LEARNING AND RETENTION OF LEARNING IN AN ONLINE POSTGRADUATE MODULE ON COPYRIGHT LAW AND INTELLECTUAL PROPERTY

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Abstract: Various forms of knowledge can be distinguished. Low-level learning focuses on recognition and remembering facts. Higher level learning of conceptual knowledge requires the development of some form of mental structural map. Further, application of knowledge requires learners to put theories and concepts into use in authentic and novel situations. This study concerns learning at a number of levels. The context is a fully online module on copyright laws and intellectual property, designed as an introductory course for all postgraduates at a university in Hong Kong. The paper also explores whether the knowledge learnt through the web-based medium was retained after three to six months. Findings ascertained the effectiveness of the new medium, not only in delivering facts but also for assisting the learning of higher level knowledge. As expected, the performance of students declined in the delayed post-tests but not to any alarming degree. Retention of factual knowledge, however, was much lower than retention of other forms of knowledge. This perhaps suggests that the role of e-learning, just as in face-to-face classes, should focus on concepts and the applied knowledge, rather than on memorization of facts alone.

1 LEVELS OF COGNITIVE REASONING

Learning involves different levels of cognitive activities. Levels of cognitive reasoning are often described by Bloom's taxonomy (Bloom, 1956), namely: knowledge, comprehension, application, analysis, synthesis and evaluation. The knowledge level of the original taxonomy is concerned with the retention of information. Comprehension refers to the understanding of this retained knowledge. At the application level, learners apply the theories and concepts to practical situations. At the analysis cognitive level, learners are able to break down the knowledge and concepts in a scenario into their sub-components. The last two levels of cognitive reasoning are synthesis and evaluation. Synthesis focuses on the assembly and putting together of the learned knowledge in new ways. Evaluation is concerned with learners making value judgments about what they have learnt and produced.

There are has been a great deal of debate over the 'knowledge' level which is somewhat problematic because the word knowledge, in common usage, has a broad range of meanings. The revised Bloom's taxonomy (Anderson & Krathwohl, 2001; Krathwohl, 2002) tackles this challenge and contains two dimensions instead of one – a knowledge dimension and a cognitive process dimension. The knowledge dimension now clearly classifies and distinguishes between forms of knowledge: factual knowledge, conceptual knowledge, procedural knowledge and metacognitive knowledge (Table 1). Anderson and Krathwohl (2001) described factual knowledge as "knowledge of discrete, isolated content elements"; conceptual knowledge as involving "more complex, organized knowledge forms"; procedural knowledge as "knowledge of how to do something"; and metacognitive knowledge as involving "knowledge about cognition in general as well as awareness of one's own cognition" (p. 27).

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As educators we are interested in students acquiring conceptual, procedural and metacognitive knowledge, as well as factual knowledge. It is somewhat paradoxical that formal education has often overemphasized factual knowledge in beginning classes, calling such knowledge 'foundation knowledge', and then expected students to make the transition to other forms of knowledge with little overt support. For example, Conway, Gardiner, Perfect, Anderson and Cohen (1997) remarked that students who achieve higher grades on essay-based examinations show conceptual organization of knowledge while simple listings of facts and concepts are correlated with low grades. The development of mental structural maps of knowledge (Novak & Gowin, 1984) and "accompanying schematization of knowledge is what educators surely hope to occur in their students" (Herbert & Burt, 2001, p. 633).

2 LEARNING AND KNOWLEDGE RETENTION IN E-SETTINGS

The use of the web as a strategy to deliver learning activities has been of growing importance as technology advances. Research studies have been carried out to evaluate the effectiveness of e-learning in achieving learning outcomes. While many studies claimed that students learn well in the new media, most of these studies did not differentiate or compare the forms of knowledge being investigated.

This paper compares and contrasts students' learning on four levels of knowledge in an online course. The first objective is to investigate whether e-learning can support the acquisition of higher order knowledge. For e-learning to be an effective learning tool, it has to be able to facilitate acquisition of knowledge at the higher levels.

The second objective of the study is to explore how well the knowledge acquired at these various levels is retained.

