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Title	Characterizing learning environments capable of nurturing generic capabilities in higher education
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Citation	Research In Higher Education, 2007, v. 48 n. 5, p. 609-632
Issued Date	2007
URL	http://hdl.handle.net/10722/54329
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Metadata of the article that will be visualized in OnlineFirst

ArticleTitle	Characterizing Learning Environments Capable of Nurturing Generic Capabilities in Higher Education	
Journal Name	Research in Higher Education	
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Schedule	Received	3 January 2006
	Revised	
	Accepted	
Abstract	There has been wide recognition that today's graduates need the type of generic capabilities necessary for lifelong learning. However, the mechanism by which universities can develop these generic skills is not clearly established. This study aimed to investigate the mechanism for their development. Structural equation modeling (SEM) was used to test a hypothesized model of capability development through a suitable learning environment with 1756 undergraduates at a university in Hong Kong. To triangulate against this model and more fully characterize the learning environment, focus group interviews were held with five to six students from three programs with good records of capability development. Analysis of the interview data resulted in a set of categories, describing a learning environment, which were consistent with the SEM model. The learning environment which seemed conducive to capability development aimed for understanding of key concepts through a variety of assessment methods and active engagement in learning activities. Teacher–student relationships were developed through interaction, feedback and assistance. The promotion of peer–student relationships led to a high degree of collaborative learning.	
Keywords	active learning - assessment - collaborative learning - generic capabilities - learning environments - qualitative & quantitative analyses - teacher–student relationship	
Footnote Information		

Research in Higher Education (© 2006)
DOI: 10.1007/s11162-006-9037-0

CHARACTERIZING LEARNING ENVIRONMENTS CAPABLE OF NURTURING GENERIC CAPABILITIES IN HIGHER EDUCATION

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There has been wide recognition that today's graduates need the type of generic capabilities necessary for lifelong learning. However, the mechanism by which universities can develop these generic skills is not clearly established. This study aimed to investigate the mechanism for their development. Structural equation modeling (SEM) was used to test a hypothesized model of capability development through a suitable learning environment with 1756 undergraduates at a university in Hong Kong. To triangulate against this model and more fully characterize the learning environment, focus group interviews were held with five to six students from three programs with good records of capability development. Analysis of the interview data resulted in a set of categories, describing a learning environment, which were consistent with the SEM model. The learning environment which seemed conducive to capability development aimed for understanding of key concepts through a variety of assessment methods and active engagement in learning activities. Teacher–student relationships were developed through interaction, feedback and assistance. The promotion of peer–student relationships led to a high degree of collaborative learning.

KEY WORDS: active learning; assessment; collaborative learning; generic capabilities; learning environments; qualitative & quantitative analyses; teacher–student relationship.

INTRODUCTION

The Hong Kong government has recognized that its education sector needs to produce graduates equipped for lifelong learning if it is to make the necessary transition into a knowledge-based economy. The Hong Kong Education Commission's (1999) consultative document,

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Journal : RIHE | Dispatch : 19-8-2006 | Pages : 24
CMS Art. No. : 9037 | ☐ LE ☑ CP | ☐ TYPESET ☑ DISK

"Learning for Life," believed that the Special Administrative Region needed to embrace the era of lifelong learning.

> Society is undergoing fundamental changes. As it transforms from an industrial society into an information society, and as our economy shifts its emphasis from manufacturing to knowledge-based activities, knowledge has become an essential element of our daily lives and our economy. Knowledge is being created all the time. New knowledge continues to emerge as existing knowledge becomes obsolete. Learning is no longer confined to school subjects or limited to classrooms; learning is no longer the prerogative of those aged 622. The age of lifelong learning has dawned. (p. 15)

Many other places have recognized similar needs (Aulich, 1990; Australian Chamber of Commerce and Industry & Business Council of Australia, 2002; Confederation of British Industry, 2000; Conference Board of Canada, 2000; Daly, 1994; Longworth and Davies, 1996; O'Neil, Allred, and Baker, 1997). More developed countries have found that their manufacturing industries have had difficulty competing with those in countries with cheaper labor forces. Economic progress then becomes dependent upon progressing towards a knowledge-based society, which requires a workforce with the types of capabilities needed for lifelong learning. To move in this direction there has been a major expansion in the numbers entering higher education and universities have been exhorted to produce graduates with lifelong learning capabilities (Candy and Crebert, 1991; Leckey and McGuigan, 1997; Longworth and Davies, 1996; Tait and Godfrey, 1999).

There are indications that higher education has not been meeting expectations from governments, employers or students in producing graduates well equipped for lifelong learning. Daly (1994) reviewed 20 major reports emanating from, or on behalf of, organizations representing the business sector in the US. The over-riding concern 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 US as the leading economic power. A review by Johnstone (1994) also reached similar conclusions by noting that "evidence continues to accumulate that our schools are not preparing students to be effective citizens of the world" (p. 170).

