Ellume Educational Endeavours Ltd. ("**Ellume**")

Strategic Primer

Contents

1. PREAMBLE

Ellume[1] is a non profit organisation concerned with the pursuit of education. The word ellume is a portmanteau of two words, education and illume. The latter is a verb meaning "to illuminate", which can be construed both literally and figuratively. Thus, Ellume aims to point the way for those who seek knowledge so that this knowledge will in turn light their path.

More specifically, Ellume focuses on (i) enhancing the quality of and (ii) enabling access to education through autonomous learning. The latter is sometimes also described as independent, autodidactic or self-directed learning.

The following questions serve as a guide to Ellume's overarching mission:

What makes a person curious and interested to learn?

If an individual has access to the internet, can they learn with limited institutional guidance once they are taught how to learn (meta-learning)?

What are the limits to this type of self-directed learning? At what age can it occur? What conditions are needed to sustain it throughout an individual's life?

At this point, it may not be apparent to the reader why any of this is remotely important. To address this, see 3.1 and 4.1 below which set out the underlying motivations for Ellume.

2. GEOGRAPHICAL SCOPE

Ellume adopts the principle that any endeavour with charitable objectives is more likely to generate a positive effect in communities that share common values as well as cultural and institutional attitudes with the organisations undertaking such endeavours.

In the case of Ellume, our activities will only be effective when the underlying community recognises the normative value of education. With that in mind, two jurisdictions have been selected, with differing objectives and timelines for each:

*   Singapore (the "**Singapore Initiative**"); and
*   China (the "**China Initiative**") (together, the "**Initiatives**").

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[1] Pronounced in the same way as the word "illume".

3. SINGAPORE INITIATIVE

3.1 Key Motivations

3.1.1 Autonomy

One of the most direct motivations for Ellume stems from my time as a tutor as well as my own experiences as a student, drawing from which I came to the following observation:

Individuals learn best when they are the ones who initiate the process of learning.

I put this down to the idea of autonomy. This concept draws upon a deep body of literature and philosophical frameworks (for instance, see John Stuart Mill's On Liberty) but in essence it emphasises the value of individuals acting in accordance with their conception of themselves and who they want to be. They hold the pen and are responsible for writing the chapters of their lives.

On the other hand, mandating someone to follow instructions and to passively absorb content – that is a reduction of one's autonomy and diminishes the individual's spirit.

Instead of being autonomous, he becomes an automaton.

3.1.2 Ossification of knowledge

Information is wedded to the cycle of time. What is new becomes dated. This, coupled with the modern education framework, creates a curious phenomena. Individuals begin their formal education and are exposed to a broad range of topics which gradually tapers as students advance up the education chain. In some cases this specialisation of knowledge continues into the workplace (for instance, where a student graduates with a degree in law and proceeds to focus on intellectual property law for the rest of his career).

Consider the following scenarios:

(a) John enrols in high school in the year 1980. He takes biology, chemistry and a variety of other humanities subjects. Subsequently John graduates and takes up a job as an electrician.

Let us assume that when John was still in school, the view was that cells form the basic building blocks in any organism. The events in the 90s, including the Human Genome Project escape John's attention as he is largely pre-occupied. John continues with life, applying the prevailing scientific view he was taught back in 1980 to deal with everyday matters. He knows there are things called viruses but in his mental framework, these are also types of cells.

In the year 2020, Covid-19 arrives on the scene. John hears about a vaccine where Covid-19 is injected into the bodies of people. Because John has no understanding of genetics, he does not realise that viral RNA is key to viral replication or that a vaccine does not actually contain potent genetic material. He thinks viruses are malignant cells so if they are introduced into his body he will still become infected.

(b) Ben has a degree in Linguistics and teaches at a university. At the same time, Ben has always had a great interest for mathematics. In particular, the factorisation of prime numbers. There are several institutions that specialise in this topic, but they are all located abroad. While Ben would love to take an entire year off work to pursue this interest formally as a mature student, his job and family commitments make this very difficult. The cost of enrolment is also a concern.

From time to time, Ben considers learning about prime numbers online through videos and other materials but worries about the lack of guidance.

The story of John and Ben raise two distinct motivations for Ellume as an organisation.

