Developing Metacognition with LASSI Online

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Abstract: The increased use of web-based learning, and pressure upon universities from both employers and funding bodies to develop students with lifelong learning skills, has brought about a shift in emphasis from a concentration on subject specialist knowledge towards more generic skills that prepare students for a diverse and rapidly changing working environment. As a result, attention has turned to the topic of metacognition or 'thinking about thinking' (Bogdan, 2000; Flavell, 1999; Metcalfe, 2000) and the twin challenges of producing students that have developed metacognitive skills, and providing evidence that universities have facilitated that development. This paper examines the impact of the introduction of the Learning and Study Strategies Inventory (LASSI) online in the promotion of a data driven approach to facilitating and evidencing the development of metacognition at City University of Hong Kong.

Introduction

Most academics now accept that web-based or e-learning is here to stay and it is no longer a question of whether to use e-learning in a university course, rather one of how it is to be used to best effect (Downing, 2001). Consequently, in order to be successful, increasing numbers of online students are required to move from expectations of being told 'what to learn and when to learn it' to a more complex learning environment which requires the adoption of a more self-regulatory approach in order to achieve success (Phelps & Ellis, 2002b; McMahon, 2002). In many ways, this self-regulatory approach is very similar to what will be expected of many graduates when they leave higher education and enter the workplace (Lynch et al., 2006) and is consequently a desirable side-effect of e-learning. Generic skills that can be developed at university and transferred to the workplace are increasingly seen as part of the 'added-value' of higher education brought about in part by the adoption of a competence or outcomes based approach, which Fuller & Unwin (2002) suggests does little to prepare employees for change and future workplace roles, unless supported through the development of metacognitive skills like problem-solving and critical reflection.

Metacognition

Metacognition is best defined as 'thinking about thinking' (Bogdan, 2000; Flavell, 1999; Metcalfe, 2000) however this definition requires further explanation, because metacognition also involves knowing how to reflect and analyse thought, how to draw conclusions from that analysis, and how to put what has been learned into practice. In order to solve problems, students often need to understand how their mind functions. In other words, they need to perceive how they perform important cognitive tasks such as remembering, learning and problem solving. Kluwe (1987) noted two particular characteristics of metacognition: the thinker knows something about his or her own and others' thought processes, and the thinker can pay attention to and change his or her thinking. This latter type of metacognition Kluwe calls 'executive processes'. Hacker (1998) points out the difference between cognitive tasks (remembering things learned earlier that might help with the current task or problem) and metacognitive tasks (monitoring and directing the process of problem solving), stressing the

importance of learning more about thinking. In defining metacognition as 'thinking about thinking' or 'second-order cognition', Weinert (1987) acknowledges that purpose, conscious understanding, ability to talk or write about tasks, and generalisability to other tasks are also important factors in determining whether a given task is metacognitive. This viewpoint is supported by Brown (1987) who agrees that metacognition requires the thinker to use and describe the process of mental activity. Many other researchers also make the point that metacognition is best defined by acknowledging that it is both knowledge about, and control over thinking processes (Allen & Armour-Thomas, 1991).

Therefore, whilst cognition focuses on solving the problem, metacognition focuses on the process of problem solving (Marchant, 2001).

Assessing Metacognition using the Learning and Study Strategies Inventory (LASSI)

Metacognition can be assessed in a number of ways but one of the most popular methods currently used in universities worldwide is through the use of questionnaires which require students' to report their perceptions about their thinking and problem-solving skills and strategies. It is generally accepted that most students who struggle at university could improve their performance considerably if they understood their learning process better. Weinstein (1988) points out that grades begin to improve when students learn the tricks of pinpointing the key points in lectures, and learning is more effective when we engage in thinking about the processes of learning, thinking, and problem-solving. As a result of her work in the field of strategic learning at the University of Texas at Austin, she developed the Learning and Study Strategies Inventory (LASSI) which is now the most widely used learning inventory in the world (Weinstein, 1987). The LASSI measures student's perceptions of their study and learning strategies and methods. In other words, it is a measure of the students thinking about their thinking, or metacognition. The tool consists of ten scales, and eighty items which provide an assessment of students' awareness about and use of learning and study strategies related to skill, will and self-regulation components of strategic learning. Research has repeatedly demonstrated that these factors contribute significantly to successful study, and that they can be learned or enhanced through educational interventions such as learning and study skills courses (Weinstein, 1994a, 1994b; King, 1991; Letteri, 1992; Hanley, 1995). The LASSI provides standardised scores for the ten different scales and provides students with a diagnosis of their strengths and weaknesses, compared to other students, in the areas covered. It measures three main areas of 'strategic learning':

i) Skill Component of Strategic Learning

These scales examine students' perception (metacognition) of their learning strategies, skills and the thought processes related to identifying, acquiring and constructing meaning for important new information, ideas and procedures. The LASSI scales related to the skill component of strategic learning are:

