OPTIMISING KNOWLEDGE MANAGEMENT
FOR STUDENT SUPPORT

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ABSTRACT
We report our findings and results from a meta-analysis to show what constitutes effective knowledge management for supporting students. With massive amounts of data flow, students need time management and continuous scaffolding support especially to prevent drop-out in the early years. Support is analysed as being internal from other students and from teachers, or as external from work colleagues, employers and family. Knowledge management support was only effective where provided as internal from more senior students. A comprehensive framework is presented that covers all the five known Domains of Learning; the Cognitive, Metacognitive, Affective, Environment, and Management Domain. The Management Domain is explained to include time management skills, and critical thinking skills for coping with massive amounts of data flow. We present what is knowledge management, how and why it is efficient - with case studies, examples and full literature references. We conclude that optimum knowledge management is achieved through mentoring by a senior student or tutor.

KEY WORDS
Affective robotics, Motivations, Intelligent tutoring, Scaffolding for automated interactions, Web 3.0

1. Introduction
In earlier works, three domains were recognized as Cognitive (knowledge), Affective (feelings), and Psychomotor (skills). These overlap to some extent, and knowledge and skills can be treated together here. The Metacognitive Domain was not considered by the researchers led by Bloom in the 1950s, but has become well recognized afterwards. A revised taxonomy was published by Anderson et al. [1] that includes the Metacognitive Domain. With the development of computer-mediated communications, various technological barriers to learning have been reported and media literacies or interactivities have been identified as an area important to learning particularly in open and distance education, but also in blended and e-learning, and all these constitute the Environment Domain.

Four Domains were identified earlier by Hartman [2]. These were the Cognitive, Affective, Metacognitive, and Environment. They share overlapping characteristics - for example, prior knowledge within Cognitive is also a basis for academic interest in Affective, and in understanding in the Metacognitive, as well as being part of resources in the learning Environment. And for example learning style, while largely in the Affective Domain, is also in the Cognitive Domain in prior educational experience, in the Metacognitive Domain in awareness, and in the Environment Domain as a task-dependent variable. The Cognitive Domain covers the aptitude, prior knowledge and skills necessary for performing a task or test. Affective covers the motivation, attitude and decision to initiate performance, the Metacognitive Domain is understanding how the task is performed, and the ability to self-monitor, evaluate and plan own learning, and the Environment Domain is defined as the social or physical forum in which learning occurs.

Student surveys have confirmed these four Domains are involved as facilitating learning or as the case may be as barriers to learning. Rezabek [3] found that barriers to learning in distance education could be categorized as situational, institutional, or dispositional. The first two are in the Environment Domain, and the third is in the Affective. Garland [4] found a fourth category of epistemological barriers concerning the technical difficulty, prerequisite knowledge and academic interest or relevance, and this category would be in the Cognitive Domain. And Leggett & Persichitte [5] found a fifth category concerning student support and study skills, which would be in the Metacognitive Domain. Dispositional aspects are therefore well known to be important and include the student’s approach to learning, attitude to learning, preferred learning style, and motivation to learn. These dispositional aspects within the Affective Domain have generally remained beyond the reach or outside the role of the tutor and institution. Most reports have dealt with only how to foster these affective aspects, rather than how to initiate them.
2. Methods: the Meta-Analysis

