Acquisition of simple and complex knowledge; a knowledge gap perspective

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ABSTRACT

This paper assesses university students' acquisition of simple and complex knowledge, in exploring whether the knowledge gap hypothesis (KGH) with its origins in community-based research into people's informal learning from mass media, provides insights into students' acquisition and retention of information. The KGH posits that attempts to equalise knowledge within a community by releasing new information into it often either has no such effect, or even worsens knowledge inequities. The present study set out to discover if members of a diverse student class, when presented with the same course-related information, both simple and complex, acquired knowledge at similar rates. After formal university education, those with less prior education acquired less knowledge from the same learning opportunities than those with more prior education at each survey point. Second, although entry education level led to different learning outcomes initially, those with less prior education did subsequently achieve the same level of knowledge as those with more prior education. The paper finally reflects on whether existing KGH claims, based on informal education through the media, apply in a formal education environment.

Keywords

Knowledge gap hypothesis, Simple and complex knowledge, Acquisition of information, Knowledge inequalities, Student learning

Introduction

A key pedagogical issue in teaching diverse groups of students, especially in a tertiary educational setting currently attracting large numbers of international students from many cultures, is to determine how successfully differing subgroups access and retain course-related information. Traditionally, successful knowledge acquisition and retention are measured by assessment results but this does not reveal the influence of specific factors such as prior educational attainment. The potential contribution to this issue from the knowledge gap hypothesis (KGH) (e.g., Tichenor et al., 1970; Eveland & Scheufele, 2000) is the light it has shed on unequal learning outcomes in informal learning such as in a community context. Distribution of information into a given population, even with the intent to equalise disparate knowledge within it, often has the opposite outcome to that intended. That is, inequality of knowledge among respondents either may not be reduced or is even worsened by such information, perhaps because "information-rich" (those with better possession and command of information) more successfully access and employ new information, in contrast to the "information-poor" (who may lack access to information or the skills to maximise its usefulness).

The present study sought to discover if members of a large, diverse class of students, when presented with the same information, acquired and retained that information at a similar rate, or if there were significant differences by subgroups, and if so, what might be the nature of those differences. In particular, we wished to determine any influence of prior educational attainment on knowledge gaps, given that much KGH research has used respondents' education level as a key differentiator within samples (e.g., Tichenor et al., 1970). The socio-economic status (SES) of students was not investigated primarily because entry to university is usually based on

prior education not SES. In addition, many KG researchers oppose the idea that SES significantly determines ability to learn (Dervin, 1980; Viswanath & Finegan, 1996).

Knowledge gap theory has also examined acquisition and retention of simple versus complex knowledge (Genova & Greenberg, 1981; Ettema et al., 1983). Intuitively, one might expect that students who possessed lesser ability or experience (such as those with less formal preparation for tertiary study) might acquire simple rather than complex knowledge, while students of greater ability or experience would be better able to access complex as well as simple knowledge.

A general aim was to assess whether the KGH findings identified in mass media studies (e.g., Dervin, 1980, Gaziano, 1997) also apply to the tertiary education experience. Considering the role of education as a discriminating factor in informal learning contexts, the absence of KGH-specific research based within formal learning environments, e.g., tertiary education, is surprising. A catalyst for this study was some researchers' observations (Chew & Palmer, 1994; Weenig & Midden, 1997) that as prior education influences informal learning, formal learning environments should also be explored to see if new information worsens or improves the knowledge inequities based on pre-entry education.

Literature Review

Knowledge gap theory arose from attempts to evaluate public information campaigns (e.g., public affairs and health education) where, despite campaign designers' intentions and best efforts, the public did not become equally informed. The theory evolved as researchers tried to explain these unexpected results and tested their theories in different contexts (Viswanath, Kahn, Finnegan, Hertog, & Potter, 1993; Weenig & Midden, 1997). A contentious aspect of KG theory is that those at the lower end of the socio-economic spectrum do not acquire the same level of knowledge as those in upper socio-economic groups and, moreover, attempts to equalise knowledge gaps within a community by releasing information into it, in fact may widen rather than lessen knowledge gaps (Viswanath & Finnegan, 1996). The implication, to which many researchers have taken exception, is that socio-economic status (SES) strongly affects ability to learn (Dervin, 1980; Viswanath & Finnegan, 1996). Their unease is justified particularly because in previous research SES has often been inferred on educational attainment rather than financial or status criteria. Key elements in the KGH are its assumption of "the initial existence of a gap in knowledge between society's 'haves' and 'have-nots'" (Eveland & Scheufele, 2000, p.216) and mass media campaigns' tendency to exacerbate pre-existing gaps. Using education level to indicate socio-economic status (SES), Tichenor et al.'s (1970, p.159) landmark study named unequal uptake of information disseminated by the media, as a 'knowledge gap' and observed that "increasing the flow of news on a topic tends to greater acquisition of knowledge on that topic among the more highly educated segments of society". Importantly, knowledge gaps are defined as "differentials in information acquired and retained by people through a learning process" (Gaziano, 1997, p.238). Much research has sought to isolate reasons for knowledge gaps. Gaziano's 1983 survey (cited in Chew & Palmer, 1994) and Viswanath and Finnegan's (1996) review of 25 years of research showed conflicting evidence: some studies demonstrated widening gaps, others showed narrowing gaps, while in others the gaps remained.