- Information Processing-the ability to process ideas by mentally elaborating on them and organizing them in meaningful ways.
- Selecting Main Ideas- the student's ability to identify the important information in a learning situation.
- Test Strategies-the student's ability to prepare effectively for an examination and to reason through a question when answering it.

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ii) The Will Component of Strategic Learning

These scales measure students' perceptions of their receptivity to learning new information, their attitudes and interest in college, their diligence, self-discipline, and willingness to exert the effort necessary to successfully complete academic requirements, and the degree to which they worry about their academic performance. The LASSI Scales related to the will component of strategic learning are:

- Attitude-the student's perceived motivation and interest to succeed in their study, and willingness to perform the tasks necessary for academic success.
- Motivation-the extent to which the student accepts responsibility for performing those tasks by using self-discipline and hard work.
- Anxiety-the degree of anxiety perceived by the student when approaching academic tasks.

iii) The Self-regulation Component of Strategic Learning

These scales measure how students' perceptions of how they manage, or self-regulate and control, the whole learning process through using their time effectively, focusing their attention and maintaining their concentration over time, checking to see if they have met the learning demands for a class, an assignment or a test, and using study supports such as review sessions, tutors or special features of a textbook. The LASSI Scales related to the self-regulation component of strategic learning are:

- Concentration-the student's perceived ability to focus his or her attention, and avoid distractions, while working on school-related tasks like studying.
- Time Management-the student's perception of the extent to which they create and use schedules to manage their responsibilities effectively.
- Self-Testing-the student's awareness of the importance of self-testing and reviewing when learning material, and use of those practices.
- Study Aids-the student's perceived ability to use or develop study aids that assist with the learning process.

There is a wealth of research, making use of the LASSI as a measure of metacognition, which identifies the value of learning to learn interventions in schools, colleges and universities (Loomis, 2000), however few studies have used the online version of LASSI to reinforce the overall added-value of thinking about thinking in an online learning environment. Therefore, this study shares some of the online data produced by LASSI and suggests how it might be used to provide evidence of metacognitive development in undergraduates, and facilitate a data driven approach to enhancing the generic skills so valued in the workplace. Successful e-learning requires high level self-regulatory skills so that learners not only understand the text itself, but also browse through the space selectively with a concurrent awareness of their study skills and strategies. This practice undoubtedly enables successful e-learners to develop their metacognitive skills considerably. Vygotsky's (1986) view was that in order to subject a function to intellectual and voluntary control, we must first possess that function. In other words, metacognition and self-reflection will develop first as a skill before it can be used as a series of consciously controlled strategies, and this is undoubtedly a skill which is required by any successful e-learner.

Method

(i) Sample

Starting from 2005-06 LASSI is offered online to all first-year undergraduate students at City University of Hong Kong in order to help them monitor and develop appropriate learning attitudes and strategies and maximize the opportunity for students to enjoy a successful learning experience during university and beyond. As a pilot study, the LASSI is currently offered on a voluntary, rather than compulsory, completion basis to all new undergraduate students within weeks 3 to 5 of their first semester at City University. It is anticipated that an interim test will follow this pre-test around the middle of the student's undergraduate programme, and that a post-test will be administered towards completion of the undergraduate programme. In other words, each undergraduate student will take LASSI three times during their undergraduate study at City University. Therefore, it should be possible to produce longitudinal data as evidence of growth in metacognitive ability over the time spent in undergraduate study, and correct any problems with this development early. It takes approximately 25 minutes to complete the inventory which is completed online. It is planned to introduce the LASSI as a compulsory assessment tool with effect from semester A (September) 2006 in order to avoid some of the sampling difficulties inherent in voluntary completion. For example, the likelihood of positively skewed scores because those students who complete LASSI voluntarily are likely to be the most interested in their learning and study strategies, and therefore more aware and interested in their metacognition than the overall first-year student population at the university.