Scenario (a)

John's scenario is typical of how most individuals acquire knowledge: gradually, incompletely and across various stages of our lives. Our knowledge of most subjects unrelated to our vocation becomes frozen in time. It gets updated on an ad hoc basis or it does not get updated at all.

Herein lies the first normative claim:

It is important to interact with the world we live in based on an understanding of it which is as close to our most updated understanding of it as possible[2].

If we accept this claim, then we should take steps to remedy the situation described in John's scenario.

Of course, life goes on regardless of the level of understanding that people have of the world and its principles. Nonetheless we should not be content with an outdated understanding of how things work in the world, particularly when there is a more compelling framework to go by.

Consider the British ironclad and the Chinese junk of the 19th century. Both sufficed for the purpose of sailing stretches of open water. But when pit against each other, torrential storms or heavy abuse, it was the junk that emerged (if at all) considerably worse for wear.

Information which is dated may not be outdated. But when it is outdated, it becomes an impediment to our goal of interacting as accurately with the world we live in as possible.

Scenario (b)

We now move on to the case of Ben. The age of the Renaissance polymaths has come and gone. There is so much accumulated knowledge today and the fields of knowledge have become so specialised that it is quite impossible to master them all. But that doesn't mean that we should be content to rely solely on the expertise of others. There are benefits to being able to go deep and broad at the same time.

Helping individuals like Ben delve efficiently into subjects far removed from their own area of specialisation is one of the long term goals for Ellume.

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[2] Some may question the importance of this. It is an interesting question worth some elaboration. There are several reasons why we might find it desirable to interact with the world based on as accurate an understanding of it as possible. First, in the case of scientific understanding, it is generally the case that later scientific paradigms are better at explaining phenomena than earlier ones. So you can choose to believe that the reason people fall sick is because of bad air (miasma) or you can believe that its partly due to bacteria and viruses. And you can take preventive steps accordingly. But it is the latter scientific paradigm which will lead you to tangible results. Second, our belief in truth means that we should view and interact with the world as it is (or at least, as we think it is). Treating your cat like a dog or your girlfriend like your mum is not fatal (with some exceptions), but this seems to violate a central principle that we should interact with the world and things in it as they really are.

Of course one might also object thus: doesnt the claim require us to follow up on everything that is going on in the world so that we have as accurate an understanding of it as possible? I agree that that would rightfully be impossible. It is an interesting criticism that's worth considering. Suppose I know that there are 5,000 people living in Macao. Two days ago someone there passed away without my knowing. Does my ignorance mean that I do not have an accurate understanding of the world? Yes it is certainly less accurate than if I did know of that one person's death, but understanding can also be further distinguished into an understanding of <u>how the world works</u> as opposed to an understanding of <u>what exists in the world</u>. I would claim that the former is more important.

3.1.3 Surfeit of information, absence of contemplation

In society it is not uncommon to come across individuals who make bold and sweeping assertions of fact. We've all encountered these situations. Short of being impolite there is no way to ask them to substantiate their claims. Worse still, the captive audience sometimes accepts the assertions on good faith and any ensuing conversation proceeds on shaky epistemological foundations.

Assume the focus is on students for now. In today's world, there is no shortage of information. There is in fact a deluge of information. In these situations, critical thought and analysis of the underlying assumptions behind any claim is far more important than the ability to look for information (though that is not to gainsay the benefits of the latter ability). What are the underlying assumptions of a claim, does it have a reliable provenance, does each segment flow logically from one to the other?

One of the key goals of Ellume is to embed a healthy dose of skepticism and reflexivity in individuals in a way which is congruent with acceptable modes of social interaction.

3.1.4 Good teachers are a scarce resource

This motivation is best explained through the following anecdote.

Sally has recently established a family. She has a 4 year old son, John, who is approaching the age for primary school enrolment. In her time, Sally attended a primary school of repute and hopes to enrol her son in the same school.

After all, a good education could open many doors for her son. The problem is, competition is fierce. The estates close to Sally's school of choice are exorbitantly priced. This is partly due to the enrolment metric, which takes into account residential proximity. Sally spends many nights thinking about this. While the purchase of a new house will burden her financially, she fears that her son will not get in if the family doesn't move closer to the school. That would affect his chances at getting into a good secondary school. Which would affect his chances of getting into university. And it might exclude him from a job with decent prospects...