Dervin (1980, p.76) observed that the KGH undermined the assumption "that the presence of information serves as an equaliser". Moreover, Haywood (1995, p.65) contends that "most publicly financed education systems have to assume that we all start from the same point" despite evidence that this does not hold for the rest of the population (Mastin, 1998). This paper acknowledges concern in the literature (Chew & Palmer, 1994; Weenig & Midden, 1997) that if education is important in informally acquiring new information then education processes need investigation to ascertain any presence of knowledge gaps, with particular reference to acquisition and retention of simple versus complex knowledge in relation to prior educational attainment.

Simple and Complex Knowledge – Acquisition and Retention

At issue in formal education is the complexity of information offered for learning. Indeed, this dimension has received some attention in informal community learning. Studies have considered the type of knowledge gained, differentiating between simple or superficial knowledge of facts, and complex, structural or deep knowledge of relationships among facts (Genova & Greenberg, 1981; Ettema et al., 1983). Gaziano (1984, p.562) simplifies these as "knowledge of" and "knowledge about". Spitzer and Denzin (1965) show that those with the most superficial level of knowledge used fewer, mostly interpersonal, information sources. When simple knowledge is acquired, it is not necessarily retained over time. Price and Zaller (1993) found that knowledge retention was

affected by the level of prior knowledge, Snyder (1990) thought it was influenced by education level, Chew and Palmer (1994) identified interest over education level, while Griffin's (1990) research indicated the interdependence of interest *and* level of educational attainment. In a further thread, Moore (1987), Wanta and Elliot (1995) and Gaziano (1997) established that over time knowledge gaps between more and less educated remain constant or narrow on simple issues, but widen on complex issues. Educators Ramsden (1992) and Biggs (1999) confirm that "surface" learning of isolated facts is often associated with misunderstanding principles and a weak long-term ability to recall detail. "Deep" learning, which focuses on main ideas and underlying meanings, is associated with the integration of new and prior knowledge and the ability to apply these ideas in new situations.

Prior Educational Attainment

Level of educational attainment is dominant in the KGH literature as a differentiating factor, following Tichenor et al.'s (1980) assumption that education provided information processing skills and ability to see the relevance of information, thereby accounting for knowledge gaps. Nearly all findings associate greater knowledge acquisition directly with higher educational achievement or indirectly through higher levels of prior knowledge that education provides. However, level of education has not influenced knowledge gain in all studies (Genova & Greenberg, 1981). Viswanath et al. (1993) noted that education determined people's exposure and attention to information, a prerequisite for acquiring knowledge. Wanta and Elliot (1995, p.313) contended that "Education influences knowledge gain since it is associated with better comprehension, retention, communication capabilities and higher levels of previously stored knowledge". Interestingly, Fischer et al. (1996) contend that those in the top academic classes at school are taught that knowledge is to be *used*, while those in the bottom academic classes are taught to *remember* what is presented to them. This is supported by Mastin (1998, p.514) who, approaching the topic slightly differently, notes, "Individuals who do not frequently interact with information as a problem solver, or as a knowledge enhancer often do not perceive information as a valid commodity". Weenig and Midden (1997) investigated whether if allowed more time, those with less education would achieve the same level of new knowledge as those with more education, but found they did not. They ascribed the differences to a lower degree of attention among the lower educated, rather than motivational or cognitive differences.

Studying Knowledge Gaps in Information Systems (IS) Learning

Considering prior knowledge gap research has mainly addressed informal learning in mass communication, then, what might be found within a tertiary environment in respect of possible gaps in formal learning practice? Because entry to tertiary education is voluntary and relatively expensive, we assume students motivated to enrol in IS courses in this way define their interest in the subject. Further, because IS is vocationally oriented, we also assume that students consider the domain knowledge is useful to them. Enrolment in these classes also places students alongside others who consider the subject relevant. A further assumption is that the opportunity to formally explore IS courses in lectures and tutorials, as well as informal discussions with staff and classmates, should improve the likelihood of acquiring deep, structural knowledge about the IS programme, because course content relates to or leads onto other IS courses. For these reasons, namely students' study motivation, their presumed view of information usefulness, and their opportunity to discuss information with others, we assume that university education potentially provides a more equal environment for acquiring equivalent levels of knowledge, compared to informal community learning.