The Management Domain covers an evolving field, and is being established to bring into account the knowledge and skills to be learnt by students in the newly emerging learning society and knowledge-creating society using the Internet since 1991. Learners are faced with an information overload in most cases - with electronic access through the Internet to libraries, news-groups, blogs, email, voice-over-internet chat, as well as face-to-face meetings, print, radio, television, and so on. Learners must develop coping strategies and skills, in order to filter this massive amount of information to obtain appropriate material in a suitable quality for assimilation and learning. These management skills also have associated costs: in conventional contiguous face-to-face teaching, the students would assume quality on the basis of the professor’s qualifications and reputation. In the move to online education, avatars and virtual classrooms, the student has had to take on some of the quality assurance responsibilities. The student has to spend time and effort to judge the quality, validities and reliabilities of the incoming information. Such time and effort should properly be included in costing. In some areas, this cost is shared by the institution - where for example MIT has its name on the website, Cambridge University puts its logo on shared open education resources, or Oxford University authenticates the podcasts of its lectures. Time management is included here, since this is an overarching influence on the information management skills. The information management skills draw on critical thinking skills (covered in the Cognitive Domain), and analyzing and synthesizing skills (covered in the Metacognitive Domain). Information management also draws on sociocultural and economic proficiency (covered in the Environment Domain). Critical thinking skills for information management include the proficiency to see causal relationships and to imaginatively search for new information. Analyzing skills for information management include becoming proficient in determining the utility of the information, the validities, and the reliabilities of the information. Reading and writing communication skills are also within this Management Domain. There are a host of literacies included here. The student function in this Domain is to imagine and then access information (or if necessary to design research to collect data to generate this information), search, evaluate and select appropriate information, and then to construct knowledge. The student needs to interact with ideas, data, information, and prior knowledge - preferably within a regulated system as opposed to a chaotic situation. The student needs to interact with other individuals, resources and organizations. Overall, this Management Domain involves learning efficient and effective communication processes. These processes should also involve the student making explicit and sharing her own knowledge with others. Indeed, the cooperation and collaboration of several persons are often needed to create knowledge especially if it is to be valued and owned by the group or institution, or organised and published as a book for others to access.

To some extent, an institution or a book serves to pre-select and organize the mass information for the learner - such learning organisation may take the form of an institution of teachers and scholars, or an online learning community, or book. In these cases, the information is validated by the organisation as suitable content for the student to learn. A library might be specific enough to provide organised access, but at the same time and place

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<th>DOMAIN</th>
<th>Coverage</th>
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<tr>
<td>Cognitive</td>
<td>the aptitude, prior knowledge and skills necessary for performing a task or test, and the content knowledge and reflective critical thinking skills to be learnt</td>
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<tr>
<td>Affective</td>
<td>the motivation, attitude and decision to initiate performance, including the will to reduce own autonomy in order to achieve group tasks</td>
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<tr>
<td>Metacognitive</td>
<td>understanding how the task is performed, and the ability to self-monitor, evaluate and plan own future learning, and the willingness to help others to learn</td>
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<tr>
<td>Environment</td>
<td>the social or physical forum and virtual or augmented reality in which learning occurs, including any group characteristics</td>
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<tr>
<td>Management</td>
<td>coping critically with massive amounts of information to obtain appropriate material in a suitable quality for learning, and time management</td>
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offers a bewildering range of information that needs filtering and abstracting. When any organisation exists, then the value of the whole is clearly more than the sum of the individual pieces of information: the group is better than the sum of individual persons. However, there is a cost to be paid for organising the information. When an institution organises the course, the student can to a large extent trust and rely on the authority of the institution. When there is no clear organisation such as on the Internet, then the student has no clear guide as to the quality and must therefore expend more time and effort to evaluate and judge the received quality. This is a cost that is put onto the student.

3. Results: Coverage of Each Domain

These five Domains are those so far recognized, and they are summarised in Table 1 above. To date, there are only these five Domains, and they accordingly constitute a comprehensive framework on which to discuss supporting the student learning.

Students nowadays need to be well organised. Not only utilizing bookshelves and hard-disk backup electronic filing systems, but mentally; including time management and cognitive linking or tagging of input to prior learning. The human brain is physically unable to cope with the massive amounts of information currently available, and some scaffolding is essential. e-Learning involves both cooperative and collaborative learning. In cooperative learning, sharing experiences leads to further massive amounts of information. The human-to-human bandwidth is very narrow leading quickly to overloading and de-contextualisation - richness is soon lost without a good knowledge management system. Collaboration involves retrieving richness on demand efficiently in time and across space. Many non-native English speakers experience this kind of overloading where having to argue in English online synchronously in audiovisual conferencing or asynchronously in discussion boards.

