Computers and Students' Conceptions of Learning: The Transition from Post-Secondary Education to the Workplace

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ABSTRACT
Recognition that we live in a rapidly changing knowledge economy has led to an increased interest in lifelong learning. Workplaces are in need of employees who can learn new skills and adapt quickly to social and technological changes. Educational institutions are faced with the challenge of providing students with the knowledge and skills so that they may adapt successfully to job-related changes after completing their formal education. In this study, 445 post-secondary students were surveyed to assess conceptions of learning and their preparation for the workplace. Use of information technology was assessed in terms of skills, attitudes, skill development, and methods of learning. Results indicated that various conceptions of learning are associated with different perceptions of the learning environment, different perceptions of learning needs and skills, and with different perceptions of the demands of the future workplace. Unlike surface learners, deep and lifelong learners prefer to learn independently, use computers for more sophisticated tasks, value their studies, see the connections between their studies and future work, and conceive of higher-level applications for their computer skills. These results present many challenges for the design of educational programs.

Keywords
Approaches to learning, Conceptions of learning, Information technology, Lifelong learning

Introduction
Students entering the work world today face unprecedented challenges. Two of the most important of these challenges are: (a) the necessity to adapt to rapidly evolving demands for new knowledge, skills, and competencies, many of which were not anticipated during their formal education; and, (b) the need to learn information technology skills, both as an end goal and as a means for other learning. These challenges in turn present a challenge to educational institutions: how should students be educated to meet these needs? In addition, rapidly changing work environments, characterized by greater competitiveness in global markets, a need to reduce costs, and changes in technology place substantial demands on organizations and their employees (Watkins & Marsick, 1993). Now more than ever, students and employees must be prepared to undertake continuous and collective learning (Knapper & Cropley, 1991).

Lifelong Learning in the Knowledge-Based Economy
In the developed world, the basis of the economy has changed from manufacturing products to creating and managing knowledge. The ability to continue learning has become more important than the possession of any particular knowledge. Furthermore, with reduced numbers of managerial layers, greater skill levels and greater capacity to develop new skills are expected of employees. A lifelong approach to learning is now essential in meeting these ever-changing requirements.

The term lifelong learning was used 30 years ago by Edgar Faure in his seminal work for UNESCO, Learning to be (Faure et al., 1973). When Cropley and Knapper (1983) began writing about lifelong learning in the 1980s, the term was not widely known. By 2001 it has become a ubiquitous slogan that appears in government position papers, university mission statements, and advertising literature for all manner of educational products and services.

Impetus for lifelong learning also came from the increasing complexity of people’s lives and the rapid pace of change, both social and technological. For example, Homer-Dixon (2000) commented that although the new
communication technologies have greatly widened the circle of people with whom we interact, this comes at a price:

We find ourselves more rushed in facing an expanding range of obligations and responsibilities, because it is easier for other people to make demands on our time. Voice-mail messages, E-mail letters, and faxes pile up. Meetings proliferate . . . Thus the technologies that save us time and labor individually – that empower each of us – bind us collectively in a frenetic mad race in which we often feel more caged by obligations and demands than before. The tools of our liberation often seem to imprison us (p. 102).

Homer-Dixon (2000) concluded that as the world and our lives become more complicated and faster-paced, we have a need for different ways of learning – ways that stress our ability to come up with creative solutions to problems we have never seen before. Homer-Dixon (2000) refers to this as ingenuity, a concept closely related to lifelong learning.

In the workplace, knowledge and skills learnt in school or university rapidly become obsolete in an environment where practices and processes change so rapidly that industries and jobs that have existed for centuries can disappear almost overnight (Knapper & Cropley, 2000). It will be necessary to abandon our traditional notion that the education we receive in school or university is like an inoculation that can equip us to deal with all possible future eventualities.

MacBeath (2000) argued that intelligence is not fixed at birth but is created and recreated throughout our lifetimes; it is not just an individual quality, but resides both within and between people. Learning is often episodic rather than logical and sequential, and most learning takes place outside the classroom, not inside. Sternberg, in a series of influential papers, has described the concept of tacit knowledge – the knowledge we need to succeed at a task that is not formally taught, and may not even be verbalised (Sternberg et al., 1993). This implies a need for people to acquire more generic learning and to learn skills that will provide the basis for adapting successfully to changing conditions.