Methodology

With the introduction of a new programme of IS courses at Massey University's Auckland campus the KGH framework appeared an appropriate way to evaluate the effectiveness of disseminating programme information. The classes are large (between 100 and 300), and the ability to survey students at lectures enhanced the possibility of a high response rate. A wide range of ages and educational backgrounds are represented in each class, and although instruction is in English, only 39% of the class speak English as their first language with 31 other 'first' languages spoken by students representing 28 different cultures. The dominant composite cultural group represented is Asian (41%) with European New Zealanders, the majority in the community, a minority in this environment (28%). This allowed a variety of factors to be explored; however knowledge acquisition and retention did not differ greatly between these two groups. In addition, the students could be surveyed at several points throughout the academic year, permitting a longitudinal study. In the present study the student population

includes graduates from secondary school, persons with some tertiary education, those with a previous tertiary degree, and "second chance" individuals admitted to university (though not having graduated from high school) over the age of 21 years. Therefore, students represent a wide variety of educational attainment.

The knowledge domain investigated was the programme of courses offered in the new IS programme and the inter-relationship of courses. This research was designed to inform IS students of programme developments, with knowledge gap theory providing the framework to measure effectiveness of these information interventions, while also exploring the applicability of knowledge gap theory in formal education. The information was prepared after discussion by one author with IS colleagues, and was designed to meet the University's expectations for what students needed to know when planning their course of study, i.e., the names and numbers of relevant courses, what the courses are about and how they build upon one another, as specified by prerequisites.

The investigation measured acquisition and retention of simple and complex knowledge at varying levels of complexity using surveys at three points in second year (US-junior equivalent) IS classes over a seven-month period. Information describing IS subject areas, and individual courses covering aspects of the discipline, appears in university enrolment packs, handbooks and the website. In addition the information was distributed to students during the investigation, describing a discrete set of 13 IS courses, their names, numbers and how they related to one another. This course information is not difficult to understand, and students had completed the first year IS course and surveyed over a period during which they were likely to be enrolled in up to four 2nd year IS courses. Potentially all students were capable of learning all this information over the two semesters when information was given out. Therefore, theoretically any knowledge gaps could reduce to zero as less knowledgeable subgroups caught up. We assumed, as stated earlier, that exposure to the academic content of courses would result in improved knowledge of the programme. In addition, the surveys captured demographic data, information about student motivation and interpersonal communication practices.

Survey Characteristics

Two courses were surveyed, one each semester. Students were surveyed at the first and last lectures in semester one and at a lecture halfway through semester two. The first semester course, 157.225 System Development: Analysis *(Analysis)* is a compulsory course for several different subject majors in the information technology (IT) field, with a prerequisite of the IS 1st year course. The second semester course, System Development: Design *(Design)*, is always smaller because although it continues on from the first semester course, it is elective and requires a pass in its only prerequisite, Analysis. These two second year courses are prerequisites for three third year courses (US-senior equivalent). The characteristics of the surveyed courses are summarised in Table 1.

Table 1. Survey Dates and Response Rates

Course	Survey Date	Class Size (A)	# at Lecture (B)	% at Lecture (B/A)	# Surveys returned (C)	Survey Response Rate (C/B)	Class Response Rate (C/A)
Analysis	March 1, 2002	238	197	83%	194	98%	82%
Analysis	May 30, 2002	238	164	69%	146	89%	61%
Design	Sept. 11, 2002	165	89	54%	81	91%	49%

Student attendance at lectures declined as the year progressed. This is not uncommon. Some students enrol but never attend e.g., 17% did not attend the first Analysis lecture. Some students rely on the lecture notes posted on the course website and some withdraw during the semester. Therefore, because the investigation involved three surveys with different sized populations, N=194, N=146 and N=81, the survey groups were tested to see whether they appeared to represent the same population. The expectation, as mentioned previously, was that the class composition should be similar in the first and second semesters. Chi square tests employed five variables

(gender, age, education level, English as first language and cultural background) and supported the null hypothesis of no significant class differences over the three surveys.

The initial survey in Semester 1 revealed a low level of knowledge about the new IS programme, so extra explanatory material was provided in a lecture and posted to the class web site. This consisted of two diagrams, (one simplifying the prerequisite structure, one displaying semester availability) and a description of how IS courses comprised three main categories. The second survey at the end of Semester 1 showed an improved but still low knowledge particularly about inter-relationships among IS courses. Therefore, in Semester 2, a diagram of IS courses' categorisation was provided in a lecture and added to the web site.