The chain of worries goes on and on but here we part ways with Sally and focus instead of Sally's concern: enrolling her child in a good school.

A good school can have value in several ways. Firstly, it may provide quality education. This is reflected in the standard of its teachers, availability of teaching facilities like virtual reality equipment, laboratory instruments and so on. Second, its value may derive from its reputation. This is of course quite independent of the education being provided, but it would be naïve to deny the value of a school with a good reputation. Coupled with a tightly knit alumni network, a student might find that his educational pedigree opens many more doors for him in future.

Ellume's focus is on the first type of value that schools provide[3]. Good teachers are a scarce resource in any community but particularly so in highly developed societies. A school with an established reputation has significantly more resources at hand. They can provide attractive remuneration for highly qualified teachers (a practical consideration for teachers in places where the cost of living is high), better school facilities, outreach programmes etc.

Top schools are by definition scarce. Even if the cost of enrolment is low, the resulting competition for enrolment spots actually imposes indirect costs on households.

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[3] Under the Singapore Initiative there is no specific solution to the second type of value that schools provide. However, an alternative approach is canvassed under Phase 3 of the China Initiative.

Consider Sally who wants to relocate but is deterred by the high prices of the flats in close proximity to the school. Indirect costs like these function as barriers to what people perceive as good quality education. But it does not have to be the case, particularly if we can shift part of the burden of instruction from teachers to students through autonomous learning techniques.

3.1.5   Advances in various scientific disciplines

The school as an institution has a long history in our culture. But the underlying framework (how to teach and why) is ripe for revision. This is due to developments in at least two areas: genetics and cognitive neuroscience.

Instead of mere theoretical models of how individuals learn (for instance, consider the idea of "schema", first raised in 1932 by Frederic Bartlett and still applied by educators today), we now know more (though still far too little) about how our brains work. For instance, the importance of sleep in relation to learning has never been doubted but there is now evidence of the underlying mechanisms. It has been observed that during sleep, the glial cells surrounding our synapses help to remove excess chemical by-products which accumulate in the process of neuronal firing.

Some other findings point to the need to re-design the way lessons are taught. Consider the experimental findings relating to memory. Within the neo-cortex, working memory is strongly correlated with the pre-frontal cortex. Long term memories on the other hand, are more strongly associated with other regions.

This has consequences for how we conduct lessons since the aim is to ensure that students transfer as much content to their long term memory as possible.

On that note, we also know more about long term memory now than as before. Instead of being static, our store of memories is constantly being pruned, with neural connections being rerouted where a piece of information is not as frequently used.

Translated to the classroom setting, this means that instead of putting students through discrete modules which are not tested till the end of the academic year, students may in fact internalise more information through periodic information retrieval/examination throughout their education cycle.

Moving on, there are other facets of brain function which can shed light on optimal modes of learning. This includes the relationship between brain activity and blood glucose level. In particular, the latter needs to be kept at a constant level to prevent dips in mental concentration.

In future, findings from experiments using real-time electroencephalography will also be able to inform the way that we conduct lessons (for a further discussion see Phase 3 at 5.1 below).

3.1.6   Curiosity as its own justification

In my limited time as a tutor, those moments where my students' eyes sparkle with curiosity remain a great source of satisfaction.

To see individuals moved by innate desire to understand the world around them and ponder their place in it, in healthy exercise of their autonomy, with the unspoken and perhaps still unknown object of realising who they really are; that is reason enough for me to continue with this endeavour.

3.2 Objectives

See 5.1 below.

4. CHINA INITIATIVE

4.1 Key Motivations

Rural communities are the main focus for Ellume because of the challenges they are facing: a net outflow of individuals and the attendant detrimental effects.

There are several factors which contribute to the outflow mentioned above. First, there are better employment prospects in neighbouring cities.

Second, the PRC compulsory education framework (九年义务教育) tops off at the junior high school/middle school level (when students are around age 15). In rural communities, the lack of higher education institutions means that students (sometimes with their immediate family) move to the cities in pursuit of further education. Many then choose to stay on in these cities.