The study of knowledge retention in non-web settings in general tends to show that the retention rate for specific facts falls behind that for a broader base of more general facts and concepts (Semb & Ellis, 1994). For example, Conway, Cohen and Stanhope (1991) studied very long-term knowledge retention by monitoring the performance of 373 students over ten years on tasks related to a cognitive psychology course. They found that "the decline in retention of concepts is less rapid than the decline in the retention of names" (p. 401).

This finding supports Neisser's (1984) schema theory that describes how conceptual knowledge is developed when students construct linkages between specific facts in their minds. Such linkages or webs or maps are called knowledge schema. They are more resistant to forgetting than isolated pieces of detailed knowledge. There might be exceptional cases, though, if the specific facts are involved in very personal contexts. Herbert and Burt (2004) suggested that context-rich learning environments (such as problem-based tasks or tasks with connections to learners' own lives) allow the building of a rich episodic memory of specific facts and this improves the motives of learners to pay attention to learning. Learners are "more likely to then know the material and schematize their knowledge of the domain" (p. 87).

Relatively little is known, however, about learning and knowledge retention patterns in e-settings. Yildirim, Ozden and Aksu (2001) compared the learning of 15 students in a hypermedia learning environment with that of 12 students in a traditional situation. They found that students learnt and retained knowledge better in the computer-based environment, not only in the lower-level domains that were about memorization of declarative knowledge, but also in the higher domains of conceptual and procedural knowledge. Bell, Fonarow, Hays and Mangione (2000), however, in their study with 162 medical students, found that "the multimedia textbook system did not significantly improve the amount learned or learning efficiency compared with printed materials … knowledge scores decreased significantly after 11 to 22 months" (p. 942). The problem with many of these studies is that the design of the online module does not provide any advantage over the printed version from the students' perspective (Reeves & Hedberg, 2003). We were conscious of the need to design for a learning advantage when deciding to use a fully online module.

The present paper aims to provide further information about knowledge retention in an online course through analysing student performance levels on a fully online introductory course for postgraduate students on copyright law and intellectual property. The course was structured to include learning activities on four levels: (1) specific facts, (2) more general facts and rules, (3) concepts, and (4) applied knowledge. These are related to the revised Bloom's taxonomy in Table 1. For the fourth category, we will use the term 'applied knowledge' but, as shown in Table 1, the tasks in this category

require some analytic skills. These categorizations are only indicative.

Table 1: Knowledge levels in the online module and the revised Bloom's taxonomy.

	Cognitive process					
Knowledge	Rem	Und	App	Anal	Eval	Cre
Factual	(1)		(2)			
Conceptual		(3)		(4)		
Procedural						
Metacognitive						

Rem=Remember Und=Understand App=Apply
Anal=Analyze Eval=Evaluate Cre=Create

3 THE CONTEXT OF THE STUDY

The topic of avoiding infringement of copyright law is central to research ethics and includes issues of honesty, credit-sharing and plagiarism. As the computer is used increasingly to disseminate information, teaching professionals also must have knowledge of the applications of the law to this developing technology (Van-Draska, 2003). There is a growing need to introduce copyright policies into university libraries (Gould, Lipinski & Buchanan, 2005). It is vital to equip students with knowledge about copyright and intellectual property, and to warn them against plagiarism. The situation is particularly true in Hong Kong as the issue of intellectual property and copyright law in research and study-related environments is currently receiving a great deal of attention in the academic community. At present the Government is revising the ordinances and laws governing copyright in Hong Kong. These laws are being interpreted and re-interpreted by many different people and interest groups. The need to educate students properly on these issues is thus particularly important.

The University Library of The Chinese University of Hong Kong (CUHK) teaches all postgraduate students a module titled 'Observing intellectual property and copyright law during research'. This course is a compulsory module for research postgraduate students; students need to complete this online module before their graduation. As the situation is very fluid in Hong Kong, the course has been designed to tackle the issue in as many practical ways as possible. Whatever the laws in Hong Kong are, it must be clearly stated that many of the issues surrounding intellectual property in academic circles are universal, and not just applicable in Hong Kong. There are two major components on the online module: the learning resources and the test.