Defining Simple and Complex Knowledge

Knowledge of course numbers and names (e.g., 157.225 Systems Development: Analysis), was considered to be *simple* **factual** knowledge. As students majoring in IS are required to take four courses (out of five) at 2nd year and four courses (out of eight) at 3rd year they must make choices. Therefore, they need to understand into which three specialist areas (described below) each course fits so they can select courses to specialise in one area, or to select from across all three areas. These three specialist areas are: an information system's organisational context; the developer activities required to produce an information system; and the major components for an information system. These three specialist areas reflect basic IS concepts which determine how an IS course relates to or leads onto other IS courses. In addition, entry to each 3rd year course requires passes in one or more 2nd year prerequisite courses. Both the categorisation of courses and knowledge of prerequisite requirements for 3rd year courses were considered *complex* **relational** knowledge.

When reviewing the simple knowledge content we expected that second year IS students would easily identify the 2nd year courses but would find identification of subsequent 3rd year courses more difficult. To reflect this differing level of difficulty, knowledge about 2nd year courses was considered as 'very simple' (VSK) and knowledge about 3rd year courses as 'simple' (SK). When reviewing complex knowledge content we expected that students would gain understanding of specialist IS areas from their current 2nd year courses and therefore find that less difficult than acquiring knowledge about entry prerequisites for 3rd year courses for their following year. Therefore, knowledge about the three specialist areas of IS courses was defined as 'complex' (CK) and knowledge about prerequisites for 3rd year courses was defined as 'very complex' (VCK). These decisions appear in Table 2 and the relevant survey questions are in Table 3.

Table 2. Defining Simple & Complex Knowledge

	Very Simple Knowledge (VSK)	**Simple Knowledge (SK)**	**Complex Knowledge (CK)**	**Very Complex Knowledge (VCK)**
Factual Knowledge	2nd year course names & numbers	3rd year course names & numbers		
Relational Knowledge			Classification of 2nd & 3rdyear courses into three main areas	2nd year prerequisite courses for each 3rd year courses
Justification	Students beginning 2nd year expected to have knowledge of 2nd year courses available.	Students beginning 2nd year may have less knowledge of 3rd year courses available	Students proceeding through 2nd year expected to understand the specialist areas into which IS courses fit	Students proceeding through 2nd year may have less understanding of prerequisites required for later enrolment in 3rd year courses.
	Easy to identify	**Less easy to identify**	**Easy to under-stand**	**Less easy to under-stand**

Factual Knowledge: VSK	List the names and numbers of all the 2nd year IS courses you know about.
SK	List the names and numbers of all the 3rd year IS courses you know
Relational Knowledge: CK	How would you categorise the IS courses? Write the name and/or number of each 2nd and 3rd year IS course beside the appropriate category: Organisational context of a system, Developer activities to
VCK	Each 2nd year IS course leads on to one/more 3rd year courses. List the names and/or numbers of prerequisite 2nd year courses for each 3rd year

Table 3. Survey Questions to Determine Student Knowledge Acquisition

Averages, Standardised Scores, Moderated Scores and Gaps

Respondents provided three kinds of information: accurate knowledge, inaccurate knowledge, or no knowledge at all about some topics. Because inaccurate information may lead to inappropriate decisions, it was considered misleading to evaluate only accurate knowledge. Therefore, the knowledge scores used throughout this study are *moderated scores* meaning that the accurate knowledge score (gross) less the inaccurate knowledge score equals the moderated knowledge score (net). Thus, the knowledge scores and knowledge gaps discussed here are a conservative estimate of student knowledge, since for the sake of providing a means to calculate overall knowledge, inaccurate knowledge has been subtracted from accurate knowledge. *Standardised scores* (out of 100) represent student characteristics e.g., level of knowledge.

Table 4. Defining Knowledge Scores

	VSK	SK	CK	VCK
Accurate Knowledge	2nd year course names & numbers 2 pts x 5 courses = 10	3rd year course names & numbers 2 pts x 8 courses = 16	Classification of courses 1 pt x 13 courses = 13	2nd year prerequisites for 3rd year courses 1 pt x 13 prereqs. = 13
Inaccurate Knowledge	1 point for each piece of inaccurate information			
Moderated Knowledge Score	accurate knowledge score less inaccurate knowledge score = moderated knowledge score			
Standardised Knowledge Score	(moderated score / possible score) * 100 = standardised knowledge score			
Standardised Total Knowledge Score	(accumulated moderated scores / total possible score) * 100 = standardised total knowledge score			

These decisions are summarised in Table 4. The *average standardised score* is used to calibrate most comparisons not only across simple and complex knowledge types but also against prior education. The average was chosen to indicate subgroup performance. A *knowledge gap* between two subgroups within the class was determined by calculating the difference between the average knowledge scores of those groups for each survey. Focusing on change in this difference over time reveals whether the education programme equalises knowledge between those groups. An increase in the gap could arise from the movement of one or both groups (up or down) with respect to each other in that period.

