ABSTRACT

One of today's central educational concerns is how to combine the contemporary students' ability to control their information needs using Information-Communication-Technologies (ICT) and their ability to manipulate ICT with active-learning (AL) curricula which were clearly not designed to accommodate ICT. Especially the potential negative impact this has on students' learning is a cause for concern. AL pedagogies routinely presume students activate their biological memory to retrieve knowledge, not their smart ICT devices' memory. Yet, the ubiquitous access to vast amounts of information via ICT devices has pervaded all levels of our lives, and education is no exception. It is these ICT-afforded students who are now undertaking higher education formal AL courses. University education seeks to guide students from novices to experts and proficient, lifelong learners in their chosen field of study. Current students are the academics, researchers, and professionals of the future and have to become competent medical practitioners. Medical students need help to navigate seemingly endless pre-requisite medical information and understanding from the pervasive resource of the ICT environment. Students must master a great deal of information, understand how to learn, become lifelong learners, be problem solver, gain medical skills, and integrate all these requirements into an empathetic, competent practitioner. It was against this backdrop that this research was conducted.

This research sought to understand students' effectivities (abilities) to informally supplement their formal AL tutorials with informal ICT perceived affordances (functionalities) and, importantly, determine how these student ICT-seeking behaviours either augment or hamper learning in the AL environment. The research focused, therefore, first on understanding the ICT-afforded students' perspective of the learning benefits of their ICT interactions. This was followed by identifying events in which students controlled the ICT affordances during formal AL and interpreting these events from the perspective of their AL educational implications. By this, I aimed to better understand the contemporary students' uses of ICT affordances during formal AL to inform future educational design in face-to-face and online teaching.

I employed a cognitive constructivist interpretivist qualitative research methodology that positions the product of learning as knowledge and understanding in biological memories, learning or the specific way in which information is stored in as students' biological memory is an individual activity and largely depends on the students' prior knowledge and life experiences. It is also impacted by the students' ICT effectivities to navigate their learning needs both formally and informally. In order to study this complex learning environment, I used a purpose-built conceptual framework using and combining Bandura' Social Cognitive Theory of learning and the group of Information Processing Theories. This framework provided the lens to determine the student's effectivities of using ICT affordances for AL. The ICT affordances enable students to access a near infinite resource of information and facts and create online learning spaces and opportunities by communicating with

diverse communities to develop knowledge collaboratively and capitalise on ICT's convergent functionalities. Superficially, these ICT affordances should align with the AL tenets of construction of knowledge through collaborative interactions whilst working on contextually relevant scenarios. So, the five affordances of ICT in education, creation, collaboration, communities, communications and convergence, combined with the three of active learning, constructive collaborative and contextual learning, can be used to evaluate where and when both sets of affordances align. One would assume that contemporary ICT savvy students are adept in navigating and using ICT affordances during active learning settings. However, investigating the alignment of ICT and AL affordances has been central to demonstrating that educators can not assume students digital confidence translates into digital competence for academic learning. In fact, many students are drowning in the unnecessary complexity they have created by misappropriating ICT affordances that may or may not enhance their learning. Hence highlighting students need help to align ICT and AL affordances to promote academic growth and development.

First-year graduate-entry-medical students volunteered for their routine AL tutorials to be video-recorded. A selected set of ICT interaction events during their AL tutorials formed the basis for in-depth analyses. The rich multi-modal data sets included videos, observations, transcripts, photos, VSRTA, group work, ICT history logs and surveys. These were triangulated and qualitatively analysed using data analysis software. Subsequently, they were interpreted using the conceptual framework with the five ICT and the three AL affordances. This research methodology allowed for unique, in-depth insights and perspectives relevant for educators and students to be aware of. One example is that students generate a learning environment fraught with ICT complexity with minimal direct learning potential resulting in increased extraneous cognitive load.