A number of governments with relatively unified higher education systems, e.g. Australia, Germany, New Zealand, Spain, Switzerland and the United Kingdom, have produced reports and plans calling for graduates to be equipped with appropriate higher-order thinking skills (for a review, see Longworth and Davies (1996)) and generic capabilities for employment (Australian Chamber of Commerce and Industry & Business Council of Australia, 2002; Confederation of British Industry,

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2000; Conference Board of Canada, 2000). Such calls obviously imply that universities might do better in this respect.

Leckey and McGuigan (1997) surveyed academic staff and students in a UK university about the importance ascribed to personal transferable skills. Staff and students thought them equally important but there was a mis-match concerning the effectiveness of their development. The staff thought they were effective in developing them but students thought they were ineffective. This conclusion is consistent with Barrie (2004) who noted that "despite extensive funding in some quarters, overall, efforts to foster the development of generic attributes appear to have met with limited success" (p. 261).

The Mechanism of Capability Development

The fundamental question then arises as to how higher education can develop graduates with these competencies for lifelong learning? There are descriptions of discrete courses focusing on the nurturing of specific generic skills (e.g. Chapman, 1999; Medlin, Graves, and McGowan, 2003; Oliver and McLoughlin, 2001; Tait and Godfrey, 1999). The more common approach has been through the belief that the development of lifelong learning capabilities should be embedded within the learning about the discipline, particularly for the higher-order thinking capabilities (de la Harpe, Radloff, and Wyber, 2000; Hattie, Biggs, and Purdie, 1996; Jackson, 2000). With crowded curricula it would be hard to find room for specific courses for the necessary range of generic skills. There is also evidence, from the meta-analysis by Hattie et al., (1996) that generic learning skills courses are not very effective, particularly for university and adult students.

While there may be a widespread belief that generic competencies can develop through discipline-specific teaching, there is little evidence of the effective mechanism. In their comprehensive review on the effects of college education, Pascarella and Terenzini (1991) found evidence of intellectual qualities being developed during a college education, but the mechanism was unclear.

> 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. (Pascarella and Terenzini, 1991, p. 156)

We interpret this finding from a very extensive and thorough review of the literature on the effects of college on students to imply that there is no empirically established model of how universities nurture lifelong learning capabilities. This would concur with the evidence given above

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of concerns that university graduates are often ill-equipped for lifelong learning. Given the concern of governments that graduates do possess the capabilities needed for lifelong learning it would appear important that attempts are made to develop appropriate theoretical models indicating important variables which impact upon capability development and suggesting the mechanism by which they do so.

While the literature on factors affecting the development of generic capabilities is limited, there has been a considerable volume of research on classroom-related learning environments and their effect on student learning outcomes. This body of literature has emanated from several lines of study.

First, the literature on the evaluation of teaching attempted to identify the characteristics of good teaching. The review of this work by Marsh (1987) makes it clear that good teaching is a multi-dimensional construct. In designing evaluation instruments it is, therefore, necessary to identify which factors characterize good teaching, which promotes student learning. The list of factors developed by Feldman (1976, 1996) appears to have been the most influential.

Students' approaches to learning have been shown to be influenced by the students' perceptions of the prevailing teaching and learning environment (Ramsden, 1987). There is then a substantial literature on the types of context which promote a deep approach to learning, which can conveniently be accessed through reviews by Biggs (1999a), Marton, Hounsell and Entwistle (1984) and Prosser and Trigwell (1999). Biggs (1999b, p. 73) drew upon the literature to identify the following four factors as likely to encourage a deep approach: a well structured knowledge base; an appropriate motivational context; learner activity; and interaction with others.

The study reported in this article was associated with a quality assurance initiative, which meant that the teaching and learning environment was characterized as far as possible by observable teaching behaviors. This stance was also desirable in that the study was policy-relevant in that it would give guidance to teachers in how to configure their teaching so as to best encourage the development of generic capabilities. The characterization of the teaching and learning environment, therefore, eschewed internal-to-the student mechanisms of learning such as self-regulated learning (e.g. Pintrich, 1995) and constructs developed from the social-cognitive mediation model of student learning (e.g. Pintrich and Zusho, 2002).

This article is from a series of studies which have progressively aimed to build up a theoretical model of capability development and test it with empirical data (Kember and Leung, 2005a, b; Kember et al., 2001;

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Leung and Kember, 2005). Kember and Leung (2005a) used structural equation modeling (SEM) to show that the principal effect on capability development came from teaching which aimed for understanding and required active involvement from students. The data came from a survey which asked graduates of a university in Hong Kong for their perception of the development of nine capabilities during the course of their program of study. The survey also asked for their ratings of a limited range of factors concerned with teaching and learning.

Kember and Leung (2005b) used the same survey technique with a sample of undergraduate students at another university in Hong Kong. The survey included a broader range of variables relating to the teaching and learning environment. The teaching and learning environment was described by three latent variables with a total of nine indicators. The three latent variables were shown to have a significant effect on students' perceptions of the development of six generic capabilities.