Exploring the Knowledge Gap Hypothesis

Initially knowledge scores and knowledge gaps were assessed for the whole class. The contours of the knowledge scores, for the class as a whole (Figure 1), suggest two trends over the surveys. First, a systematic decline in the *level* of knowledge occurs as knowledge complexity increases. Second, there is a discernible shift upward in knowledge scores as the class received IS information over time.

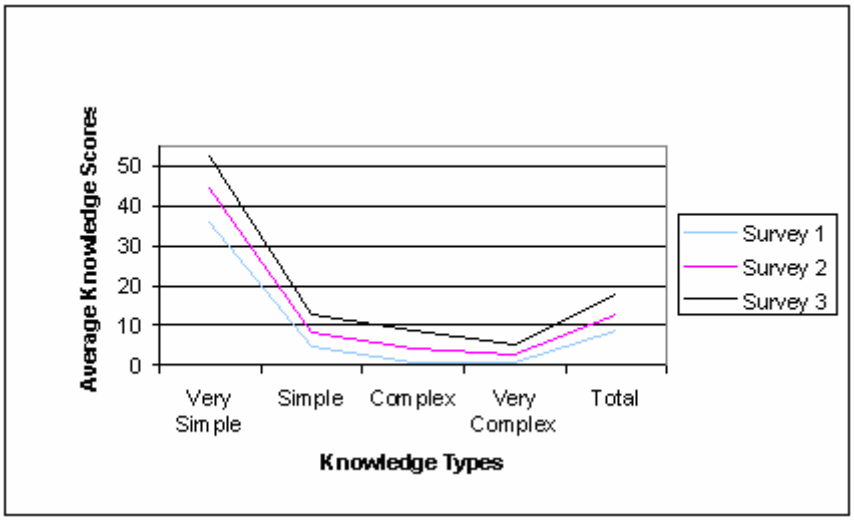

Figure 1. Comparison of Class Knowledge Scores at Each Survey

Education Level as a Discriminator

The KGH suggests that those with higher education are likely to acquire more knowledge than those with less education (Tichenor et al., 1970). Initially, the groups with the lowest and highest prior education were compared. However, although the proportion in each category remained the same in all three surveys, the absolute number who responded dropped to 5 and 15 respectively by the third survey. Consequently, we decided to combine the two lowest and the two highest categories and to test the hypothesis by comparing those who had received secondary education only and those with any level of tertiary education. The key issue is the extent to which absolute and relative changes in knowledge gaps are influenced by students' prior education (Figure 2).

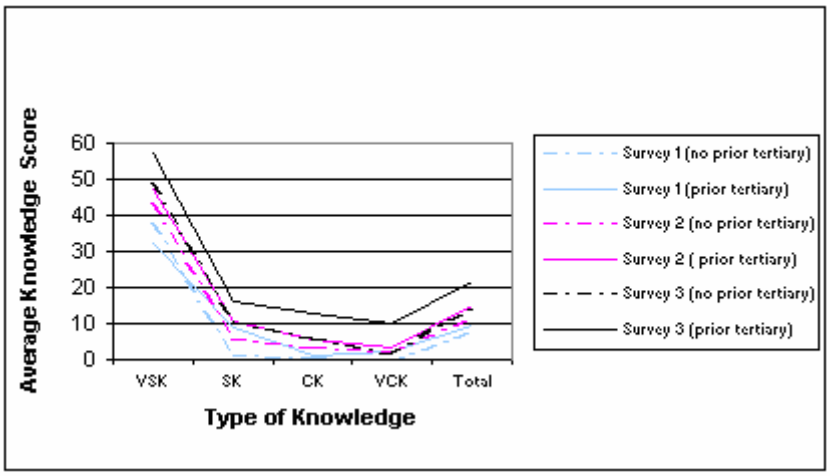

Figure 2. Knowledge Scores - With & Without Prior Tertiary Education

In the first survey little difference (approximately 2 points) occurred in total knowledge scores, however the gap widened by the third survey to approximately 7 points, as those with tertiary education acquired more total knowledge than those with secondary education. However, the knowledge scores also showed both groups not only retained knowledge (i.e., didn't have less knowledge than at the previous survey), but also continued to improve their knowledge level. Interestingly, the ability to answer questions at different levels of complexity appeared to be associated with a corresponding higher incidence of inaccurate knowledge. The implication of this is now considered.

Inaccurate Knowledge

The proportion of respondents attempting to answer the knowledge questions on each survey appears in Table 5. Almost all respondents attempted to answer the first (very simple) knowledge question although fewer attempted the remaining three questions. A marked increase in response levels for simple, complex and very complex knowledge questions was noticeable between the first and third surveys although answer rates for very simple and very complex knowledge peaked in survey 2.

