scales which are not shown in the Appendix as they were not incorporated in the model tested in this article.

2.2. *Sample and Procedures*

The questionnaire was administrated to a total sample of 2786 first-year and third-year undergraduate students from a university in Hong Kong. The sample consisted of all students in half of the 52 undergraduate degree programmes offered by the university. The programmes selected were a structured sample representative of undergraduate degrees offered by the comprehensive university. There were programmes from each of the seven faculties of Arts, Business Administration, Education, Engineering, Medicine, Science and Social Science.

TABLE I
Return Rates by Year of Study and Faculty

	Return rate (%)	
Faculty	Year 1	Year 3
Arts	74.9	63.3
Business administration	68.4	54.2
Education	44.0	61.1
Engineering	60.9	51.0
Medicine	82.2	58.2
Science	68.4	60.7
Social science	71.8	56.3
Overall	69.8	57.2

Two versions of the questionnaires were prepared, namely, a print version and an online version. The print version was sent by mail to each selected student, accompanied by a cover letter which explained (1) the purpose of the study, (2) procedures for completing the questionnaire, (3) the voluntary nature of participation, and (4) the guarantee of anonymity and confidentiality of all the responses. A few days later, the online version of the questionnaire was sent to the selected students through an e-mail message with similar content to the covering letter. The students could choose to complete the questionnaire either online or through the paper version. Three weeks later, the two versions of the questionnaires were sent out again in an attempt to obtain a higher return rate.

The questionnaires were administered near the end of the academic year. The first-year students, therefore, were able to reflect on almost one whole year of academic study and the third-year students could reflect on most of their degree.

A 63.9% response rate was obtained, with questionnaires being received from 1779 students (Year 1, $n = 1028$; Year 3, $n = 751$). Deletion of 23 cases with missing data ultimately yielded a final sample of size 1756, or 63.0% of the total sample. A breakdown of the return rate by year of study and faculty are shown in Table I.

3. Data Analysis

3.1. *Scale Reliability*

Before testing the structural relationship among the 15 scales in the study, we first established their reliabilities. By far the most common approach to establishing scale reliability is the use of Cronbach alpha coefficient (e.g. Raykov & Shrout, 2002). As most readers will be familiar with this procedure, Cronbach alpha values were calculated and are reported here. The alpha values, computed using SPSS11.5 (Norusis, 2002), for the 15 scales are shown in Table II. Schmitt (1996) discusses the value of the alpha coefficient that is considered acceptable and noted that a number of sources recommend the 0.7 level, but also argued that values as low as 0.5 would not seriously attenuate validity. The scales were kept as short as possible to boost returns and this would have tended to reduce alpha values (Schmitt, 1996).

TABLE II

Mean, Standard Deviation, Cronbach Alpha and Coefficient of Determination for the 15 Scales in the Study

Scale[a]	Mean	*SD*	No. of items	Cronbach alpha	Coefficient of determination
Capability					
Critical thinking (critical)	3.44	0.89	2	0.78	0.78
Self-managed learning (self-managed)	4.00	0.71	2	0.72	0.72
Adaptability (adapt)	3.86	0.67	2	0.60	0.61
Problem solving (problem solving)	3.71	0.68	2	0.67	0.67
Communication skills (comm)	3.33	0.96	2	0.72	0.72
Interpersonal skills and groupwork (interpersonal)	3.37	0.85	2	0.54	0.54
Teaching and learning environment					
Active learning (active)	2.94	0.90	2	0.69	0.69
Teaching for understanding (understanding)	3.65	0.78	2	0.79	0.79
Feedback to assist learning (feedback)	3.46	0.78	3	0.80	0.81
Assessment (assessment)	3.48	0.78	3	0.58	0.65
Teacher–student interaction (ts interaction)	3.35	0.93	2	0.88	0.88
Assistance from teaching staff (assistance)	3.50	0.82	2	0.84	0.84
Relationship with other students (ss interaction)	2.96	1.08	2	0.86	0.86
Cooperative learning (cooperative)	3.44	0.87	2	0.71	0.71
Coherence of curriculum (curriculum)	3.31	0.84	3	0.79	0.79

[a]The abbreviations of the scale names are given in brackets.

Of the scales in the instrument, 10 scales had Cronbach alpha values above 0.7 and the remaining five scales had reliabilities between 0.54 and 0.7. The scales in the questionnaire can therefore be interpreted as reliable. Mean scores for the scales were then computed by averaging their corresponding items and these are also included in Table II.