The study by Kember and Leung (2005b) concentrated on SEM analysis of the quantitative data and provided a detailed explanation of the SEM procedures. This article reports an extension of the same study which goes further towards characterizing the types of teaching and learning environment which play a part in nurturing capabilities by reporting both a SEM model of capability development and a qualitative study of three programs found to have teaching and learning environments most effective in developing capabilities for lifelong learning.

Fraser (1998, p. 3) gives a definition of a learning environment.

> 'Learning environment' refers to the social, psychological and pedagogical contexts in which learning occurs and which affect student achievement and attitudes.

The concept is, therefore, a broad one. Learning environment refers to the teaching and learning in- and out-of-class and to the contextual factors which influence the way that learning is approached. It resembles the holistic sense of the term "curriculum," as it is used in the school sector (e.g. Brady, 1990; Kelly, 1999).

QUANTITATIVE STUDY AND FINDINGS

Data for the quantitative part of the study were gathered through a survey of undergraduate students at a university in Hong Kong. The survey examined perceptions of capability development and ratings of factors in the teaching and learning environment.

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Development of the Instrument

The capabilities most relevant to the ability to engage in lifelong learning were selected by panels of academics from each faculty of a university in Hong Kong. Each panel was asked to describe the capabilities needed by graduates in their discipline area to function as a lifelong learner. The outcomes from the panels were then compared and a synthesis made of the most common capabilities and those indicated as most important (Leung and Kember, 2005). Testing of the questionnaire with graduates from a university in Hong Kong led to several iterations, after which the questionnaire consisted of nine scales measuring graduate capabilities (Kember and Leung, 2005a).

To make the questionnaire more applicable to undergraduate students, who were the target population of the current study, three scales about the desirable capabilities of graduates were deleted and one scale was reworded. As a result of this exercise the questionnaire included scales for the following capabilities needed for lifelong learning (Kember and Leung, 2005b):

- *Critical thinking*
- *Self-managed learning*
- *Adaptability*
- *Problem solving*
- *Communication skills*
- *Interpersonal skills and groupwork*

Throughout this article we adopt the convention of showing scale names in italics. The titles for latent variables in structural models are shown bolded.

The scales used to describe the teaching and learning environment were also developed over the series of studies. The original instrument had more scales focusing on the student experience (Leung and Kember, 2005). As it was found that the teaching and learning environment had a greater than expected impact on the development of capabilities, the instrument used in Kember and Leung (2005a) placed more emphasis on teaching and learning. Factors found to have significant relationships to perceptions of capability development in these previous studies were retained and similar constructs added.

The following scales were used to describe the teaching and learning environment (Kember and Leung, 2005b).

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- Active learning
- Teaching for understanding
- Assessment
- Coherence of curriculum
- Teacher–student interaction
- Feedback to assist learning
- Assistance from teaching staff
- Relationship with other students
- Cooperative learning

All items were scored on a 5-point Likert scale ranging from 1 = 'strongly disagree' to 5 = 'strongly agree'. Appendix 1 displays the questionnaire with 33 items measuring the development of the six capabilities and the nine elements in the teaching and learning environment. The nature of the items should help readers understand the constructs measured by the scales. The questionnaire had other scales which are not shown in Appendix 1 as they were not incorporated in the model tested in this article.

Sample and Procedures

The questionnaire was administrated to a total sample of 2,786 year 1 and year 3 undergraduate students from a university in Hong Kong. The sample consisted of all students in half of the 50 undergraduate degree programs offered by the university. The programs selected were a structured sample representative of undergraduate degrees offered by the comprehensive university. There were, therefore, programs from each of the seven faculties; Arts, Business Administration, Education, Engineering, Medicine, Science and Social Science.

A 63.9% response rate resulted in questionnaires being received from 1,779 students (year 1, $n = 1028$; year 3, $n = 751$). Deletion of 23 cases with missing data ultimately yielded a final sample of size 1756, 63.0% of the total sample. A breakdown of the return rate by year of study and faculty are shown in Table 1.

Scale Reliability

Before testing the structural relationship among the 15 scales in the study, their reliabilities were established with Cronbach-α. Mean, standard deviations, and α values of the 15 scales were computed with SPSS11.5 (Norusis, 2002) and are shown in Table 2. Schmitt (1996) discussed the value of α which should be acceptable and noted

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TABLE 1. Return Rates by Year of Study and Faculty in the Study

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

that a number of sources recommended the .7 level, but argued that values as low as .5 would not seriously attenuate validity. The scales were kept as short as possible to boost returns and this would have tended to reduce α values (Schmitt, 1996). Of the scales in the instrument 10 had Cronbach α values above .7 and the remaining 5 were between .54 and .7.