The module was originally conducted solely through face-to-face workshops organized by the Library. The problem with this method was that teaching was restricted to designated times and places. In recent years, the Library has been investigating the potential benefits of putting the course online, similar to the University of Illinois at Chicago (Rockman, 2004). An online version of this particular topic was deemed to be an appropriate strategy for the following reasons:

- *The course is an introductory course*: Most of the study materials are easy to understand. This type of content is good for self-learning through students' individual reading and consideration of the online materials.
- *Students are from various disciplines*: Gathering students physically for a lesson has always been difficult, as they have conflicting timetables. With e-learning methods, learning can take place on-demand, and students can be given greater control over their learning than before (DeRouin, Fritzsche & Salas, 2004).
- *Online learning might be effective*: Our reading provided sufficient examples of studies where higher level learning seemed to be supported by an online environment. For example, Iverson, Colky and Cyboran (2005) compared introductory courses held in the online format and traditional format. Their findings suggested that online learners can gain significantly higher levels of enjoyment and significantly stronger intent to transfer their learning to other contexts.

With effect from 2004–05, the format of this compulsory module was changed from lecture-based to online-based. The online version of the course was run the second time in the academic year 2005–06. The online module is offered four times a year from September to April each year and it is offered under the 'Research' section of CUHK's Improving Postgraduate Learning programme (http://www.cuhk.edu.hk/clear/library/booklet/29.htm). At the time of writing, the module had been run eight times.

4 ONLINE MODULE

4.1 Procedure

All postgraduate students are entitled to enrol in the course. In fact, they are required to take (and pass) the course before their graduation. There are four cohorts each year, and each cohort last for about two months. Eligible students may enrol themselves into any one of the cohorts; they then have to complete the course and the course-end test within the two-month duration.

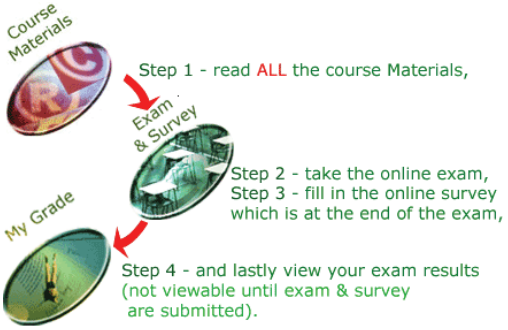

Figure 1: Flow of learning activities of the online course.

The flow of the course is illustrated in Figure 1. In order to complete the course, students are required to complete the following four tasks in sequence within the course period:

1) read ALL the course materials;
2) take the online exam;
3) fill in the online survey (not viewable until the exam is submitted); and
4) view their own exam results (not viewable until the survey is submitted).

Students can attempt the summative test only after they have completed reading all the course materials.

4.2 Course Content

The learning resources consist of 28 pages of course content that focuses on five areas of issues: *copyright around the world* and *copyright in Hong Kong* cover **specific facts** such as history and the enactment bodies of copyright laws in Hong Kong and around the world; *permitted act for research and private study in Hong Kong* introduces the more **general facts and rules** governing the accepted academic practices; *avoiding plagiarism* is a **conceptual** section as it defines plagiarism and explains various related concepts; lastly, *intellectual property & copyright* focuses on the **applied knowledge** by showcasing various real-life situations and commenting on appropriate practices. Each page contains easy-to-read materials; some are linked to PowerPoint slides and/or further readings. In all, the course gives students a clearer understanding of the core issues of intellectual property, copyright law and plagiarism in academic research. The course provides advice about compliance in 'dealing with' intellectual property 'fairly'.

4.3 Course-end Test

The summative test consists of 20 questions randomly selected from a pool of 29 questions. The pass mark of the test was 10. Students fail the test if they score 9 or below. If they do so, they need to retake the course. The test questions followed the course structure and asked students' knowledge on the five themes described above. The questions were set at different levels of knowledge.

Specific facts are "facts that referred to details of specific theories and findings highlighted in the course" (Conway, Cohen & Stanhope, 1991, p. 398). They are related to a restricted setting. Example test questions include "Where was the Convention signed in the 19th century which protects literary and artistic works?" and "The Hong Kong Ordinance on Copyright was substantially revised in which year?"