Table 5. Percentage of Respondents Attempting Knowledge Questions

	VSK	SK	CK	VCK
Survey 1	91	27	12	18
Survey 2	100	56	27	57
Survey 3	96	73	66	46

However, this increased response rate to the knowledge questions resulted not only in knowledge gains generally but also in a higher proportion of people recording some inaccurate knowledge. An earlier study (Gaziano, 1997) associated a higher level of *inaccurate knowledge* with those with less education. In the light of this, we subdivided respondents into those with and without prior tertiary education to examine the percentage of each subgroup recording inaccurate knowledge. In all three surveys, a slightly smaller proportion of the less educated group recorded errors than those in the better educated group (Figure 3). This also revealed an unanticipated high percentage of respondents with inaccurate knowledge, so the error rate was looked at more closely.

The average error rate was calculated by dividing the total number of errors by the number of respondents recording one or more errors. The respondents with inaccurate knowledge in each survey were 27%, 54%, and 65% respectively.

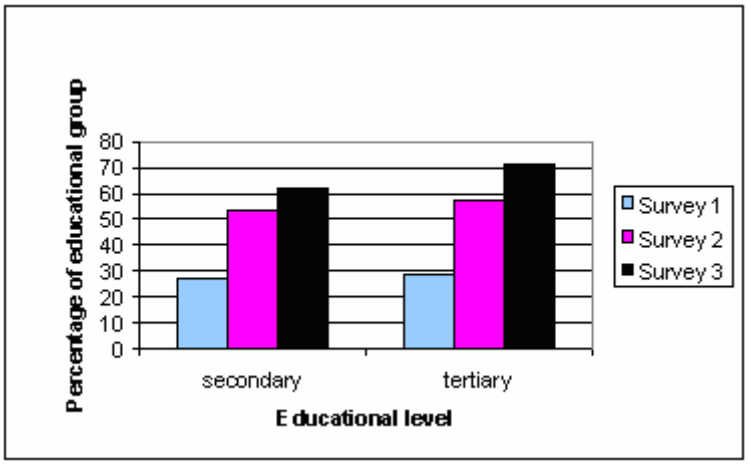

Figure 3. Percentage of Respondents with Inaccurate Knowledge

When the error rate of respondents with inaccurate knowledge is examined against prior educational level (Figure 4), the average error rate of the secondary educated group increased over the three surveys whereas the error rate of the tertiary educated group increased then decreased. More importantly, the average error rate range between both groups varies little at each survey (0.3 –0 .4), suggesting that previous educational attainment does not strongly influence current knowledge inaccuracies. Although the group with more prior education increased its knowledge score by 12 points compared to the increase of 7 points by the group with less prior education, as shown in Figure 2, prior educational attainment does not affect the *accuracy* of knowledge acquisition.

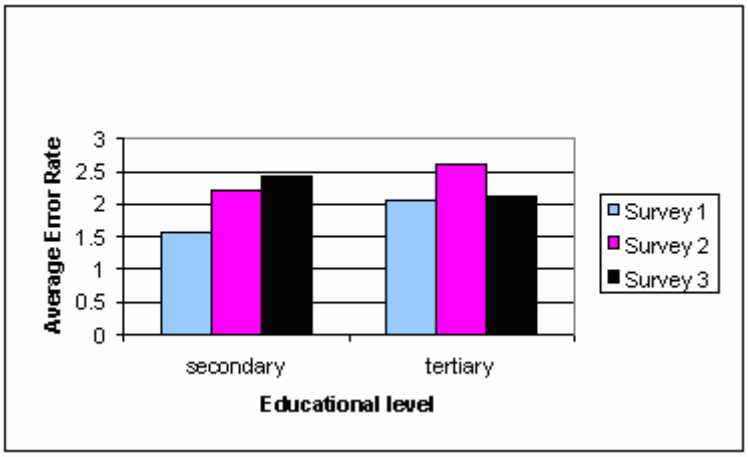

Figure 4. Average Error Rate of Respondents with Inaccurate Knowledge

Discussion

This investigation differs from previous knowledge gap research in four ways. First, the population studied is specialised, being the tertiary education sector in New Zealand and students in IS. Prior education level would place most university students at the top of the population, and they could be regarded as 'information-rich'. However, within this group a range of values exists.

Second, investigating knowledge gaps in formal education represents a different environment compared to informal learning, the main earlier focus. This formal education environment posed both challenges and opportunities for method. Most immediately, existing tenets of KG literature must be reinterpreted for university and IS scene in New Zealand. On the other hand, the formal environment permitted a longitudinal study, enabling more thorough investigation than usually possible in KGH studies.