This outflow of individuals has negative consequences. Back in the villages, the elderly are left behind with the very young while bread winners seek employment in the cities. This weakens the social support system for both groups. Young children grow up in the absence of parent figures while migrant adults are cut off from those that they are emotionally connected to, often having to put up with sub-optimal living conditions due to the higher cost of living in the city.

4.2 Objectives

It goes without saying that the prevailing educational infrastructure in the rural communities is vastly different from the situation in Singapore. Consequently, Ellume's objectives for the China Initiative have to be formulated with this in mind.

The luxury of learning for learning's sake must be tempered by economic reality: the living standard for the communities we are looking at is such that education is very much a means of survival – a way to escape poverty and a life of hard labour on the farm.

Remote access to education through wireless means is the main goal here. By providing further education which can lead to technical qualifications, Ellume hopes to eventually create online job opportunities for individuals and contribute to the efforts being made to stem the net human outflow in these rural communities.

To do so, Ellume will partner with Sowers Action, a Hong Kong charity established since 1992 and which has had a strong presence over the years in Yunnan Province, China.

5. ROADMAP

The Initiatives can be divided into three phases. These phases correspond to the estimated time required for their implementation, with Phase 1 being the shortest and requiring 1 to 2 years, Phase 2 requiring up to 5 years or above and Phase 3 requiring close to 10 years or above.

5.1 Singapore Initiative

Phase 1	With Ellume's focus on autonomous learning in mind, this phase aims to help individuals (in particular, students around the age of 13 and above) learn more effectively on their own.
	There are two aspects to this: a) substantive learning; and b) meta-learning. Their relationship is illustrated by the following diagram.
	Substantive Disciplines Chemistry Economics History Geography Biology Literature Physics Others **Meta Cognitive Backbone** Critical thinking: source/fact checking, cross reference, underlying assumptions, cognitive biases, guess calibration Memory: working, long term, aids (memory palaces, mnemonics) Brian chemistry: blood glucose, acetylcholine, dopamine, serotonin, amphetamine etc
	First Component - Meta Cognitive Backbone
	As its name suggests, the meta-cognitive backbone forms the underlying framework for learning all other types of content. Therefore, we will deal with it before moving on to the substantive learning component.
	In equipping individuals with the skills needed to learn on their own, Ellume will aim to apply pertinent and contemporaneous research findings in the fields of memory, cognition as well as neurochemistry.
	1) Memory Palaces
	The use of memory palaces relies on a particular scientific observation. Most people have a heightened sense of spatial awareness which allows them to remember places more easily than numbers. By placing key ideas, concepts and other information in the palaces (i.e. a location), information retrieval is improved[4].

[4] Qureshi, A., Rizvi, F., Syed, A., Shahid, A., & Manzoor, H. (2014). The method of loci as a mnemonic device to facilitate learning in endocrinology leads to improvement in student performance as measured by assessments. *Advances in physiology education*, *38*(2), 140–144. https://doi.org/10.1152/advan.00092.2013

An example of a possible memory palace is provided below (in this case, a stairwell in Greece).
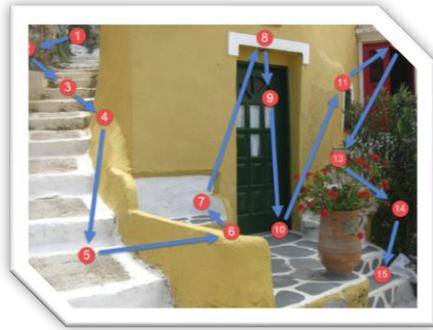
This memory technique is most efficient when a suitable memory palace (i.e. a place which participants have a strong impression of) is used.

Memory palaces can be further combined with a pegging system (like the phonetic alphabet peg) to increase the range and volume of information that can be memorised.

End product

Ellume will create bespoke memory palaces by taking images and videos of familiar locations in the students' school environment. The material that needs to be memorised can then be "visually placed" in these palaces. The mode of execution can take two forms:

a) Ad hoc courses conducted as electives/sabbaticals for students

b) Collaboration with curriculum coordinators for the purposes of helping students memorise a particular type of information (e.g. topics in Biology, History, Olympiads etc)

2) Brain Chemistry and Nutrition

The absorption, retrieval and application of information is often seen as an intellectual and therefore mental process.