TABLE 2. Mean, Standard Deviations, and Cronbach α Values of the 15 Scales in the Study

Scale	Mean	St. Dev.	α
Teaching & Learning Environment			
Active learning	2.94	.90	.69
Teaching for understanding	3.65	.78	.79
Feedback to assist learning	3.46	.78	.80
Assessment	3.48	.78	.58
Teacher–student interaction	3.35	.93	.88
Assistance from teaching staff	3.50	.82	.84
Relationship with other students	2.96	1.08	.86
Cooperative learning	3.44	.87	.71
Coherence of curriculum	3.31	.84	.79
Capability			
Critical thinking	3.44	.89	.78
Self-managed learning	4.00	.71	.72
Adaptability	3.86	.67	.60
Problem solving	3.71	.68	.67
Communication skills	3.33	.96	.72
Interpersonal skills & groupwork	3.37	.85	.54

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Structural Analysis

SEM was used to test a model for the development of capabilities through the teaching and learning environment. The hypothesized model was based on previous work (Kember and Leung, 2005a, b; Leung and Kember, 2005). The model, with error terms of the scales and disturbance terms of the latent variables omitted for simplicity, is shown in Fig. 1.

The capabilities are grouped under two higher order latent variables. The **Intellectual** latent variable groups four capabilities concerned with higher-order thinking skills. The **Working together** latent variable subsumes *communication* and *inter-personal* capabilities. The teaching and learning environment is characterized by nine variables structured under three latent variables labeled; **Teaching** which is characterized by four scales *active learning*, *teaching for understanding*, *assessment* and *coherence of curriculum*; **Teacher–student relationship** which had three scales *teacher–student interaction*, *feedback to assist learning*, and *assistance from teaching staff*; and **Student–student relationship** subsumes *relationship with other students* and *cooperative learning* scales. The latent variables on each side of the model were hypothesized to be co-related. It was also hypothesized that there would be paths between the teaching and learning environment side of the model and the capability half, though the exact nature of these paths was left open for SEM testing.

The EQS package (Bentler, 1995) was used for the SEM analysis. 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 and Cudeck, 1993) and the standardized 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, judgment of model fit based on a two-index strategy which includes SRMR less than .08 and a supplemental index with a given cutoff criteria is superior to those only based on a single criterion. In this study, a model with SRMR $< -.08$, RMSEA $< .06$ and CFI $> .95$ would be considered as an excellent fit to the data.

Results of Structural Analysis

The goodness-of-fit and misfit indices obtained for the final model were SRMR = .04, RMSEA = .06, and CFI = .92 which yielded a reasonably good approximation to the data. The model hypothesized

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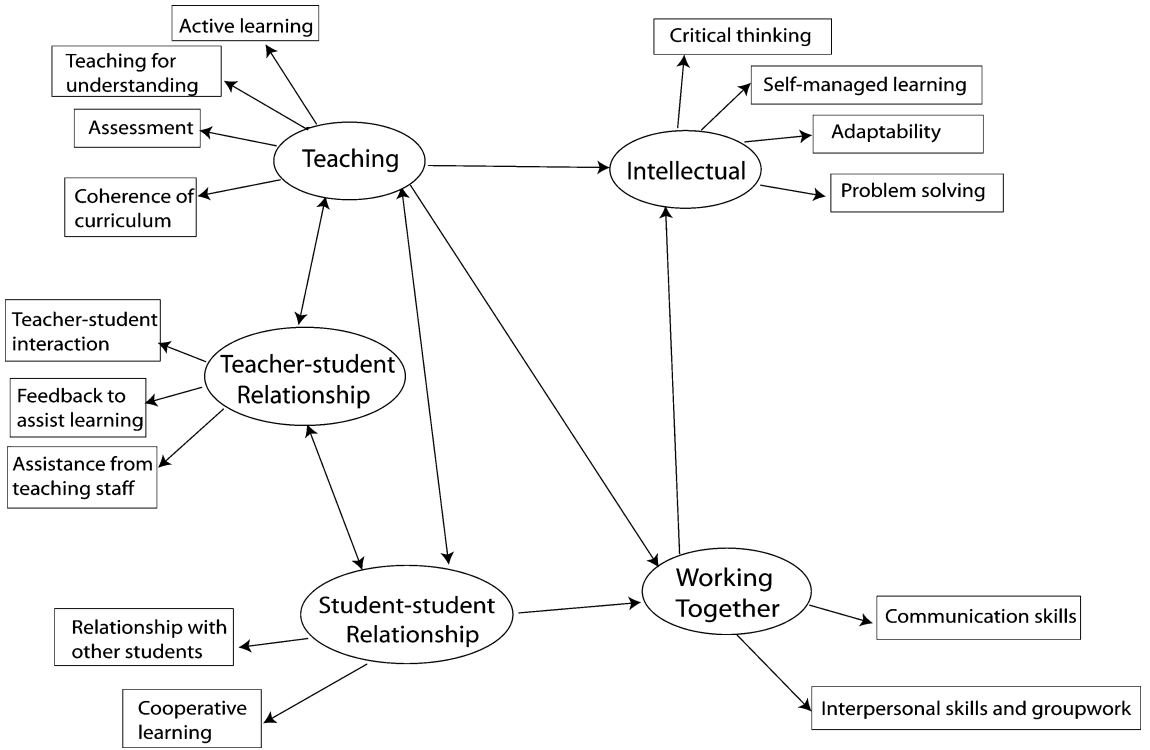