(ii) Materials

The Learning and Study Strategies Inventory (2nd Edition) Weinstein & Palmer, (2002).

Demographic 'entry' data collected by City University of Hong Kong during the student admission process.

(iii) Participants

LASSI data was collected from a total of 1,821 (N = 1,821) new first-year undergraduate students at City University of Hong Kong, and correlated with variables taken form the same students' demographic data collected as a normal part of the admission process.

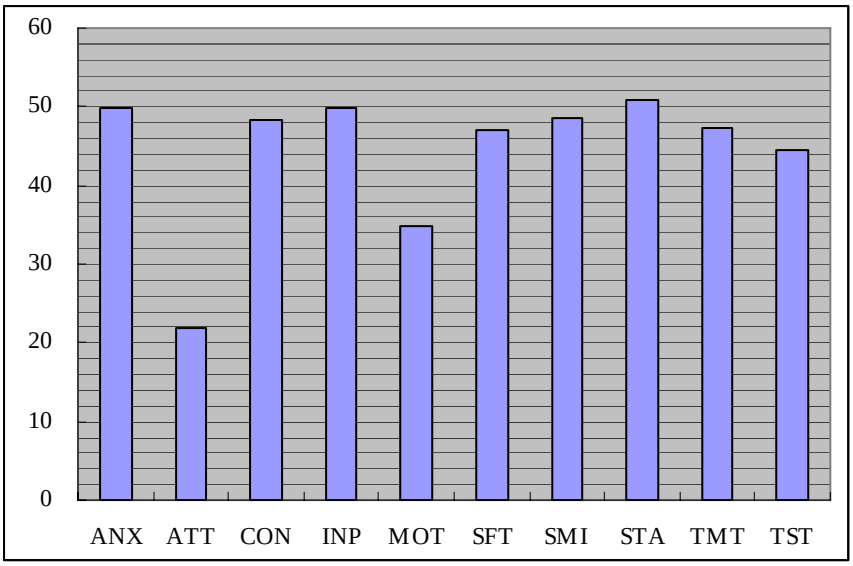
(iv) Procedure

1,821 City University of Hong Kong freshmen voluntarily completed the LASSI online during weeks 3 to 5 of semester A 2005. The data was fed back to them immediately and individually via automatic electronic method and was also made available to their year and course tutors.

Results

Not surprisingly for a large-scale study of this type, a range of data for correlation was collected and analysed. However, only a small selection of the possible analyses are presented in this paper in order to stimulate thinking about the value of LASSI online data to colleagues engaged in facilitating e-learning courses and programmes.

Table 1: *Average score of all students*

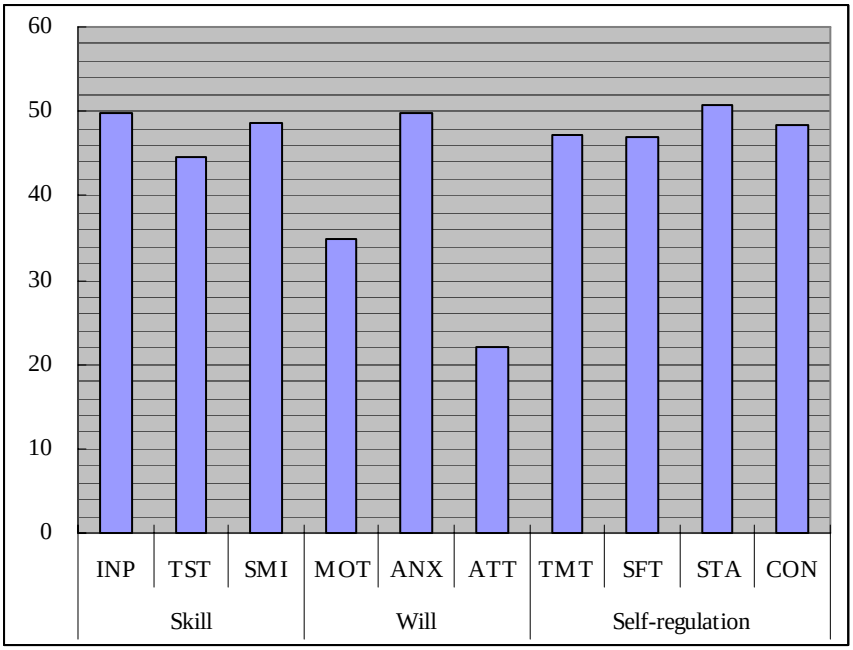


ANX	ATT	CON	INP	MOT	SFT	SMI	STA	TMT	TST	Total Score
50	22	48	50	35	47	49	51	47	45	444