General facts and rules are the "more global aspects of theory" (Conway, Cohen & Stanhope, 1991, p. 398). Rules are general facts in this sense as they are set procedures that are true in a wider context. Questions that fall into this category include: "Printing out any records or articles from the electronic resources subscribed by the Library will infringe the copyright; True/ False?" and "Copying by a person for research is fair dealing if the copying will result in copies of the same material being provided to more than one person at the same time and for the same purpose; True/ False".

Concepts are explanations and definitions of theories and ideas, and clarifications of the linkages between these theories and ideas. They are "highly familiar, generalized knowledge which students tend to simply know" (Herbert & Burt, 2004, p. 78). Test questions in the course concerning concepts include "Which of the following actions is regarded as plagiarism?" and "Leaving out some words in a quoted passage without any indication is plagiarism; True/ False?"

Lastly, there are questions that required application of knowledge, and students were asked to make decisions based on theories and concepts learnt in highly-specific situations. For example, there are questions "You want to set up a factory in Shenzhen to make a black and gold-coloured pen, and you want to call the pen a 'MAN BLANK'. Which of the following would you need to check?" and "You want to use a photograph of a painting by Leonardo Da Vinci (1452–1519) in your dissertation. Who owns the copyright?"

Table 2 illustrates the relationships between the content themes of the questions and their respective knowledge levels.

Table 2: Categorization of the exam questions.

Knowledge levels	***Content themes***	***Questions***
Specific facts	Copyright around the world Copyright in HK	6, 7, 8, 9, 11 5
General facts & rules	Permitted act for research & private study in HK	13, 14, 15, 16, 17, 18, 19, 20, 25, 27, 28, 29, 30
Concepts	Avoiding plagiarism	12, 21, 22
Applied knowledge	Intellectual property & copyright	1, 2, 3, 4, 10, 23, 24, 26

4.4 Evaluation Strategies

CUHK is a strongly face-to-face university in its teaching style and e-learning is not used extensively (McNaught, Lam, Keing & Cheng, 2006). It is therefore especially important to evaluate innovations, especially in courses that are conducted totally online. We devised an evaluation plan which is composed of multiple evaluation instruments. The evaluation questions that interested the course organizers include: accessibility – whether students can readily access the course; learning – whether students can learn the concepts of the course effectively through online means; and retention of learning – whether the learning is retained.

Concerning accessibility, the research team kept detailed records on the access and activity logs of the students' visits to the various pages on the site and their attempts at the tests. We will illustrate this aspect by quoting the logs kept in the eight cohorts across two academic years (2004–05 and 2005–06).

Regarding students' learning, the data came from students' test scores and their opinions elicited through surveys conducted in the same eight cohorts in the academic years 2004–05, and 2005–06. The surveys collected students' feedback on how much they valued the course, and how much they thought they learnt from the course.

Lastly, regarding retention of knowledge, two attempts to invite students to take retests were carried out. During the 2004–05 academic year, the first trial of this study was carried out. The retest was launched in June 2005 for both students in Groups 1 and 2 in the 2004–05 cohort. Group 1 students originally took the online course test in October 2004 and the original test period of the Group 2 students was December 2004. Therefore, there was a time gap of six to eight months between the first time the students did the test and the retest. The content of retest was the same as the original examination, and consisted of 20 multiple choice questions randomly selected from a pool of 29 questions.

The retest received a relatively low completion rate in the first trial: 16.5% (52 did the retest out of the 315 students who were in either Group 1 or 2 and had taken the original test). Thus, in order to boost the response rate, a lucky draw prize ($HK500 – ~Euro51 – book coupon) was offered in the second trial in the 2005–2006 academic year.

The second study was launched in March–April 2006. This time we invited students in Groups 1 and 2 of the 2005–06 cohort to take the retest. The original test period of the 2006 Group 1 was 3–28 October 2005 and that of the Group 2 students was 21 November–16 December 2005. Thus, the time gap between the exam and the retest ranged from three to six months. The retest invitation was sent to those Group 1 and Group 2 students who had taken the course test. No retest invitation was sent to those who did not take part in the examination. The number of students who received the invitation of retest was 387. Reminders were sent twice. At the end, there were a total of 148 retest participants. The completion rate for the second trial is 38.2% (148/387).