Other consistent findings of this study were that students' ICT effectivities to use ICT affordances for their personal lives do not automatically translate into students knowing how to use ICT for learning. Students assume that they are 'digital natives' who have grown up with ICT and can therefore use ICT seamlessly and with great facility in any given situation. As a result, students overestimated their ICT effectivities in using ICT in the AL setting. But this digital confidence did not simply translate into digital competence in the arena of academic AL. Instead, it led to complex learning traps. Inversely, educators also assumed students to be digitally competent, so they left this learning arena untouched.

Consequently, students' ICT knowledge and skills for learning were not commensurately scaffolded and developed alongside other subjects within their formal AL courses. Furthermore, when creating their own ICT-afforded learning environment, they did not invite academic teaching staff, such as social media groups. As a result, when students sever the connection between the bounded, quality controlled learning environment of the formal curriculum and instead relied on the infinite and poorly quality-controlled informal learning environment of the internet. In doing so, they

lose the scaffolding and safe guards provided by the educators and need to make judgements about the veracity of information themselves.

When ICT affordance or applications selection was left to the students, I found they were drowning in self-selected complex online resources, which increased extraneous cognitive load considerably. Students created multiple layers of disparate and disconnected information and formats for which they expended massive extraneous cognitive effort and learning time but which they could not use under time-constrained conditions. They were using ICT affordances to create extensive learning networks consisting of multiple online libraries with excessive numbers of digital textbooks, websites, images and notes, which they mistakenly perceived to be beneficial. They further created multiple online self-selected learning groups, used multiple ICT devices and multiple online applications, which were all purported to help them learn and organise their study life balance. Essentially, students were creating and storing multiple disparate pieces of information, but these remained isolated and could not be searched and accessed purposefully. Therefore, students keep relying on search engines, such as Google, to find just-in-time information. Consequently, students become lulled into believing their collected pieces of information is the same as their own biological knowledge. But the mere fact that these ICT repositories are unsearchable demonstrates how much this is in direct conflict with the AL tenet of construction of biological knowledge.

In light of this, students increase reliance and dependence on ICT fuelled their intolerance of uncertainty which, in turn, droves their need to be correct and decreased their confidence in their knowledge. As a result, they were uncomfortable and felt a need to quickly resolve unknowns, uncertainties and check their biological knowledge before sharing anything with the other students. Because of this, students relied on having continuous internet connectivity to retrieve just-in-time information to cater to this desire always to 'know' and have answers. When internet access was not forthcoming, they manipulated their ICT devices to ensure connectivity even at the expense of face-to-face AL opportunities.

There are two important implications to consider with this 'need-to-always-know' and have answers. Firstly, the AL safe environment of small group learning, which presents learning triggers of unknowns and uncertainties to motivate shared cognitive meaning-making, is not utilised. In such an AL environment, students can proffer diverse information for collaborative learning. Offering perfect answers does not allow for this learning. Instead, students can learn from their own and each other's mistakes in the traditional AL context to negotiate a path towards groups consensus and resolution. With these quick resolutions of their 'unknowns' and 'uncertainties', the AL affordances inherent in small group learning for collaborative construction of knowledge are truncated as AL is not about answers or quick resolution. Instead, AL recognises the cognitively effortful learning journey to contextually construct memorable long-term memory schemas that can be quickly retrieved when the practical situation requires it.

Secondly, by relying on internet connectivity, students form transactive memory relationships with their devices. Some students, struggling with the volume of information to learn, delegate the role to remember to their ICT device rather than their own biological memory, and in doing so, they mistakenly believe this *is* their learning. Although previous research in more experimental settings found that students formed ICT transactive memory relationships, which enabled them to remember where the online information was but not the information itself. In my study with students in their naturalistic learning group and under time-constrained conditions, they could not even remember where to find the information and, consequently, the information itself. The salient point here is that when students are provided with enough time, they could potentially navigate to their ICT stores to resolve unknowns, but when under pressure, as in real practice, they simply cannot.