The appropriateness of the Cronbach alpha coefficient as an estimator of reliability has recently been questioned (e.g. Miller, 1995; Raykov, 1997, 1998), particularly if scales are not unidimensional, as could be the case for complex constructs like generic capabilities (Kember et al., 2001; Leung & Kember, 2005; Tait & Godfrey, 1999). For this reason, we also provide coefficients of determination which are optimally weighted sums of items (Jamshidian & Bentler, 1998; Shapiro, 1982). These are shown, for each of the scales, in the last column of Table II. The value of Cronbach alpha and the coefficient of determination were very close for all the 15 scales.

3.2. *Structural Analysis*

Structural equation modelling methods, based on the EQS package (Bentler, 1995), were used first to test structural models for the capabilities and the teaching and learning environments separately. The aim was to replicate as closely as possible the models in Kember and Leung (2005). The main differences in the models would inevitably result from changes to the scales included in the revised instrument.

Before estimation of latent structural models, the normality of univariate and multivariate distributions of the measured indicators was examined. The distributions of the variables were slightly skewed (skewness ranged from −1.2 to −0.0; kurtosis ranged from −0.9 to 1.7; Mardia's coefficient was 49.6), but the large value of the normalised estimate (46.04) is highly suggestive of non-normality in the population (Bentler, 1995; Byrne, 1994). The robust maximum likelihood estimation procedure (Satorra & Bentler, 1988, 1994) then was used for the parameter estimations in the SEM to correct for non-normality.

Assessment of model fit was based on multiple criteria including both absolute misfit and relative fit indices. The absolute misfit indices included the root mean square error of approximation (RMSEA) (Browne & Cudeck, 1993) and the standardised root mean squared residual (SRMR) (Bentler, 1995). The relative goodness-of-fit index computed in the study was the comparative fit index (CFI) (Bentler, 1990). According to Hu and Bentler's (1999) simulation study, judgement of model fit based on a two-index strategy – which includes SRMR being less than 0.08 and a supplemental index with a given cut-off criterion – is superior to those only based on a single criterion. In this study, a model with SRMR <0.08, RMSEA <0.06 and CFI >0.95 would be considered as an excellent fit to the data.

4. Results

Because the overall model is quite complex, the SEM analysis is shown in three stages. Firstly, we tested a model in which the capabilities were grouped under two higher-order factors. Secondly, the teaching and learning environment scales were fitted to a model with three latent variables. Finally, the two half models were combined to show how the teaching and learning environment influenced the capabilities. In each case, the model tested was a development of that in the previous study.

4.1. *Capabilities Domain*

In Kember and Leung (2005), the capabilities were grouped under three higher-order latent variables. The **Working together** latent variable could remain as it was. The **Intellectual** latent variable no longer had the Creative Thinking indicator and Self-Managed Learning was substituted for Ability To Pursue Lifelong Learning. The **Learning outcomes** latent variable in the old model was no longer applicable as neither of its indicators were in the new questionnaire.

The capabilities were therefore hypothesised as a two-factor model, with the two latent constructs of **Intellectual** and **Working together**. The variances of the two latent constructs were fixed at 1 for identification. In the SEM analysis, all the measured variables loaded on their intended construct and the factor loadings were all statistically significant. The hypothesised model provided a good approximation to the data and no modification was necessary (SRMR $= 0.04$, RMSEA $= 0.08$ and CFI $= 0.95$). The standardised parameter estimates of the model for the capability domain are depicted in Figure 2. The fit indices for the three models reported in this study are summarised in Table III.

4.2. *Teaching and Learning Environment Domain*

The teaching and learning domain had five extra variables in an effort to characterise the teaching and learning environment more fully. The scales of Assessment and Coherence Of Curriculum were added as additional indicators to the **Teaching** latent variable. To the **Teacher–student relationship** latent variable, the Feedback To Assist Learning scale was added.

TABLE III
Summary of Fit Indices for the Three Models

	Fit index		
Model	SRMR	RMSEA	CFI
Capabilities domain	0.04	0.08	0.95
Teaching and learning environment	0.03	0.06	0.96
Overall model	0.04	0.06	0.92

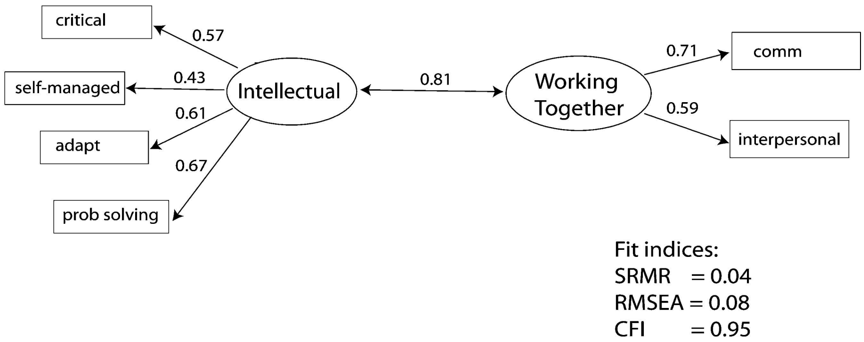

Figure 2. Standardised parameter estimates of the model in the capabilities domain.