Additionally the student individually must take part in determining the quality of the information arising. The Internet has much so-called ‘grey literature’ without any clear authentication. Therefore the student has to take on some of the distributed costs of ascertaining quality. The more ‘free’ the information, then the higher these costs. Certainly academic counselling from a senior student can help the student directly by identifying the quality of the available information and learning resources, and indirectly by providing a scaffolding or keeping the learner on a scaffold - even weekend telephone calls or text messaging can help here.

The results from deploying knowledge management counselling are good, and cost efficient. The transition from being an outsider to becoming an insider requires internal support, particularly for those at the start of a course - at any age, gender or academic level. There are two competing forces involved here - one is external support from work colleagues, employers and family, and the other is internal support from fellow students and teachers. Internal support can best help academically: Jung [6] reported that first-year students who received mentoring by third or fourth-year students achieved summative grades higher than those achieved by normal non-mentored students. External support has been found to be detrimental: Shin & Kim [7] found that those with significantly more external support were more likely to discontinue their studies. External support from parents lies in the Environment Domain, whereas internal support
lies in the Management Domain with overlap in the Cognitive Domain, Metacognitive Domain, and Affective Domain. Academic support in the Management Domain includes aspects such as time management and personal knowledge management. Students at the beginning of their studies do not yet know how to study, and academic counselling is important. Simply studying in a group of peers may be the-blind-leading-the-blind: an in-depth study by Choi, Sung, Song & Song [8] found that student grades were not improved by group-work. This is in line with numerous other studies worldwide [9] [10]. Bettinger & Baker [11] have reported that senior students were effective in improving retention, improving time management and improving academic grades. Since these senior students concentrated on linking the student’s outsider life with insider academic life, the mechanism seems to be in promoting the transition. Knowledge management counselling is an efficient academic intervention to help students learn how to learn.

Learning how to learn can be measured through monitoring the student’s use of critical thinking skills and related deep questioning. Our own study findings show that second-year students who are cognitively overloaded with large textbooks show a decrease in self-management, while older students start to show more and more the desired deep thinking required at university. Results shown in Figure 1 are for students at a medical university.

The Management Domain of Learning includes the capability and coping strategies of information searching skills, and a personal library of resources that serve the individual. Coping skills are those used to identify the quality of incoming information, filtering out low quality or distracting noise, and tagging the information to use in constructing one’s own knowledge. The various coping skills are summarised in Table 2 below. In particular the reader here should notice that a more senior student or tutor is the best equipped with the necessary experience to help the learner in all these aspects.

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<th>Skill(s)</th>
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<tr>
<td>Searching</td>
<td>includes pro-active listening, aesthetic reading, choosing, joining and leaving news and discussion groups, time management, prioritising and goal setting, coping with available limited resources</td>
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<tr>
<td>Library</td>
<td>includes collating, tagging, storage, backup, revising everything routinely and ad hoc when context varies, being open and willing to revise</td>
</tr>
<tr>
<td>Analysing &amp; Evaluating</td>
<td>include assessing knowledge and priorities, methods, and monitoring own learning effectiveness and efficiencies, recognizing own needs and choosing strategic optimal ways to get new knowledge in order to learn, filtering input, tagging own knowledge</td>
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<tr>
<td>Organising</td>
<td>includes integrating, expanding prominence and decreasing prominence, deconstruction and reconstruction, establishing new connections and breaking other connections, refining tacit knowledge, fitting knowledge parts together to form larger parts</td>
</tr>
<tr>
<td>Retrieving &amp; Sharing</td>
<td>includes presenting, writing, teaching</td>
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Table 2: Coping Skills within Knowledge Management
4. Conclusion

We have found that adult students need support not only to organise their own knowledge but also to re-organise it. The cognitive learning process involves disjunctive reasoning in which the learner must hold her own conceptualisation in abeyance while pro-actively considering the merits of all possible alternative worlds. Adults generally come to the learning forum with much experience and often some tried-and-tested foundational experiential knowledge. They are often reluctant to question their own knowledge on which they have depended for years successfully, and are even more reluctant to have others question it - which can lead to dropping out. At least it can lead to an undesirable surface approach to learning new information. Senior students as knowledge management experts and counsellors are effective to support adult students.

References