This leads to the pivotal role of the individual student's prior knowledge in accessing ICT affordances in a meaningful and effective way under time-constrained conditions. Limitations in their working knowledge in combination with the pressure of group work expectations repeatedly led to surprisingly significant errors in keyword writing and judgement. These errors were surprising because the searches seemed so simple for somebody with the relevant prior knowledge. So, when students have on-topic prior knowledge, they are better positioned to navigate entry to and selection of appropriate ICT collaboratives and communities of knowledge. This prior knowledge then means they can judiciously write keywords and judge the search engine results (SERs) for veracity and relevance. So, on-topic prior knowledge is an absolutely necessary prerequisite. But if students, do not have sufficient on-topic prior knowledge to communicate with the ICT affordances succinctly, they make remarkably simple errors in keywords and mistakes in judging the SER's as they go on attempting new keywords without obtaining relevant answers. When this occurred, students invariable abandoned their search to no avail.

This also has possible important implications for open book and online examinations. If the students have not prepared, committed, and processed information to their biological memories, they will be unlikely to quickly find answers and information to help them pass their examinations. ICT affordances do not provide the correct information unless the students' effectivities of prior knowledge guide their online search. Similarly, students who do not have sufficient prior knowledge lose valuable time away from the AL affordance of collaborative promotive interactions and miss thus out on its benefits for their learning in the task context.

The act of online searching is a cognitively demanding activity. Despite many students' belief that they can 'leave an ear open for interesting information!' whilst searching online, students in these situations made simple errors in both the ICT search domain and the collaborative domain of the face-to-face group. Obviously, multiple demanding activities lead to attentional focus splitting resulting. This not only leads to a situation of insufficient attention for each of the tasks in themselves, but the continuous task switching takes up cognitive resources as well. Despite the

assumption that contemporary students are better multi-taskers, such dividing of attention between cognitively demanding tasks means that students dilute their cognitive capacity between the tasks and cannot multi-attention or multi-task in such learning situations. This explains one of the important findings as to why students made simple errors, were frustrated at not succeeding in simple tasks and had to eventually abandon either the online search or AL involvement.

Contemporary students are proficient informal ICT consumer and are able to navigate their ICT devices technically very well. But this study exposes the vulnerability of contemporary students who use ICT affordances to converge their role as students with the educator's role. The latter occurs because students deliberately do not connect the formal and informal learning spaces or the ones between themselves as 'digital natives' and their educators as 'digital immigrants'. Although students, who control their informal informational needs through ICT affordances, believed they were learning, they still wanted and sought as many informal and formal learning opportunities and resources as possible. In fact, students want it all.

Another finding highlights the convergence of the students' role and that of the educators. By controlling their information needs, students have converged with the educators' role who oversee the curriculum and instructional designs. The students have clearly gained a sense of agency and control over how they learn, but as a result, they lack the necessary guidance on managing the huge number of affordances and the vast amount of information that they find extremely difficult to navigate. Or, to put it differently, the line between student and educator has blurred. Therefore, directly acknowledging this ICT-afforded convergent situation will open up future research perspectives to explore conduits for educators and students to work closely together to broker an educational design to support learning strategies that resonate and promote incentive for students to explore and develop. The principal aim is to develop their academic digital competencies to interweave ICT and AL affordances successfully. For this to occur and to successfully interweave ICT and AL, the ICT affordances of communication, communities, collaborations, creation and convergence, and AL of constructive, collaborative and contextual will need to guide all educational design.

The currency of AL is that information is processed biologically by the learner into knowledge and eventual wisdom and, who during this learning journey, will develop life-long learning skills. This takes persistent cognitive effort and time, with repeated rehearsal, performance and reflection. Students in AL courses and for lifelong learning must be prepared to and be willing to be incorrect, know how to work through one's and each others' understanding and learning needs. Essentially learning is not easy. It takes time and requires students to apply and question themselves and others irrespective of the collaborative space. ICT affordances can supplement this process, but they cannot replace it. Learning is hard work with no shortcuts, with contemporary students of today being no exception.