We recently developed and tested a measure of individual inclination to lifelong learning (Maki et al., 2001). Items for this scale were developed from the descriptions of lifelong learners by Knapper and Cropley (2000). For example, lifelong learners typically plan their own learning, apply existing knowledge and skills effectively, evaluate their own learning, locate information from different sources, use different learning strategies in different situations, and enjoy complex problems with multiple or uncertain solutions.

**Conceptions of Learning and Lifelong Learning**

Whether individuals are likely to engage in lifelong learning depends upon how they conceive the nature of learning and their role as learners. The ways in which students approach their learning in academic settings has been studied extensively (Biggs, 1985, 1987, 1993; Entwistle & Ramsden, 1983; Kember et al., 1999). According to Biggs (1985), an approach to learning comprises a set of motives and strategies used by the student to achieve desired learning outcomes.

Motives tend to be associated with types of learning strategies (Biggs, 1987). Persons who are motivated by the prospect of gaining qualifications employ strategies that aim to reproduce essential information. Learners who take a course based on interest tend to use strategies which help them understand the material, while those who are motivated by high grades focus on optimizing their study effort. An approach to learning, then, refers to the learner’s motives towards, and conscious use of strategies in pursuit of, recognized learning goals. Three broad learning approaches have been identified (Biggs, 1987; Entwistle & Ramsden, 1983) and are discussed next.

Learners who take a surface approach to learning are motivated to meet minimum task requirements and seek to avoid failing. The corresponding strategy is one of reproduction based on memorization of factual information. Individuals who take a deep approach to learning seek meaning and understanding. They are intrinsically motivated to learn the subject matter and attain competence in the area. These learners employ strategies such as identifying underlying arguments, reading widely, and relating new information to previous knowledge.

Students who take an achieving approach to learning are motivated by competition and self-enhancement. They place priority on obtaining high grades, regardless of how interesting the material is or how well they understand it. Achieving learners also wish to perform well in front of their teachers and peers. Learners motivated by the achieving orientation will employ strategies that are concerned with organizing study time and work space.
Approaches to learning have recently been studied in the workplace. Kirby et al. (2001) found that employees’ approaches to learning were based on three dimensions, which they termed deep, surface-rational, and surface-disorganized. The deep factor was essentially the same as in the student research, based in intrinsic motivation and meaningful learning. The student surface factor split into surface-rational (marked by memorization and attention to detail) and surface-disorganized (marked by a sense of being overwhelmed and an avoidance of meaningful learning). The deep approach was associated with workplaces that had supportive supervision and provided choice and independence in how employees worked. Both surface scales were associated with less choice and independence, and surface-disorganized was further associated with lack of good supervision and the perception of too much work.

The deep approach to learning is a critical component of lifelong learning, but the two constructs are distinct. Similarly, much of the surface approach is not suited to lifelong learning, especially the aspects related to avoidance of meaningful learning and disaffection with school or work. Lifelong learning is positively related to the deep approach and negatively to the surface approach in university and college students (Maki et al., 2001).

The Current Research

The hypothesis that guides our research is that performance in educational programs and at work is affected by students’ and employees’ conceptions of learning, including their inclination toward lifelong learning. How they approach learning will affect how they respond to educational programs, learn information about and by means of information technology, how they regard the applicability of their computer knowledge, and how they make the transition to the workplace. In the workplace, their conceptions of their own learning will affect how they approach new tasks, make use of their school-acquired knowledge, and plan their future learning. Environmental conditions, both at school and work, provide the context within which learning occurs, and will also affect not only the actual learning but also the approach to learning adopted. The ultimate goal of this research is to better understand the interplay between learning environments and learners, to improve the fit between educational programs and students, and between workplaces and employees.