An extra latent variable **Student–student relationship**, with indicators of Relationship With Other Students and Cooperative Learning, was added to the model. This additional latent variable was intended to represent the benefits of learning from student peers in-class (Jaques, 1991; Johnson, Johnson & Smith, 1998) and out-of-class (Yan & Kember, 2004a, 2004b).

The three latent constructs were hypothesised to be co-related. The variances of the three latent constructs were fixed to 1 for identification purpose. The standardised parameter estimates of the hypothesised model are presented in Figure 3. The nine scales related to the three latent constructs as hypothesised. No modification to the model was made.

The result showed that all factor loadings of the measured variables on the established constructs were statistically significant. The three latent constructs were strongly and positively related as anticipated. The fit indices for the model were SRMR = 0.03, RMSEA = 0.06 and CFI = 0.96, which suggested an excellent fit to the data.

4.3. *Overall Model*

The two halves of the overall model then needed fitting together to examine the effect of the teaching and learning environment on the development of

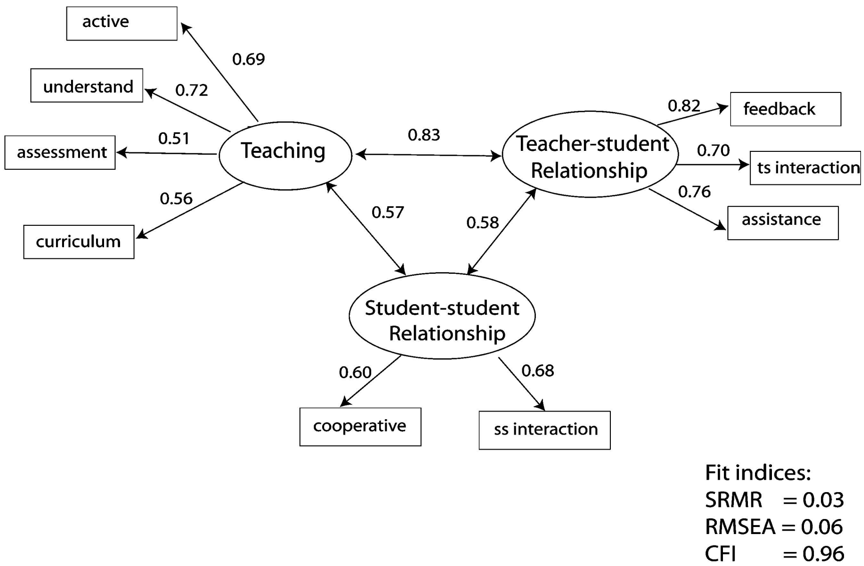

Figure 3. Standardised parameter estimates of the model in teaching and learning environment domain.

capabilities. The two halves retained essentially the same structure within the overall model. A model was postulated with paths similar to those in Kember and Leung (2005). Direct paths were hypothesised from the three latent constructs in the teaching and learning environment domain to the two constructs representing the capabilities. Some minor adjustments to these paths were made with the LM and Wald tests and theoretical considerations. For identification purpose, the variances of the three latent constructs in the teaching and learning environment and the unstandardised factor loadings of the two scales Critical Thinking and Communication Skills were fixed at 1.

As shown in Figure 4, the factor loadings remained similar to those obtained in the models for the two domains shown in Figures 2 and 3. The results of the standardised parameter estimates for the final revised model are depicted in Figure 4. The goodness-of-fit and misfit indices obtained for the final model were SRMR = 0.04, RMSEA = 0.06 and CFI = 0.92, which yielded a reasonably good approximation to the data.

5. Interpretation of the Model

The discussion section is primarily an interpretation of the model, concentrating upon the implications for teaching and learning in universities.