FIG. 1. The hypothesized model relating the teaching and learning environment to capability development. *Keys*: Latent variables are in ovals and observed variables are in rectangles.

that the 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 standardized coefficients indicate that 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** (standardized coefficient = .11, $p < .001$). Combining both the direct and indirect effects, **Teaching** impacted strongly on **Intellectual** capabilities (standardized total effect = .43) and the qualities needed for **Working Together** (standardized total effect = .29). The tested version of the model, with the standardized coefficients, is shown in Fig. 2.

The SEM model hypothesized that a teaching and learning environment can play a role in the development of the capabilities needed for lifelong learning. The model had a good fit to the data. Students perceptions of a high quality in elements in the teaching and learning environment tended to coincide with perceptions of the nurturing of the selected capabilities.

USE OF QUALITATIVE DATA TO AMPLIFY THE MODEL

While the SEM model provides a succinct definition of a suitable environment for nurturing lifelong learning capabilities, we felt that it would be helpful to teachers and curriculum designers to have a more detailed and richer description of such an environment. This could be provided through complementary qualitative data. Obtaining complementary qualitative data could also help in strengthening the conclusions by triangulation between the two data forms.

The quantitative data had been gathered in a quality assurance project, which aimed to give feedback to departments on the programs they offered. The data were reported to departments as profiles showing mean scores on each scale, together with z-scores which compared results to those of the other programs. There were also qualitative comments obtained as responses to two open-ended questions.

It was, therefore, possible to identify programs which were more successful at developing capabilities for lifelong learning. Accordingly three programs were selected which had above average scores for perceptions of capability development on each of the capability scales. Focus group interviews were then arranged with five or six representative students from the three programs. The students were generally from the latter years of the programs, so that they could comment upon most of the

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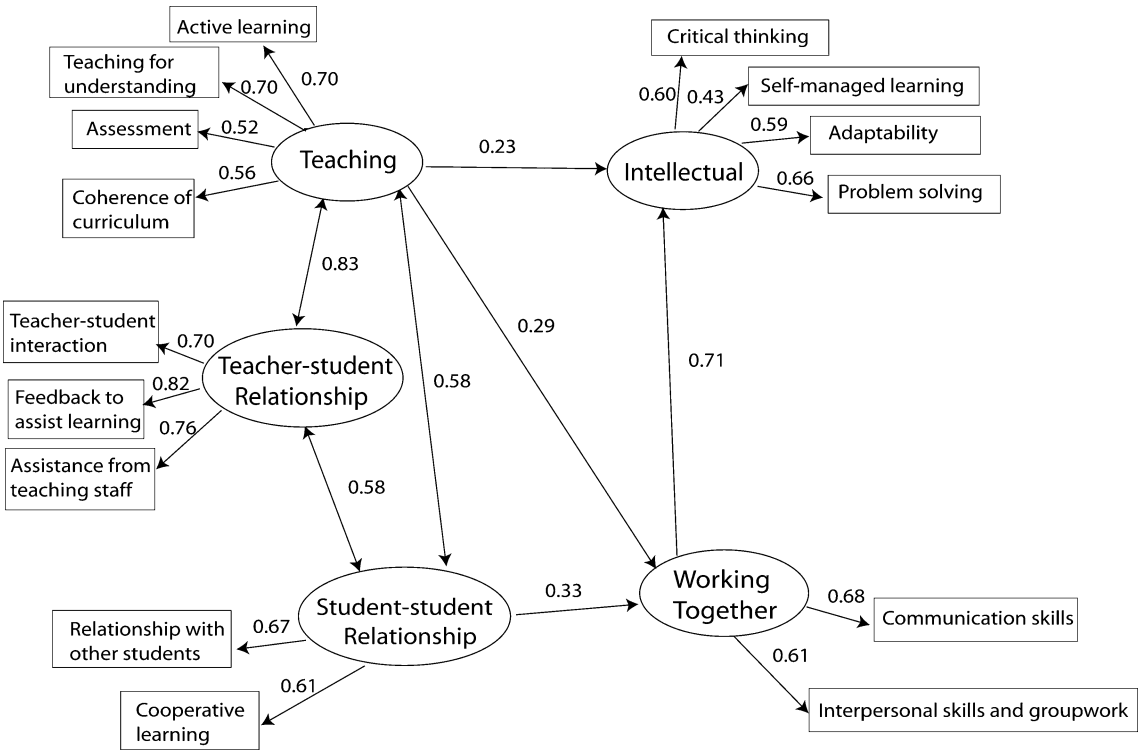

FIG. 2. Standardized parameter estimates of the structural model relating the teaching and learning environment to the development of capabilities. *Keys*: Latent variables are in ovals and observed variables are in rectangles.

program. The students would have previously completed the questionnaire survey.