5 FINDINGS

The online course was readily accessed by students. For example, in the academic year 2005–06, the 571 students who took the course and finished the online test had visited the site (recorded by the counter on the first page of the site) a total of 5,786 times, meaning that each student on average accessed the site 10.1 times. The counters on the 28 course

content pages, on the other hand, recorded a total of 119,034 visits. Thus, on average, each student accessed these pages 208.5 times to prepare for the course-end test. Most students who registered the course actually finished it. A total of 1,278 students registered for the course in all the eight cohorts, and among them 1,134 successfully completed the course-end test. The completion rate was 88.7%. Overall, students answered 17.8 questions correctly out of the 20 attempted questions, a percentage score of 88.9%.

A total of 1,120 students answered the opinion survey attached with the course-end test (out of the 1,134 students who completed the course; response rate being 98.8%). The students were assured that their feedback on the survey would not in any manner affect their scores on the test. The survey in general affirmed that the course was overwhelmingly welcomed by students. For example, the average score on the question "The modules achieved the stated objectives" was 4.0 in a 5-point Likert scale in which 1 stands for strongly disagree and 5 means strongly agree. This is very high for a compulsory module.

The following sections explore the performance of a subset of the students (the 200 students who completed both the test and retest in our two study trials) in their learning and retention of the knowledge acquired in the course.

5.1 Learning of Knowledge

The learning outcomes of the students can be gauged by the performance of the students in their original course-end tests. The 200 students performed very well in the original test, achieving a percentage score of 93.4% among the questions they attempted.

Their scores of each of the knowledge levels were slightly different, though still very high in general. They scored, on average, 91.3% correct in questions that were about specific facts, 93.7% in the questions about general facts and rules, 97.4% in questions on concepts, and 93.0% in questions about applied knowledge. The distribution of the marks is illustrated in Figure 2. It is also noted that the performance of the 52 students in the first 2004–05 study trial in general showed the same pattern as that of the 148 students in the second 2005–06 trial.

One-way ANOVA found that the between-group differences were statistically significant at the 0.01 level. Post-hoc Scheffe tests were then carried out which established that the main difference was from the exceedingly high marks on the concepts

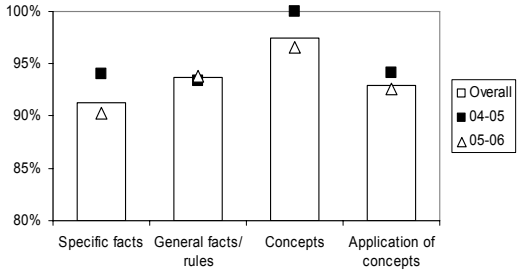

Figure 2: Performance in different knowledge levels.

category. The differences between students' performances on questions related to concepts and those in questions related to other knowledge domains were all statistically significant at the 0.05 level.

5.2 Retention of Knowledge

Retention of knowledge was investigated by comparing the 200 students' performances in their original tests and re-tests. Paired-sample *t*-tests were used to test for any differences between the mean scores of the examination and the retest.

Although the first trial of the study in 2004–05 had a much lower response rate than the second test–retest study in 2005–06, the two set of results were actually very similar.

In 2004–05, students scored on average 94.4% in their original test while they scored 78.0% in their postponed retest. In 2005–06, the scores were 93.0% and 77.9% respectively. Overall, the 200 students scored 93.4% and 77.9% in their original tests and retests. The result from the paired-sample *t*-test revealed that the differences between these original test scores and retest scores are statistically significant at the 0.01 level.

It is worthwhile to note that although the students' performance in the retest declined significantly; nevertheless, their performances were quite reasonable, with an average percentage score of 77.9%.

A closer look at the data on the various knowledge levels revealed the patterns portrayed in Table 3 and Figure 3.

Table 3: Retention by knowledge domains.