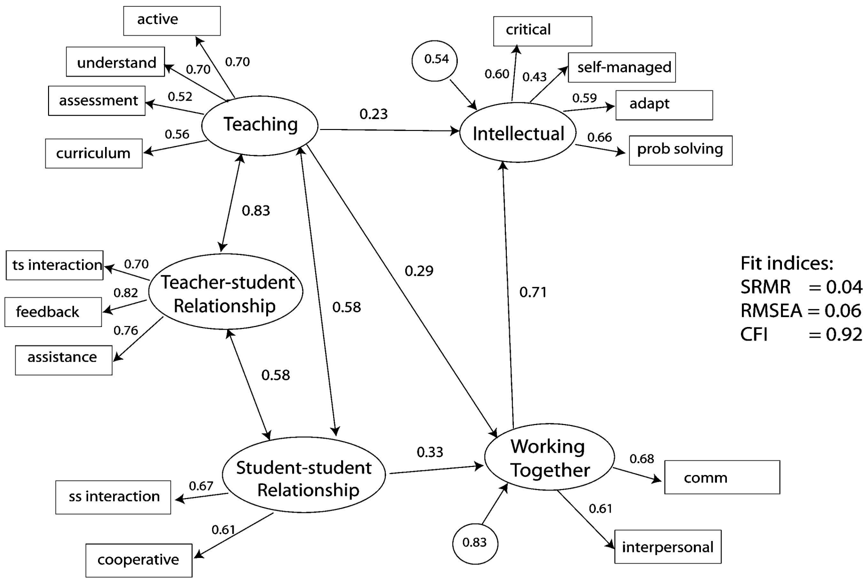

Figure 4. Standardised parameter estimates of the overall model relating the teaching and learning environment domain and the capabilities domain.

The model indicates the mechanism by which capabilities can be nurtured. The development of key graduate capabilities has become increasingly important in the era of information technology. As the relevance half-life of knowledge decreases, graduates need to be equipped with self-managed learning skills to keep abreast. Knowledge-based economies need graduates with qualities like critical thinking, adaptability, communication skills, problem-solving ability and the capability of working productively in teams.

The model examined students' perceptions of the development of these capabilities. The capabilities were grouped together under the two higher-order latent variables of **Intellectual** and **Working together**.

The model tested the hypothesis that these capabilities can be nurtured through an appropriate teaching and learning environment, which is described in the model by nine indicators grouped under three higher-order factors. The strongest effect on capability development came from the nature of the teaching. **Teaching** had direct influences on both capability latent variables and a significant indirect effect on **Intellectual** through **Working together** (standardised coefficient = 0.11, $p < 0.001$). Combining both the direct and indirect effects, **Teaching** impacted strongly on **Intellectual** capabilities (standardised total effect = 0.43) and the qualities needed for **Working together** (standardised total effect = 0.29).

The type of teaching capable of nurturing these capabilities can be described through the four indicators and their constituent items. The teaching should employ approaches in which students participate actively. The focus needs to be on understanding key constructs. Assessment should include a variety of methods which require students to display the capabilities under the **Intellectual** factor. The courses needed to be integrated so that the students can perceive their degree programme as a coherent whole.

There are quite strong intercorrelations between the three latent variables in the teaching and learning environment. These correlations can be interpreted as mutually reinforcing effects. Teaching methods which involve interaction and active participation of students promote better relationships between teacher and students and coherence within a class group. Where there are established relationships within students in a class and with their teacher, approaches to teaching which necessitate interaction will be more successful and teachers will feel more confident using them.

The **Student–student relationship** latent variable had a direct effect on the promotion of capabilities concerned with working together and an indirect effect on the intellectual capabilities. Elements of the relationship are a sense of belonging to a class group and coherence in working together. Cooperative learning outside the classroom through discussion of course material was also important.

Yan (2001) characterised out-of-class group learning approaches. The approaches were consistent with a spectrum with poles for *engager* and *avoider* approaches. Those adopting an avoider approach worked together to minimise the workload of each individual, whereas the engager approach was adopted to better understand concepts (Yan & Kember, 2004a, 2004b). A set of detailed case studies showed that the group approach adopted was heavily influenced by the broad curriculum and the teaching and learning environment (Yan & Kember, 2003).

The **Teacher–student relationship** factor did not have direct paths to either of the latent variables on the capabilities side of the model. However, it was strongly intercorrelated with both of the other latent variables in the teaching and learning environment domain; therefore it does have an appreciable indirect effect on capability development. Establishing good teacher–student relationships might be seen as a prerequisite to being able to teach in an interactive way. Building ties between teachers and students can be a mechanism for developing coherence within a class group (Yan & Kember, 2003). The **Teacher–student relationship** factor was characterised by the extent and quality of interaction, by the availability of assistance and by the provision of feedback.