Total participants: N=1821

The data in this table can be compared with international norms for various institutions worldwide and can give a good overall comparison of the metacognitive and meta-affective skills of students on entry. This can be compared at a later date with student scores in year two of their study and at graduation. The LASSI is scored automatically through electronic means and uses percentiles. Percentiles are values that divide a sample of data into one hundred groups containing (as far as possible) equal numbers of observations. For example, 30% of the data values lie below the 30th percentile. The median is the 50th percentile. After residuals are ordered from smallest to largest, the 90th percentile is the value with 10% of the values above and 90% below. Percentiles are simply statements of the percentage of scores lower than a specific score. For example, if you score 60 on a test, and are told that your score puts you at the fiftieth percentile, which means that 50% of the people taking the test scored lower than 60. In standardised testing, the percentile score is the percentage of a norm group who scored lower than your score. If you score at the 50th percentile on a standardised test, that means that 50% of the sample used to set norms for the test scored lower than you.

Table 2: *Average score of all students, grouped by 3 components*



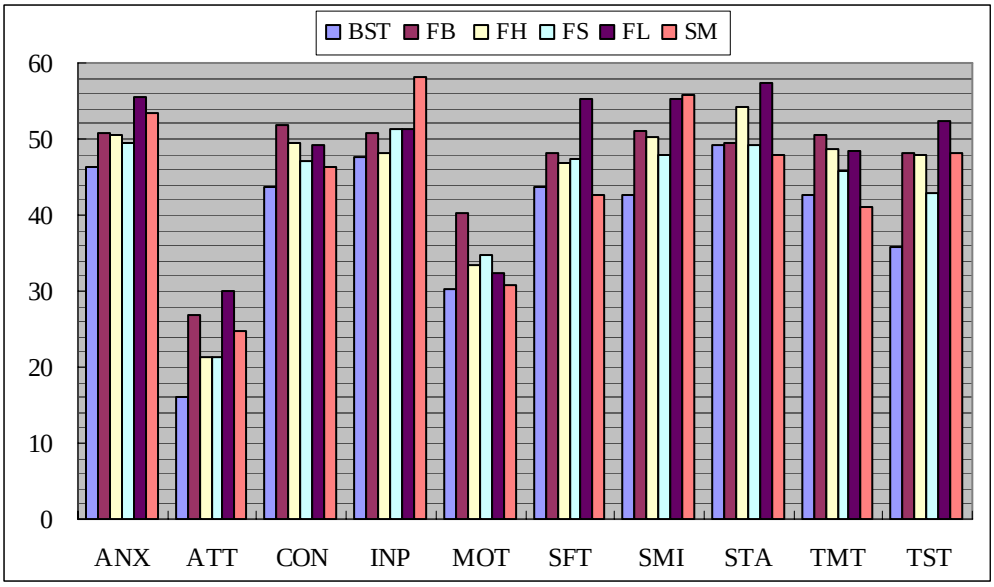
Skill			Will			Self-regulation				Total Score
INP	TST	SMI	MOT	ANX	ATT	TMT	SFT	STA	CON	
50	45	49	35	50	22	47	47	51	48	444

Total participants: N=1821

In this example, the LASSI scores are grouped according to the three correlated components of the test, 'will', 'skill', and 'self-regulation'. This grouping is particularly helpful in providing data that can be used to analyse relative strengths and weaknesses and direct freshmen to appropriate sections of online or traditional 'learning to learn' courses, rather than requiring them to attend a complete sequence. Whilst looking at these aggregate scores horizontally across LASSI items is not particularly helpful given the use of percentiles and ordinal data, a longitudinal analysis (not yet available) to ascertain how the institution is doing in developing the metacognitive abilities of its students is exceptionally valuable data (see discussion below).