Third, the traditional 'simple' (factual) and 'complex' (relational) knowledge were extended to include 'very simple' and 'very complex' knowledge. This was because, unexpectedly, one of the factual knowledge questions was easier to answer, and one of the relational knowledge questions was also easier (Table 2). The 'very simple' scores were consistently higher than the 'simple' scores, despite both questions being factual knowledge not relational knowledge.

Fourth, the longitudinal approach was successfully operationalised. Of paramount importance to the investigation was having sufficient information about the students surveyed (in addition to their knowledge scores) to better define characteristics of each surveyed subgroup. Survey data collected enabled a common population across the three surveys to be statistically verified and allowed subsequent analysis to proceed in reasonable confidence that changes in scores reflected prior education and were not aberrations resulting from exits from and new entrants to the class.

The Knowledge Ceiling

As earlier noted, the information distributed comprised a description of a 13-course IS programme along with details of how courses inter-related. The specifics of this information meant all students could acquire all of these facts (i.e., reach the knowledge ceiling), so knowledge gaps among subgroups theoretically could reduce to zero as the less knowledgeable caught up. This did not occur and there are several possible explanations.

Although courses are described by course name and number in all formal university contexts, identification of courses within departments is much more casual. For instance, while the University Calendar may list 157.225 Systems Development: Analysis (where '157' indicates an IS course), staff and students refer only to '225' in normal conversation. This informal convention may have influenced the ways students answered the two simple knowledge questions asking for the name *and* number of each course. As many students provided both as requested it is hard to know if those who gave the number only, did so because they were following this informal convention, or whether they didn't know or remember the course name. Consequently, it is likely that those

surveyed knew more simple knowledge about the courses than they recorded. This did not impact on responses to the two complex knowledge questions because those questions asked for course name *or* course number.

Second, in the past many students may have enrolled in IS courses without knowing what the discipline was about, other than "IT". The present study grew out of a concern that students understand the content and relevance of the IS programme to enable them to make informed enrolment choices. Therefore, the material disseminated was prepared following collegial discussion, and it could not be more simple or less complex without being trivial.

To encourage student responses, (i.e., to avoid concerns about additional assessment) course content was not directly addressed in the surveys. Although the knowledge domain was descriptive material about the IS programme rather than course content, participation in courses should also improve understanding of other courses and how they interrelate. But knowledge about the IS programme is of course not assessed in examinations, and in today's pressured academic environment non-examinable material is unlikely to motivate student study. As one mature student who answered the questionnaires said, "I'm sorry I didn't answer all the questions but I know where the information is and I'll look it up when I need it."

Access to student classes for surveys must go via the University's Human Ethics Committee, whose permission is granted only for research deemed of sufficient merit. The introduction of the new IS programme and the opportunity to survey a sizeable student population over seven months encouraged the use of a comprehensive questionnaire. Therefore, a range of issues potentially relevant to tertiary education were incorporated resulting in surveys of 20, 25 and 19 questions respectively. This questionnaire length may have influenced some respondents to skip the knowledge questions and to answer what may have appeared as the easier, multiple-choice questions.

IS staff often comment on a general recent decline in student essay writing ability across all cultural groups. Further, students strongly prefer multiple-choice tests. Therefore, a reluctance to write answers may have been as much a factor in the low answer rate for the knowledge questions, as the length of the questionnaire. So although reaching the "knowledge ceiling" was possible for all students, the reasons outlined above may explain why no respondents achieved this.

Finally, the survey results were echoed by student academic performance. Although the simple knowledge scores were low and the complex knowledge scores were even lower, these results were mirrored in the mid-semester tests of student mastery of course content where less than half the class passed each semester's first test. Although these surveys evaluated a different (albeit related) knowledge domain, the students' academic performance is consistent with the survey results and can therefore (with caution) be extrapolated to the wider domain.

The Influence of Prior Education

Students possess a range of educational backgrounds, from only secondary education to completed prior tertiary education. Comparing knowledge scores of the secondary educated and the tertiary educated revealed that (with the exception of very simple knowledge at survey 1), those with tertiary education acquired more knowledge at all three surveys**.** This reinforces earlier findings (Tichenor et al. 1970; Tichenor et al. 1980; Viswanath et al. 1993) where lesser-educated people gained less knowledge. However, our results differ from others (Moore, 1987; Wanta & Elliot, 1995; Gaziano, 1997), which considered retention of simple and complex knowledge over time (although it is unclear what time frames they used). Those studies found that gaps in simple knowledge between more and less educated remained constant or narrowed but the gaps in complex knowledge widened. In our study, the gaps in both simple and complex knowledge narrowed over three months but widened over seven months. Nevertheless, both groups improved their knowledge scores at each survey, across all knowledge types (except that the less educated did not retain their level of very complex knowledge at survey 3). So, although the secondary educated may acquire both simple and complex knowledge more slowly than those with prior tertiary education, they do retain that knowledge over the longer term. However, a 'lag effect' emerged suggesting that the secondary educated subgroup can catch up with the tertiary educated over time. This contrasts with Weenig and Midden's (1997) finding that more time made no difference to knowledge levels acquired by the less educated. Nevertheless, we found that overall, the KGH (that knowledge gaps between more and less educated widen over time) applies to these students at specific survey points.