The interviews had an open format. Semi structured questions asked the students to describe the approach to teaching, the assessment and the curriculum. Prompts were used to seek greater depth and richer descriptions where necessary. The three interviews each lasted for approximately 90 minutes.

Illumination of Variables in the Teaching and Learning Environment

The aim of the analysis was to synthesize a composite picture of good teaching practice which included common aspects across the three programs. The teaching in the programs was not perfect; so the students noted a range in teaching quality between teachers and courses. The analysis concentrated on interview comments which were seen as descriptions of the best practice; so that it was possible to describe a composite picture of the type of teaching and learning environment most capable of nurturing the type of capabilities needed for lifelong learning.

The analysis started with an open inductive stance which sorted the interview comments into categories referring to aspects of teaching and learning such as assessment or the relationship between teachers and students. The categories which emerged were then compared to the elements of the teaching and learning environment in the SEM model. There was a reasonably strong overlap between the qualitative categories and the quantitative scales. Evidence for the veracity of this assertion can be found in the following parts of this section in which extensive quotations from the interviews can be seen to fit comfortably under headings or category labels corresponding to the scales in the SEM model.

The trustworthiness of the conclusions was established by triangulation (Miles and Huberman, 1994). As five or six students were included in each focus group it was possible to examine the consistency between the comments of individuals. The sense of all of the quotations included was verified against the comments of at least one other member of the focus group. An extra dimension of triangulation was provided by fitting the qualitative data against the quantitative model.

In this section, the interview data are used to amplify the meaning of each of the nine elements of the teaching and learning environment and to verify the model shown in Fig. 1 as a model for the development of capabilities. Essentially the qualitative data is used to provide a rich

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description of the teaching and learning environment. Sufficient detail about the three programs can be derived from the quotations to see how the programs operate and see how they function to nurture capabilities. Presenting the data in this way provides powerful substantiation for the model through triangulation between the quantitative and the qualitative analyses.

It is noteworthy that there is a degree of overlap within the quotations with respect to the aspects of the teaching and learning environment to which they apply. This is consistent with the hierarchical nature of both halves of the model. Each element of the teaching and learning environment is subsumed under three higher-order latent variables. Finding a degree of overlap in quotations is, therefore, consistent with the model.

The three focus groups were from programs in Architecture, Government and Public Administration and Nursing. At the end of the quotations which follow the student's program is identified by the letters A, G and N respectively. Each student was given a numerical code in addition.

The first four variables are grouped under the **Teaching** latent variable and describe the nature of the teaching approach, the assessment and the curriculum. The **Teaching** latent variable, and its four constituent indicators, impacted directly on the development of capabilities grouped under both the **Intellectual** and **Working together** latent variables.

Active Learning

An important characteristic of the teaching approach was the degree of interaction between teachers and students. There were activities which prompted discussion in class.

> In our program, we have a lot of tutorials and small group discussion. We have lively interaction with professors. We are engaged in forming and voicing our views and the professor will duly respond to us. They would choose topics which are rather unusual that would shock your system and make you really think. They would have prepared a lot of questions that stimulate our thinking and students are actively engaged in thinking and generating their opinions/answers. (G2)

These interactions gave the students practice in critical discussion which helped in the development of critical thinking and other higher order thinking capabilities. The importance of providing practice in the deployment of the capability in learning activities is also illustrated in the next quotation. This time the capability in question is self-managed

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learning. In the Nursing course the students were not presented with a complete set of content; so they had to practice the management of their own learning by finding some material themselves.

> For instance, sometimes the notes given do not contain all the information, then we will look up from the references for details of the situation, what is happening and the current thinking abroad. (N1)

Teaching for Understanding

To stimulate the capabilities linked under the **Intellectual** latent variable (critical thinking, self-managed learning, adaptability and problem solving) it was necessary for the teaching to focus on depth and understanding of key concepts. The higher order thinking skills develop through their application during the program of study.

> The good teachers give real life examples, the presentation is informal and yet full of intellectual reflections. They show you how to go in depth into analyzing an issue rather than just touching the surface. (G3)

The teachers, therefore, needed to refrain from being too didactic or directive. Instead students needed prompting and encouragement to explore issues themselves.

> They won't give you a ready-made answer and they expect you to further explore the topic yourself. They use questions to stimulate you to think deeper into the issue or answers. From the point of view of study, some students might prefer teachers to give them a straight answer. (N4)

Assessment

Assessment is important as it has a strong influence on the learning approach students adopt (Biggs, 1999a; Thomas and Bain, 1984). To encourage the development of lifelong learning capabilities it is, therefore, necessary to have a variety of forms of assessment which require the deployment of the desired capabilities. The three quotations below show the variety of forms of assessment used in the Nursing courses. There is also an indication that the students can see how the types of assessment are relevant to the capabilities they will need in their future practice.