Our study focuses primarily on students in a variety of professional fields, because it is in the professional fields that post-secondary institutions are most concerned that their programs meet workplace requirements. The sample included 445 final-year students surveyed in 2000 and 2001. These students were selected from university programs in nursing, education, engineering, life sciences, computer science, and sociology and from college programs in office administration, various computer technology programs, and health sciences. A survey was developed for this study to measure many aspects of information technology - use, expertise, attitudes, institutional expectations - and variables related to learning and work. Included in the survey were our lifelong learning scale and Biggs’ (1987) Study Process Questionnaire, to measure students' approaches to learning (deep, surface, and achieving). The students were administered the survey in one of three ways: paper format during class, paper format to take home and return, or a Web-based format. Choice of administration depended on the amount of class time the researchers were allowed.

Given the space constraints, we only review selected findings. More extensive reports of the research findings are in preparation. We present next an overview of results (see Table 1) to describe how the conceptions are associated with experiences and attitudes. In most cases the results are weak to moderate, with significant correlations ranging from about .1 to .4. We see the overall pattern as more important and interpretable than any particular relationship.

Experience and Skills with Computers

We correlated the four measures of conceptions of learning (deep, surface, achieving, and lifelong) with student responses to a variety of questions about what computer applications they used and how they felt about working with computers. Those with higher scores on the lifelong learning scale were more confident that they could learn new technologies easily, and were less likely to report being nervous or frustrated about working with computers (all of these relationships, and all others reported here and in Table 1, were significant at the .05 level). Deeper learners reported enjoying working with computers, and were also less likely to report being frustrated by them. We use the phrases “deeper learners” and “deep learners” in this paper to indicate those with high scores on the deep approach scale; equivalent phrases are used for the other scales. Only surface and achieving students tended to worry that computers made learning too impersonal. Lifelong and deep learners are more confident and positive about using computers.
We asked a series of questions about student skill levels with various computer applications and tasks. As can be seen in Table 1, lifelong and deep learning were associated with greater reported skill level in using computers for many purposes. A very different picture emerges from surface learners, who report greater skill in playing computer games, accounting/financial management, record keeping, and taking tests by computer, and lesser skill in searching databases. These skills are more procedural than high level, and show less aptitude for creative uses of computers. Achieving students reported a mix of the skills reported by deep and surface students, plus skill in submitting assignments by computer.

Learning with and about Computers

We asked a number of questions about how students felt computers affected their learning and work. Lifelong learners reported that computers increased their access to information, and disagreed with statements that computers increased workload and that the cost of computing could interfere with their education. Deeper learners thought that computers saved them time, improved the quality of their work, enabled them to work more efficiently, and increased their access to information. These results show that lifelong and deep learners have positive and productive views of computers. In contrast, surface learners thought that computers did increase workload, though they also felt that they saved them time. Students high on the achieving scale thought computers saved them time, improved the quality of work, allowed them to work more efficiently, and increased their access to information, but were concerned that computers increased what they had to learn.

We asked the students how they had learned their computer skills and how well they liked those methods. Lifelong learners indicated that they liked learning by themselves (from manuals or through trial and error), or through helping others, and had not learned much from professors or formal classes, or from their fellow students. Deep learners reported learning from librarians and technical support staff, and also liked learning by themselves, and through helping others. While both deep and lifelong learners report appropriate means of learning, the lifelong learners appear more independent, as one might expect. Surface learners reported learning from professors, classmates, technical support staff, and preferred formal classes or consulting faculty outside of class times. Achieving learners reported learning from professors, and liked a variety of methods including formal classes, online courses, manuals/books, and consulting faculty outside of class; perhaps true to their competitive spirit, they reported not liking getting other students to help them.

Finally we asked where the students had acquired their computing skills. Whereas both deep and lifelong learners indicated they did so primarily through personal exploration, with manuals and through trial and error, surface learners said they did so at high school, college or university, and not through personal exploration. Whereas surface learners showed a tendency to have learned by playing computer games, deep and lifelong learners indicated they had not done so.

These results show clear and consistent patterns. The deep and lifelong learners are more sophisticated learners, showing considerable independence or reliance upon resources, whereas the surface learners appear to be more dependent upon formal classes and teachers.