This belies the physiological foundations of cognition. Research into glial cells, GABA receptors, blood sugar levels and dopamine feedback loops have shown that these have a role to play in regulating brain function.

End product

a) Information checklist for users to assess their daily habits and ensure optimal brain function at the physiological level (e.g. length of sleep, types of food to avoid during exam-taking, explanation of blood sugar-insulin feedback mechanism)

b) Customised daily nutrition pack for students tackling a series of examinations over a 2 to 4 week period

3) Thinking Rationally

Most of us like to think that we are, for the most part, rational individuals. What we often fail to take into account is how much happens through our subconscious, through a series of reflexive neural responses accumulated in our genetic makeup across millennia. The latter has its uses but unfortunately also causes us to make bad decisions in the modern world. Take for instance, the tendency of individuals to be loss adverse. Experiments have shown that individuals accord a disproportionate weight to the risk of losing something as compared to the chance of gaining something even when the probabilities are matched.

For starters, Ellume hopes to evaluate the heuristics (rules of thumb that guide decision making) that accompany us in daily life and identify those that tend to lead to poor decision making.

End product

Rational+ courses: a long term relationship with the Centre for Applied Rationality in the US to conduct workshops that aim to identify cognitive biases, question underlying premises and help individuals think more rationally

4) Making Critical Analysis a Habit through Gamification

A lot of learning in fact takes place beyond the classroom. But the nature of casual social interactions is such that information exchange is not rigorously scrutinised. This leads to the promulgation of unsubstantiated statements (which would not stand up to close scrutiny) that become lodged in the minds of individuals due to constant repetition[5]. Games are a far more acceptable medium in social situations outside of the classroom and can help to bridge this impasse between being intellectually rigorous and being socially pliant.

End product

"Wait a Sec" -- a card game to encourage socratic questioning in casual settings where similar to the game of tag, player A "tags" another player B with a card when B makes a questionable statement. Cards involving different characters are available. Each character deals with a type of issue that B's statement faces (e.g. unverified claim, over-generalisation, fallacy etc). B then has to provide evidence the next time the pair meet or perform a forfeit.

Sample:

- Front of card (details different characters that can be used to "tag" the other party, with matching aesthetics to appeal to students)

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[5] Take for instance, the commonly refrain that beef can be eaten raw but not so for pork or chicken

- Back of card (describes the actions that can be performed once a card is "played", QR code enables the game to be tracked on an app)

Second Component - Substantive Learning

1) Applied Learning

An anecdote may be appropriate at this juncture.

As a science student, Ben had his fair share of experiments in the chemistry lab. But he never really understood what titration was for despite having done all that fancy swirling.

Many years later, Ben realises that he is getting old and needs to eat healthily. So he starts looking into the nutritional content of different foods. In particular, he wants to find out how much Vitamin C can be obtained from an orange (this would affect how many oranges he needs to consume each day).

There were many factsheets available online but Ben isn't convinced. For instance, although the UN FAO factsheet states that an orange contains 1000mg of Vitamin C, the variety/size of oranges varies across regions. Ben has no proof that the orange in his hand has anywhere close to 1000mg of Vitamin C. He wants to test this empirically. And after close to ten years, Ben finally has his moment of epiphany – he realises how the titration/back titration he did back in school can be of use.

The point of this anecdote is to illustrate how there is often a mismatch in the frame of mind between two parties: the conveyor of knowledge and the receiver.

In terms of learning, the proverbial moment where "things click" varies from individual to individual, depending on the stage in life that they're in, their current pre-occupation etc. Consider how parents are often keen to dish out advice to their teenage offspring, only to have such advice fall on deaf ears till many years later.

Often the timing might not be ripe. Or the individual may simply lack an environment which helps him to draw the connections between what is being taught and why it is relevant. Regrettably (though quite understandably), our

	educational institutions often prescribe content to learners in a way which is abstracted from daily life, in a uniform manner according to a uniform timeline.
	
	Ellume hopes to help learners bridge the gap between abstract knowledge and its application in life (i.e. answering the question "why does this matter at all?") by linking topics to practical tasks and challenges.
	