Table 3 below also demonstrates that LASSI can be used to compare the entrance requirements for particular faculties and check patterns of scores to identify particular overall strengths and weaknesses. When entry data is available for a second intake in September 2007 it will be possible to compare the relative metacognitive skill base of the pool of freshmen commencing their study at City University of Hong Kong with the 2006 cohort and gradually build up a trend picture which provides much useful information to feedback to secondary schools and faculty/departmental entrance tutors.

Table 3: *Faculty average score*



Faculty	No. of Students	ANX	ATT	CON	INP	MOT	SFT	SMI	STA	TMT	TST	Total Score
BST	308	46	16	44	48	30	44	43	49	43	36	399
FB	437	51	27	52	51	40	48	51	50	50	48	468
FH	500	51	21	50	48	33	47	50	54	49	48	451
FS	519	50	21	47	51	35	47	48	49	46	43	437
FL	31	56	30	49	51	32	55	55	57	49	52	486
SM	26	54	25	46	58	31	43	56	48	41	48	450

Total participants: 1821

It is also possible to correlate LASSI scores with a number of other significant or potentially significant factors in terms of metacognitive development. For example, a small scale pilot study conducted by Downing et al. (2006 forthcoming) demonstrates a significant relationship between LASSI score and type of housing, or more accurately, whether a student is living in the 'home' environment (Family Home or FH). In this study students from the Chinese mainland coming to Hong Kong to study (moving away from 'home') with unidentified housing type obtained by far the highest overall LASSI scores (n=127, mean score=619.73) with those students living in City University's accommodation on campus producing the second highest LASSI scores (n=45, mean score=580.58). Perhaps less surprisingly, those living in private housing produced (n=621, mean score=435.83) the third highest LASSI scores (see Table 4). The results from this study N=1815 were analysed with ANOVA and produced highly significant effects as can be seen from Table 5 below. These results raise the question of the extent to which the metacognitive skills assessed by the Learning and Study Strategies Inventory are influenced or associated with moving away from the home environment in order to engage in undergraduate study. In other words, does a significant change in the social context like moving away from home to study, impact positively upon metacognitive development? This question is dealt with in Downing et al (2006 forthcoming).

Table 4: *Mean Total LASSI score according to Type of Housing (FH vs. NFH).*

		N	Mean LASSI Score
LASSI	Staff quarters (FH)	5	369.8000
	HOS/PSPS (FH)	269	419.3494
	Private housing (FH)	621	435.8293
	Public housing (FH)	748	418.4238
	Student halls (NFH)	45	580.5778
	From Chinese Mainland (NFH)	127	619.7323
	Total	1815	442.4887

Key:FH – Living in family home. HOS - Home Ownership Scheme. NFH – Living away from family home. PSPS - Private Sector Participation Scheme.

Table 5: *ANOVA*

		Sum of Squares	df	Mean Square	F	Sig.
will component	Between Groups	531261.269	5	106252.254	40.561	.000
	Within Groups	4738756.397	1809	2619.545		
	Total	5270017.666	1814			
skills components	Between Groups	546883.932	5	109376.786	31.883	.000
	Within Groups	6205872.248	1809	3430.554		
	Total	6752756.180	1814			
self-regulation component	Between Groups	785366.094	5	157073.219	31.249	.000
	Within Groups	9093021.373	1809	5026.546		
	Total	9878387.468	1814			
LASSI	Between Groups	5478997.128	5	1095799.426	45.101	.000
	Within	4395286	18	24296.		