Institutional Experience and Workplace Orientation

We asked a number of questions about the students’ experience in their college or university programs, about workload, choice, importance of classes, and so on. Lifelong learning was negatively associated with thinking that lectures were more important than tutorial or discussion sessions, and with the belief that extra reading was unnecessary. Deep learners found instructors to be friendly and take student ideas and interests seriously, and were less likely to think that outside reading was unnecessary or that there was too much work in their program. Surface learners felt that the workload was too high and that there was a lot of pressure on them, thought that the lectures were most important and that extra reading was not necessary, and also felt that students did not have much choice in how they went about learning. Achieving learners agreed with the surface learners that there was too much pressure.

Finally, we asked where the students had acquired their computing skills. Whereas both deep and lifelong learners indicated they did so primarily through personal exploration, with manuals and through trial and error, surface learners said they did so at high school, college or university, and not through personal exploration. Whereas surface learners showed a tendency to have learned by playing computer games, deep and lifelong learners indicated they had not done so.

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A further set of questions asked about how the students’ programs had prepared them for the workplace. Although the students had not yet entered the workplace, all four scales were associated with statements that the students had good ideas about what their future workplace would be like, and that they had established goals for career and professional development. Lifelong learners thought that their programs had prepared them for the workplace, but felt that it was the student’s responsibility to learn about the workplace. Deep learners agreed
with both of those sentiments, and also indicated that the computer skills they learned in their programs were related to their future work. Surface learners thought their course work, but not their computer skill, was related to their future employment. Achieving learners had a pattern of results similar to those of the deep learners.

### Approach to Learning

<table>
<thead>
<tr>
<th>Experience with computers</th>
<th>Deep</th>
<th>Surface</th>
<th>Achieving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less frustrated about, enjoy working with, computers</td>
<td>Computers make learning</td>
<td>Computers make learning</td>
<td>Learn new technologies easily, less nervous and less frustrated</td>
</tr>
<tr>
<td>Computers make learning</td>
<td>.impersonal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skill in using computers for</td>
<td>Accounting, computer games, record keeping, taking tests</td>
<td>Reports, project management, accounting, planning, scheduling,</td>
<td>Databases, newsgroups, presentations, reports, statistics, project</td>
</tr>
<tr>
<td>databases</td>
<td>Less skill in searching databases</td>
<td>simulations, record keeping, submitting assignments</td>
<td>management, on-line courses</td>
</tr>
<tr>
<td>Learning with and about computers</td>
<td>Increase access, quality, efficiency, save time</td>
<td>Increase access, quality, efficiency, save time</td>
<td>Increase access - (Increase workload, cost a problem) neg</td>
</tr>
<tr>
<td>Increase workload, save time</td>
<td></td>
<td>Increase what I have to learn</td>
<td></td>
</tr>
<tr>
<td>Like to learn alone (manuals, trial &amp; error), on-line help, on-line courses, by helping</td>
<td>Like to learn from professors, formal courses, technical support</td>
<td>Like to learn by self (manuals, trial &amp; error), on-line courses,</td>
<td>Like to learn alone, (manuals, trial &amp; error), by helping others -</td>
</tr>
<tr>
<td>others, from librarians and technical support</td>
<td></td>
<td>from professors, formal classes</td>
<td>(Learn from professors, formal classes) neg</td>
</tr>
<tr>
<td>Learn by personal exploration, with manuals and through trial and error</td>
<td>Learn at high school, college or university</td>
<td>Learn by personal exploration, with manuals and through trial and</td>
<td>error</td>
</tr>
<tr>
<td></td>
<td>- (Personal exploration) neg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Institutional Experience and Workplace Orientation</td>
<td>Instructors friendly, take students seriously</td>
<td>Lectures more important than tutorials, discussion</td>
<td>Lectures more important than tutorials, discussion</td>
</tr>
<tr>
<td>- (Extra reading unnecessary) neg</td>
<td>Extra reading unnecessary</td>
<td>- (Extra reading unnecessary) neg</td>
<td></td>
</tr>
<tr>
<td>- (Too much work) neg</td>
<td>Too much work, pressure; not enough choice</td>
<td>Too much pressure</td>
<td></td>
</tr>
<tr>
<td>Good ideas about future</td>
<td>Good ideas about future</td>
<td>Good ideas about future</td>
<td>Good ideas about future</td>
</tr>
<tr>
<td>Established goals for career/professional development</td>
<td>Established goals for career/professional development</td>
<td>Established goals for career/professional development</td>
<td>Established goals for career/professional development</td>
</tr>
<tr>
<td>Program prepared them for workplace</td>
<td>Student responsibility to learn about workplace</td>
<td>Program prepared them for workplace</td>
<td>Student responsibility to learn about workplace</td>
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<tr>
<td>Student responsibility to learn about workplace</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important for work:</td>
<td>Work related coursework - (Computer skills related to later work) neg</td>
<td></td>
<td>Computer skills related to later work</td>
</tr>
<tr>
<td>Searching databases, presentations, project management, statistics, on-line courses</td>
<td>- (Searching databases, presentations) neg</td>
<td>On-line courses - (word processing, computer games, installing</td>
<td>Searching databases, presentations, project management</td>
</tr>
<tr>
<td>-Statistics, on-line courses</td>
<td></td>
<td>upgrades) neg</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Survey items significantly related to conception of learning scales