> We have a variety of assessment methods, such as term paper, final exams, oral exams, clinical skills exams in class and in hospital, writing of care plans. We are also assessed continuously on our mannerism and behavior, things like if we are polite to the patient, if we are punctual and our language, if we live up to our professional integrity and conduct. (N4)

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> I can give an example. In one course, it was the first year we were asked to do some posters as part of the assignment. (N3)

> This care plan was made statutory by the Nursing Council, to assess our ability in diagnosing the patient's needs, setting goals and expected outcomes, then design what interventions are required, then evaluate the effectiveness of our interventions. The objective of the day is to do this and write it down on paper for assessment by our tutors. (N1)

The three programs had a low proportion of the assessment in the form of tests and examinations compared to other undergraduate programs in the university. Much of the assessment for architecture was from their design projects. They also used a variety of forms of assessment in other components of the program. The subjective nature of the assessment indicates that it was testing higher-order thinking.

> We have presentations, case study analysis, essay writing, term paper based on some research. Occasionally, we have quizzes, but not frequently. Other than quizzes, all these assessment methods tend to be a bit subjective. This is understandable since design is a subjective thing. (A2)

The Government and Public Administration program offered flexibility in assessment. The students had some choice in the way they were assessed through their choice of courses. There was also flexibility over choice of topics for assignments. This meant that students could pick a subject they were interested in and examine it in great depth.

> I am very satisfied with the assessment practice. Based on my combination, I am free to choose to do a term paper and a presentation. I am given the freedom to concentrate and research in-depth into the topic that I've chosen. I like that very much, to be able to do what I am really interested in. The trade off could be that I only know a lot of a very narrow part of the knowledge and not knowing very well other broader issues. (G4)

Coherence of Curriculum

In order to prompt students to seek a deep understanding of key concepts in a discipline, it is important that they can see the relationship between topics. Otherwise topics are treated as isolated chunks of information, which can be forgotten as soon as the course has been completed.

Bringing coherence into a curriculum is illustrated by the Architecture program. The department had seen a parallel between coherent curriculum design and their own discipline. The program was bound together by the studios. These were integrated with subsidiary subjects. The

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design had clearly worked, as students had perceived the intended links and structure.

> Our design studio is a vertical studio. Each year has four sections and each section has a cross-year group which forms different studios. There are a few parts in a studio, and each part is led by a different tutor. (A4)

> We have to take the major's courses which include studio design, architectural history, building technology. You have to take them in each semester. There are some other electives which you can select. (A5)

> That was the same for me. Other courses were subsidiary to be integrated into the studio. So I think there is slight change from when we were doing our course. (A2)

> Other courses such as history, structure, how to use materials are useful knowledge being given whereas you are actively creating something in the studio. (A1)

Teacher–student Interaction

The next three sections refer to the three variables subsumed under the **Teacher–student relationship** latent variable. This latent variable does not impact directly upon the development of capabilities, but acts indirectly through the other two latent variables on the teaching and learning environment side of the model. Good teacher–student relationships and a high degree of interaction are needed to support the type of teaching described above. Development of close relationships also facilitates the teaching which requires the students to be actively engaged in discussion. Positive teacher–student relationships also help promote coherence within a class group, which leads to positive peer–student relationships.

Each of the focus groups reported high levels of teacher–student interaction. The degree of interaction was consistent with the deployment of teaching approaches requiring active student engagement. The quotation from an Architecture student below shows that it was not just the amount of interaction which was important, but the nature of it. Questioning techniques which required students to delve deeper and be more reflective were more likely to stimulate higher order thinking capabilities.

> Sometimes it feels the more you ask, the more it becomes unclear and lacking direction. From the beginning, based on my own perception of thinking of my design, I feel firm about my idea. Then you go and see them. They will not offer you an alternate idea and tell you that your original one is not good.

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> Rather, they will continuously ask you questions, 'Do you think this is good in this way here?' I recognize that they are trying to make us reflect on our own work. But when they are posing so many questions, this leads me wonder if they want me to do it in a different way. It really depends on their questioning technique. (A4)

Feedback to Assist Learning

The good teachers provided feedback to students on their work. This could be to the whole class.

> Feedback to assignments is done in a collective way during lessons. They will tell us what problems we have in general. For individual feedback, you'll need to go and see the course co-ordinator. (N2)

It could also be to individuals.

> Sometimes, if you've done a very good piece of work, or otherwise, the professor will discuss it with you in private. It's quite flexible and informal. (G2)

Assistance from Teaching Staff

To generate the high levels of interaction the teachers needed to be available to talk with students.