Inaccurate Knowledge and Prior Education

As this investigation progressed, more respondents attempted to answer the knowledge questions, which mirrored the increase in knowledge levels. Two patterns appeared. Most importantly, as the percentage of respondents attempting to answer each question rose at each survey, the percentage of each educational subgroup committing errors also rose. Second and consequently, the range of average error rates of these 'inaccurate' respondent groups within each survey (0.3 – 0.4), and the range within each group across all surveys (0.5 – 0.8) were very narrow. Therefore, in this study, educational attainment level does not appear to influence either the proportion of the subgroup that records some level of inaccuracy or their error rate, thus does not support Gaziano (1997) who found that those with less education have a higher level of inaccurate knowledge.

Conclusion

This paper explored two key questions. Do knowledge gaps revealed in informal education by the mass media, also occur in tertiary education? Are university education outcomes influenced by entry education level? Investigating effects of introducing new university courses provides tentative answers. The study transferred knowledge gap theory from its original context of informal education of the general population, to a university context evaluating outcomes of formal education of a more highly educated group. The findings fall into four categories.

First, some results supported the KGH, with those possessing less prior education acquiring less knowledge than those with more prior education. The secondary educated acquired less knowledge than the tertiary educated in the same period, i.e., the knowledge gap widened.

Second, several results did not support aspects of knowledge gap theory. Earlier findings suggest that even when given more time to acquire knowledge, the less educated were not able to achieve the same level as the more educated. However, our study found that over seven months, although the tertiary educated kept ahead, the secondary educated appeared able to match the very simple, complex and total knowledge levels of the tertiary educated in the subsequent period. That is, at survey 2, secondary educated reached the survey 1 level achieved by tertiary educated, and at survey 3 they had reached the survey 2 level achieved by the tertiary educated. Also, previous studies have associated lower educational levels with acquisition of a higher level of inaccurate knowledge. In contrast, our study detected similar levels of inaccurate knowledge across educational levels.

Third, our results conditionally support theoretical claims that those with less education did not retain complex knowledge. In our study, both the secondary-educated and tertiary-educated groups retained complex knowledge after seven months and very complex knowledge after three months. However, although the tertiary educated also retained very complex knowledge after seven months the secondary educated did not.

Fourth, the study considered two new aspects of potential interest to KGH research, namely the intention of education and the categorisation of knowledge types. Whether education is formal or informal, presumably information disseminators intend to improve knowledge levels across the whole population. What this study showed, however, was that although levels of simple and complex knowledge generally increased over time, the increases were not very great. Unexpectedly, the occurrences of inaccurate knowledge also increased. But, as importantly, the numbers of people *able or prepared to respond* to the knowledge questions increased. An important aspect of knowledge acquisition and retention, therefore, is not just *how high* the level of knowledge is in the surveyed population, but in addition *how many* of the surveyed population have been able to acquire some knowledge.

Sub-classifications of simple and complex knowledge categories were created for this study using questions varying in difficulty. The level of student knowledge differed dramatically between very simple and simple knowledge. This opened up a greater level of detail about what knowledge the respondents had acquired and retained over time. The difference in the very simple and simple knowledge scores demonstrates how different questions can produce quite different results.

An impetus for this investigation was whether tertiary education can meet expectations of governments, when they "profess to see educational opportunity as the key factor in developing their human capital" (Haywood, 1995, p.60), and academic leaders, who declare "our priority is to reduce any barriers to students achieving an excellent university education" (McWha, 2001). The findings suggest that such expectations are not straightforward. Knowledge gaps observed after informal public education by the mass media have also been

observed after formal education at university. Those with less prior education acquire less knowledge from the same learning opportunities than those with more prior education at specific points in time. However, although entry education level leads to different outcomes initially, it does appear that over time those with less prior education can catch up. This is indeed good news – education can make a difference. Assessments, like surveys, are snapshots in time. This study highlights how the assessment process ranks students with their peers and recognises top achievement but does not necessarily measure or value the *progress* that students make in their educational journey.

Acknowledgements

We acknowledge input from IS colleagues and support from IS students who responded so willingly to three comprehensive surveys.

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