Note: neg indicates a negative correlation.
Finally, we asked the students what computer skills they thought would be important in their future work, using the same list we had shown them when asking about their current skill levels in various applications. Lifelong and deep learners were more likely to select skills related to more advanced applications (see Table 1). Surface learners saw the future need for statistical analysis and taking online courses, but disagreed with the need for searching databases and for making presentations. Achieving learners saw the need for taking online courses, but disagreed with needs for several skills that they may have seen as lower-level.

Again we see a pattern in which lifelong and deep learners value their studies, see the connections between their studies and future work, and conceive of higher-level applications for their computer skills. On the other hand, surface learners (and to a lesser extent achieving learners) are more focussed on workload and pressure, and see more procedural or lower-level applications of their computer skills.

Interpretations and Conclusion

Our interest in this research is to see how individual learners’ conceptions of learning influence their learning and use of information technology skills at school and as they enter the workplace. The present results only concern their experience as students, but we suggest that important patterns are apparent. The various conceptions of learning (especially lifelong, deep, and surface) seem to be associated with different perceptions of the learning environment, different perceptions of learning needs and skills, and with different perceptions of the demands of the future workplace. These differences present challenges for educational programs, because, for instance, the same instructional element will be viewed and valued differently by the various types of student. Highly detailed and “user-friendly” instruction may suit the surface learner, but be counter-productive for deep and lifelong learners. Problem-based learning and discussion may fit the needs of the deeper learner, but fail to engage the surface learner. Even the most straightforward conclusion, that alternative learning methods and pathways should be provided, will not suffice: some students (those of deep and lifelong orientations) will perceive these alternatives as enriching, but others (of the surface orientation) may see them as unnecessary or even as adding to workload. Higher-level computing goals will be seen as worthwhile by some, as unnecessary by others. An important question concerns students who are high on surface learning, and/or low on deep or lifelong learning: should we attempt to adapt to these students’ learning preferences, or should we aim to alter their conceptions of learning? Instruction aimed at teaching certain skills may fail until the underlying conception of learning is addressed.

It is necessary to raise three caveats before concluding. First, these are correlational not causal data. We think it most likely that the students’ conceptions of learning influence their perceptions, but we should not forget that students’ learning environments can also shape their approaches to learning (Kirby et al., 2001; Ramsden & Entwistle, 1981). Furthermore, student competencies (knowledge, ability) may be associated with both approaches and perceptions – the more able students may receive more appropriate instruction and encouragement to adopt deeper approach. Conceptions of learning, learning environments, and student abilities interact dynamically and may resist simple changes.

Second is the question of validity. All of our data are from self-report measures, so it is possible that what students report about their approaches to learning, their skills, and their instructional experiences are inaccurate. This may not be crucial, in that perceptions may be more powerful than reality (as determined by an external observer).

Finally, and most importantly, we need to examine what happens to these relationships as these students enter the workplace. Our previous workplace research (e.g., Kirby et al., 2001) leads us to expect that the conceptions of learning will continue to operate in much the same ways. Research in the workplace is underway and should shed further light on relationships between conceptions of learning, work preparation, workplace learning conditions, and the role of information technology in supporting learning.

References