	End product
	
	See below.
	
	2) Gamification and Autonomous Learning
	
	Many educational games have an interesting property; they encourage the player to engage in semi-autonomous learning within certain guiding parameters. Examples abound on how important scientific knowledge and skills may be imparted through gameplay. For instance, see Foldit (online platform where players help to test protein folding configurations) and Mozak (users help to trace neural connections in images of mouse brains taken using serial-section electron microscopy). This is very useful in light of Ellume's focus on promoting autonomous learning.
	
	End product
	
	sCoolplay[6]: a line of games which serve as substitutes for syllabus modules within a formal academic curriculum produced in collaboration with:
	
	    a) educators in each of the substantial disciplines; and
	
	    b) game design organisations including Press Start Academy (Hong Kong) and Clubon (Taiwan)

Phase 2	Planning for activities in this phase will be contemporaneous with Phase 1 but unlikely to be introduced until the end of Phase 1. This is because Phase 2 activities are resource intensive activities and will involve extensive research into academic literature as well as consultation with subject matter experts. It is also likely that such activities will not be revenue generating in and of themselves. Phase 1 activities therefore serve the important role of providing financial support for Phase 2 activities. 1) Cross Discipline Deep Diving This section references the predicament of Ben in scenario (b) under 3.1.2 above. How can we make it possible, in an age of intense specialisation, for individuals to rapidly pick up knowledge outside of their area of expertise while avoiding the pitfalls of someone who comes to a subject/field as a stranger (including excessive time commitment, systemic misunderstanding etc)? *An illustration relating to the field of law:* Kevin is an engineer by training. In 2010, his aging mentor Stanis says that when he dies, his house will go to Kevin. Because of this promise, Kevin never buys a house of his own. But Kevin is worried. What if Stanis dies and it turns out that he

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[6] Pronounced: "School-Play"

doesn't actually bequeath his house to Kevin? Under the law does Kevin have any protection?

To locate the answer, Kevin spends many hours on google but soon realises that there are too many conflicting answers out there. Same for forums. Textbooks on the subject are dense and thick. Kevin finds an Australian case that seems to be based on facts that are very similar to his, but he has no idea if Australian cases can be relied upon in his jurisdiction.

Kevin's situation illustrates the potential hazards of venturing into an unknown field without any formal guidance:

a) Time incurred as a result of wild goose chases
b) Uncertainty as to what counts as authoritative sources of information
c) Haphazard accumulation of knowledge due to the absence of a systematic framework
d) Acquiring factual and conceptual inaccuracies during the self-learning process

A subject matter expert (in this case, a lawyer) would be able to assist Kevin. But everyone's time is precious. Lay persons are unlikely to have ready access to experts without formally engaging their services.

Where the need is largely driven by academic curiosity[7], what alternatives might there be? In Kevin's case, instead of actually providing advice, a lawyer could assist Kevin in his search by providing guidance on how to acquire legal information. This will be referred to as meta-guidance and in the legal context, can comprise issues like:

a) what counts as a source of law and what is mere opinion; and

b) how the credibility of information located can be ascertained

End product

CIRFGen[8] – a standard protocol for cross-disciplinary information retrieval and framework generation (in other words, giving individuals meta-guidance on how to retrieve information and organise the information according to a cognitive framework)

Underlying Principle:

While the acquisition of content is a lifelong process, rules on how to acquire content can be picked up more easily and within a short span of time.

Goals

The protocol should:

1. Identify sources of credible information which will serve as initial points of enquiry

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[7] Formally engaging an expert serves a variety of other functions. This can include compliance with government regulations, mitigation of liability etc. When knowledge is sought for such purposes, individuals should of course hire an expert.