6. Conclusion

As societies move towards knowledge-based economies, there is a growing recognition that graduate capabilities are becoming more and more important. Significant parts of the knowledge taught in many disciplines will be of limited relevance by the time today's graduates retire. It is no longer possible to provide a professional education which will equip graduates for a lifetime of work.

Today's graduates must anticipate the need to refresh and update their knowledge of their discipline on a continuing basis. Indeed, many will be expected to make shifts into new fields. The pace of change in technology and society is such that graduates most need to be prepared for change and uncertainty.

It is therefore vital that universities are capable of equipping graduates with the capabilities that they will need to cope with this future of change and uncertainty. Development of these capabilities to their full potential is more likely to occur if universities are aware of the mechanism by which the capabilities can be nurtured. Examination of the literature suggests that there has been no clear picture of how this happens.

The established position in the literature seems to assume that capabilities develop through exposure to a stimulating campus environment based upon a rather traditional vision of a university. This study suggests that the principal mechanism for capability development is more specific than this. The results suggest that capabilities needed for a knowledge-based society are best developed through a type of teaching and learning characterised by the active engagement of students in learning activities and with frequent interaction between teacher and students and student peers.

This type of teaching and learning environment is probably not that most commonly found in higher education. Lecturing is accepted as being the most common mode of teaching in universities (Bligh, 1980; Brown & Atkins, 1988). This is most commonly a didactic form of teaching, with limited periods of interaction or student activity. The results of this study suggest that this mode of teaching is not the most appropriate for nurturing generic capabilities.

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APPENDIX

STUDENT ENGAGEMENT QUESTIONNAIRE

Please indicate your level of agreement with the statements below. Please choose the one most appropriate response to each question.

1 Strongly disagree
2 Disagree
3 Only to be used if a definite answer is not possible
4 Agree
5 Strongly agree

Critical Thinking

1. Through this programme, I have developed my ability to make value judgements about opposite perspectives.
2. I have become more willing to consider differing points of view.

Self-Managed Learning

3. I feel that I can take responsibility for my own learning.
4. I have become more confident of my ability to pursue further learning.

Adaptability

5. During my time at university, I have learned how to be more adaptable.
6. I have become more willing to change and accept new ideas.

Problem Solving

7. I have improved my ability to use knowledge to solve problems in a systematic way.
8. I am able to bring information and ideas together from different topics to solve problems.

Communication Skills

9. In this programme, I have developed my ability to communicate effectively with others.
10. In my time at university, I have improved my presentation skills.

Interpersonal Skills and Groupwork

11. I have learnt how to become an effective team or group member.
12. I feel confident that I can deal with a wide range of people.

Active Learning

13. Our teaching staff use a variety of teaching methods.
14. Students are given the chance to participate in class.

Teaching for Understanding

15. The teaching staff try hard to make us understand the course material.
16. The teaching staff for this programme design classes with the aim of the students reaching an understanding of the course content.

Feedback to Assist Learning

17. When I had difficulty with assignments, I found the feedback provided by the teaching staff useful.
18. There was sufficient feedback on activities and assignments to ensure that we learnt from the work we did.
19. When I was unsure about an assignment, the teaching staff helped me to reach an understanding about how to finish it.

Assessment

20. The programme uses a variety of assessment methods.
21. To do well in assessment in this programme, you need to have good analytical skills.
22. For the assessment in this programme, it is important to have developed self-learning capability.

Teacher–Student Interaction

23. There is a close relationship between teaching staff and students.
24. The communication between teaching staff and students is good.

Assistance from Teaching Staff

25. When I had difficulty with the course content, the teaching staff were available to help.
26. I found teaching staff helpful when I had problems understanding the course content.

Relationship with Other Students

27. I feel a strong sense of belonging to my class group.
28. My class groups have developed a strong sense of working together.

Cooperative Learning

29. I have frequently discussed ideas from courses with other students out-of-class.

30. I have found that discussing course material with other students outside classes has helped me to reach an understanding of the material.

Coherence of Curriculum

31. I can see how courses fitted together to make a coherent programme of study for my major.
32. The programme of study for my major was well integrated.
33. I could clearly see the relationship between the courses in my major programme.

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DAVID KEMBER AND DORIS Y. P. LEUNG
Centre for Learning Enhancement and Research
Room 302, Academic Building No. 1
The Chinese University of Hong Kong
Shatin, Hong Kong
E-mails: david.kember@cuhk.edu.hk; doris.leung@cuhk.edu.hk

(Correspondence to: Doris Y. P. Leung. E-mail: doris.leung@cuhk.edu.hk)