Groups	4.391	09	774		
Total	4943186	18			
	1.518	14			

Discussion

The introduction to this paper identified twin challenges of producing students that have developed metacognitive skills, and providing evidence that universities have facilitated that development. The Universities General Council of Hong Kong (UGC) mandate on the adoption of outcome-based teaching and learning (OBTL) and the move to the 4-year curriculum have put the onus of providing evidence for effective student learning as a major responsibility for universities in the SAR. In its various communications, the UGC has also made clear that the quality of such evidence will be used to inform direct funding to universities. Therefore, a reliable, valid, and recognised tool has to be engaged to help universities collect and disseminate information to improve student learning and provide evidence for eventual submission to the UGC. This tool must be flexible enough to allow large quantities of useful data to be collected efficiently online, with automatic feedback mechanisms available for staff and students so they are able to act on the data received and ensure students get the specifically targeted help they need promptly, and with the minimum of complicated analysis by hard-pressed staff. Used appropriately, LASSI can assist staff and students to identify areas of relative weakness in study strategy and assist in the development of the highly valuable metacognitive skills so essential for both the modern workplace, and lifelong learning. In addition, the data collected, and subsequent analyses, can be used as evidence of 'value-addedness' of university undergraduate programmes to the UGC in Hong Kong, and other university funding bodies. This is particularly pertinent in view of the change to the 4-year curriculum in Hong Kong where the UGC intends to claw back student numbers for re-distribution based on evidence of improved student learning. The move towards a four-year curriculum and the subsequent need for more flexible modes of delivery will inevitably require students to more effectively self-regulate their own study habits. In addition, the rapid rise in the use of interactive technologies and e-learning will ensure a consistent demand for graduates who possess life long learning skills that will enable them to continually upgrade and revise their knowledge and skills through their own self-motivation (Bennett, Dunne, & Carre, 1999; Dearing, 1997). Ensuring sufficient support for undergraduate students in this new flexible, technologically rich, environment requires an understanding of the importance of metacognitive development if we are to avoid the high attrition rates sometimes associated with e-learning (Brooks, 1997), and a set of tools which allow institutions to monitor and develop their strategies for facilitating student development. It is no longer sufficient to evidence learning outcomes purely based on subject specific ability and the often hidden (and largely un-evidenced) metacognitive skills developed during undergraduate education need to be more explicitly stated and backed-up with appropriate data.

The effective use of LASSI depends upon a determined and coordinated approach which ensures that the various initiatives and courses offered by education development offices, student development services, and faculties, are demonstrably LASSI data driven. LASSI is best regarded as a reasonably accurate but relatively 'blunt' diagnostic tool for individual students, faculties and the university. However, it is clear from a number of studies into LASSI in various parts of the world, including City University of Hong Kong (Corrigan and Lee, 1997), that LASSI is a useful measure to diagnose those learning areas which need most attention. However, whilst LASSI might generate data which shows that graduates have

improved their scores over time, it would be unwise to rely upon it as the sole measure of metacognitive development. Consequently, having identified the areas for development using LASSI, consideration should be given to sharper and more specific measures of successful intervention when working with students and staff on these areas. Blakey & Spence (1990) identify some useful strategies for developing metacognitive behaviours which are easily adapted to the e-learning environment:

- Self-evaluation.
- Planning and self-regulation.
- Debriefing the thinking process.
- Talking about thinking.
- Identifying 'what you know' and 'what you don't know'.
- Keeping a thinking journal.

The fact that LASSI is administered as a diagnostic tool, and as means of providing evidence of value-addedness, will ensure that students are engaging in self-evaluation about their planning and self-regulatory processes. It is then for learning and teaching staff to ensure that students are encouraged to talk about the thinking process and this can easily be achieved with appropriate use of formative and summative discussion or bulletin board questions related to the LASSI scores. E-portfolios and self-reflective exercises can also be used to encourage students to think about what they do and don't know. For example asking students to formulate questions in advance of an online tutorial session can be an effective way of assisting in the development of appropriate metacognitive behaviours. Another effective way of encouraging students to think about their thinking is the peer interaction that occurs online when students are asked to collectively critique an academic or newspaper article.

Conclusion

Clearly, there are a wide range of opportunities for teachers to engage students in metacognitive behaviours but this can only happen if staff are aware of the importance of this area of their work, and student awareness of the importance of metacognitive development is raised. The introduction of a diagnostic tool like the LASSI can assist those engaged in facilitating learning at universities to raise staff and student awareness of this important concept, target appropriate 'learning to learn' interventions more effectively, reduce online attrition rates, and provide financially vital evidence of adding value to undergraduate education.

The examples provided in this paper indicate the potential value of this online inventory in meeting the changing needs of undergraduates, employers, universities, and higher education funding bodies. The key role that inventories like the LASSI can play in meeting the twin challenges of producing students that have developed metacognitive skills, and providing evidence that universities have facilitated that development should not be underestimated, particularly given the move towards a four-year curriculum in Hong Kong, and the continued growth of e-learning across the globe.

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