Knowledge domains	***Exam***	***Retest***	***Diff.***
Specific facts	91.3%	52.7%	**38.6%**
General facts and rules	93.7%	81.2%	**12.5%**
Concepts	97.4%	87.1%	**10.3%**
Applied knowledge	93.0%	82.5%	**10.5%**

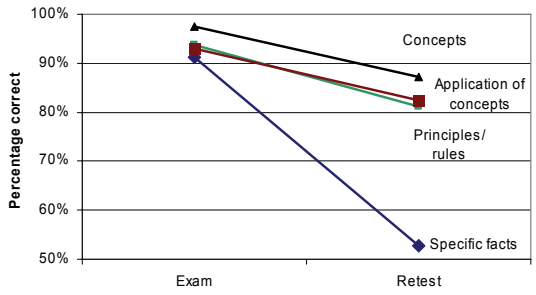

Figure 3: Decline in performance by knowledge domains.

The data show the sharpest decline in performance on question items that relate to specific facts when compared with the other knowledge domains. This was a 38.6% drop (91.3% to 52.7%) while the declines in performances in the other three questions levels were only 12.5%, 10.3% and 10.5%, respectively. This represents more than three times the percentage change when compared with the other changes.

6 DISCUSSION

The online module appears to be an effective learning tool. The scores on the original tests were all very high, showing that e-learning is good not only in delivery of facts, but also in explaining concepts (in fact, students' scores on the questions related to concepts were the best), and teaching applied knowledge.

Students performed slightly worse in the retests than in the first tests. Compared with the very high scores in the original test, students' scores in the retests were clearly poorer. This drop in scores, however, is quite expected as time is always regarded as affecting retention of knowledge. In fact, students still managed to achieve relatively good performance in the retests and this shows that e-learning can have extended effects on students' learning, contrary perhaps, to the observations of Bell, Fonarow, Hays and Mangione (2000), who found material learnt on computer is not retained; but more or less in line with the position of Yildirim, Ozden and Aksu (2001) that e-learning can produce long-term learning. While this small study in no way solves the ambiguity in the research literature, it does contribute to our understanding.

While students generally found all categories easy (above 85% of the answers in all categories were correct), they found one category increasingly more difficult as time passed. This is the category of specific facts. Students differed in their retention of different forms of knowledge. Knowledge of specific facts tended to drop to a far greater extent than learnt knowledge in the other domains. The decrease of scores in this category significantly outnumbered those in the other categories, dropping more than 35% while the other declines were in the 10% level. Unrelated facts are difficult to remember in traditional classroom teaching (Conway, Cohen & Stanhope, 1991) and we now have evidence that, although e-learning can be used to disseminate facts, facts learnt in 'e-classrooms' are not retained over time. There is thus a resemblance between knowledge retention in the two learning environments.

Education is concerned with the development of the higher cognitive reasoning skills rather than memorization of facts and unrelated concepts. The findings of this study seem to support the role of web-assisted teaching as not being limited to delivery of isolated facts and information. The web can be effective in facilitating learning at higher levels. Knowledge of isolated specific facts is not retained while acquired knowledge concerning more general rules and concepts, and their applications, appears to be more worthwhile as the focus of online materials.

The findings of the study provided timely feedback to the development team about which questions in the module to consider for revision and how we might refocus some of the information in the module. There have thus been tangible benefits from the study.

The present study has clear limitations. First, the delayed retests took place after a relatively short period of time (three to six months) and so the retention pattern of these various forms of knowledge in a more extended period of time is largely unknown. Nevertheless, many previous studies have shown that the period immediately after the learning activity is actually the most critical as this is when the decline in knowledge retained is most serious (Bahrick, 1984; Bahrick & Hall, 1991; Conway, Cohen & Stanhope, 1991). Second, we are aware of the fact that many factors, such as individual differences, prior knowledge of learners, content organization and structure, etc., affect learning and memory retention (Semb & Ellis, 1994; Semb, Ellis & Araujo, 1993). The present study on a single online module utilizing one specific way of content design is far from being able to make any

general claims about retention of knowledge forms in e-medium learning environments.

7 CONCLUSION

The study confirms that e-learning can be an effective tool not only in the dissemination of facts, but can also effectively explain concepts and assist students in applying knowledge. Specific factual knowledge is hard to retain. The findings of this study suggest that the role of e-learning, just as the role of traditional teaching, should focus on concepts and applied knowledge rather than on memorization of facts alone.

The data from this study come from one course alone and so must be treated as indicative. Further studies in a range of discipline areas are warranted.

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