> In general, most professors have an open door policy whereby students feel welcome to go and see them whenever they need. If students don't take that opportunity, it is their loss really. Few individual professors might seem to be a bit more reserved, but according to my own experience, they are very happy and able to give you guidance whenever you seek their help. (G3)

The Architecture course employed a student-centered approach to teaching, which left students to discover ideas themselves. The teachers were available to provide support when necessary, though.

> Even if the teachers do not give much during the lesson, we can ask them directly. They will give us sufficient time that we can freely go and see them, or we can send them an email. They will suggest some books or paths for reference. (A5)

Relationship with Other Students

The final two variables are grouped under the **Student–student relationship** latent variable on the teaching and learning environment side of the model. This two-variable factor impacts directly upon the development of the **Working together** capabilities.

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Teachers are able to play a part in developing student–student relationships and coherent class groups. One method was through the active learning approaches described above. While engaging in discussion in- and out-of-class the students are provided with an opportunity to get to know each other. Having group activities led to class coherence.

> We get to know each other quite well in our first year. Our social group is then formed and will remain through the years, whereas, academically, we are constantly arranged into different groups for projects, tutorials and clinical practice, and we get to know more students that way. (N4)

Architecture prompted good student–student relationships by providing an open studio in which students of all years could discuss their work.

> Among students we discuss a lot, which is really helpful. We'll look at each other's design and gather more opinions that way. Our studio is open without walls. Students from all years are there. There will be MArch Year 2 students sitting next to me (a second year undergraduate student). They are able to give me ideas. We communicate really well. (A4)

Cooperative Learning

The benefit of good student–student relationships comes through the formation of study groups which try to make sense together of difficult concepts.

> Occasionally when there are stuff that we don't understand during lectures, we'll ask our friends after class quite naturally. (N3)

> Stuff that we don't understand, we'll reach an understanding when we revise together. (N1)

The students in all three programs worked together out-of-class using an *engager* approach (Yan, 2001; Yan and Kember, 2004a, b), which implies that the collaboration was focused towards members of the group trying to reach a better understanding together. This cooperative learning provided practice in communication and interpersonal skills, which in turn led to their development.

> Cooperative learning out of class is quite important for me. My academic performance in Year 1 was quite poor and I was lucky to have a few students who could help me out. We would continue our discussion right after class which helped me a great deal in understanding the subject and consolidating my memory. We also discussed how we would tackle the paper assignments and before exams. This has definitely improved the quality of my learning, much better than if I were to do it on my own, going to the library and dig the book out by the author's name. (G5)

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CONCLUSION

There is wide acceptance of the need for university graduate to be able to display the types of generic competencies needed for lifelong learning. Higher-order intellectual capabilities, such as critical and creative thinking, adaptability, the ability to solve ill-defined problems and the ability to manage one's own learning are seen as important. The ability to work with others is necessary; so communication and interpersonal skills are vital.

While most universities would now claim to be nurturing such capabilities in their graduates, few would be able to clearly articulate how this is accomplished and provide evidence to substantiate their claims. This is not surprising as the mechanism by which lifelong learning capabilities are nurtured has not been clearly established in the literature.

This study attempted to provide some guidance to universities in how to develop lifelong learning capabilities by demonstrating that a particular type of learning environment is conducive to capability development, and then providing a detailed characterization of that environment. The method employed was unusual in that it featured a combination of SEM and qualitative data from focus group interviews.

SEM is a powerful statistical technique able to test the type of complex multifaceted models which describe real social science and educational phenomena. These invariably involve multiple variables which show a high degree of interaction or influence with each other. In this instance the SEM was able to test a model which incorporated a teaching and learning environment defined by nine factors grouped under three higher order factors. A model which hypothesized this environment nurturing six capabilities needed for lifelong learning showed a good fit to the data.

The data from the focus group interviews with students from three programs perceived to have good records in nurturing capabilities was consistent with the SEM model. Triangulation between the qualitative data and the SEM analysis strengthens the evidence that the teaching and learning environment can influence students' perceptions of capability development. The interviews also provide a richer and more detailed description of the teaching and learning environment which had been successful in developing the generic capabilities. In the interviews the students described good practices in teaching and curriculum development; so provided a characterization of a teaching and learning environment capable of developing lifelong learning capabilities.

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ACKNOWLEDGMENTS

This work is partially supported by funding from the University Grants Committee of Hong Kong

APPENDIX 1. STUDENT ENGAGEMENT QUESTIONNAIRE

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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 program I have developed my ability to make value judgments 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 program 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

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Teaching for Understanding
15. The teaching staff try hard to make us understand the course material
16. The teaching staff for this program 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 program uses a variety of assessment methods
21. To do well in assessment in this program you need to have good analytical skills
22. For the assessment in this program 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 program of study for my major
32. The program of study for my major was well integrated
33. I could clearly see the relationship between the courses in my major program

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784 Received January 3, 2006.

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