[8] Pronounced: "Surf-Gen"

2. Set out subject specific methods for assessing the credibility of information located

3. Ensure that knowledge obtained by users can stand up to some level of scrutiny:

    a. Anyone conducting a Google search can obtain information and plausible answers. That is far too low a threshold. CIRFGen users must obtain knowledge that can stand up to scrutiny. But what exactly does such scrutiny entail?

    b. It is proposed that an "undergraduate test" be applied. The test can be formulated thus: when Y explains his recent findings (as facilitated by CIRFGen) to a target X who has been exposed to that particular field at the undergraduate level, Y's exposition of the core facts and concepts are accepted and any peripheral statements made by Y are only subject to minor corrections by X.

    c. Asides from that, a tiered system of error tolerance also needs to be put in place:

        i. Low tolerance – CIRFGen users (a) cannot come away with incorrect statements of fact (e.g. glucose molecules have 6 carbon atoms) [9] and (b) must be able to apply acquired concepts correctly (e.g. after learning about inertia, a user should be able to conclude that when X jumps upwards in a moving train, X will not be slammed into the front of the carriage)

        ii. Moderate tolerance – for normative statements (e.g. the role of law in society is to enforce morals), hypotheses and unsettled concepts, there is greater room for discussion

4. Propose ways for users to check their understanding after a period of self-learning

    a. Theoretical clarity VS messy reality: Ellume takes the view that it is more important to relate our learning to the world as it is and far less important to work towards the model answer in an assessment book. This has an impact on how users check their understanding because being correct is more than just being validated by what a textbook or group of people say

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[9] The issue of detail/level of resolution: the principle we adopt here is that less is not = wrong. How deep a user intends to go in his/her search is dependent on individual needs. So even if Daniel doesn't know the configuration of the carbons in a glucose molecule or whether they have cis/trans arrangements, Daniel is not deemed to have factual errors in the process of deep-diving into another subject.

Preliminary Template:

	Biology	Law
Fundamental building blocks	• Experimental findings • Principles (Hayflick limit, Hardy-Weinberg etc)	• Legislation (statutes, regulations, bylaws etc) • Cases
Authoritative institutions/ sources	• Research journals (Nature etc) • [Pending further input from subject matter specialists]	• Links to official websites (Hong Kong e-legislation website, Singapore Statutes Online etc) • Case databases (Lexis, Westlaw, Bailii etc)
Sources of opinion	• Textbooks • [Pending further input from subject matter specialists]	• Textbooks (Treitel, Dicey Morris & Collins: The Conflict of Laws, Salmond on Torts etc)
Framework for organising knowledge acquired	• Textbooks [Pending further input from subject matter specialists]	• [Pending further input from subject matter specialists]
Ways to check understanding	• Textbooks • [Pending further input from subject matter specialists]	• [Pending further input from subject matter specialists]

Caveats

From the outset, it is admitted that specialisation of knowledge is quite inevitable in this day and age. It is also quite impossible to expect that a few weeks of deep diving in unfamiliar waters will confer greater proficiency in a field than someone who has spent years researching the same. Indeed, the current framework is still highly preliminary in nature and further discussion with subject matter experts will be required to ensure that it can be put into practice.

But the core motivation for CIRFGen remains clear. It is about encouraging individuals to venture out of their comfort zone, into areas beyond the realm of their expertise. It is about broadening the scope of own's knowledge and replacing paradigms from the earlier years of one's education which have since become obsolete. This is done by providing a framework for deep-diving which reduces the attendant obstacles and risks.

2) Computer assisted learning

This is largely aimed at individuals in Singapore who remain unable to obtain access to education. See roadmap for the China Initiative below.

Phase 3	Phase 1 and Phase 2 address specific motivations. In contrast, Phase 3 has a broader ambit and the proposed activities are more suited to explanation in the form of questions: 1) What is Understanding? What does it look like? In 2016, I spent some time working at a tuition centre. One of the skills we learnt was how to "activate schema". I didn't understand the concept back then, but the objective was simple. Create an exercise or talking point which will help engage the student (I treated it like turning on the lights in a dim house) — this makes the delivery of your lesson content more effective because the student is "on the same page". Alongside the use of schema, tutors would also set assignments which would test students on specific concepts taught during class (known as checking for understanding) to see if they had actually understood said concepts. But what if there is a more direct method of assessment? If we have a fever, we take it as a symptom, an indication that we might have a viral infection. But the most direct approach is in fact to test for the virus in one's bloodstream. What then is the most direct way of determining whether a student has understood something? Based on the prevailing literature in the field of cognitive neuroscience, it is clear that thought is related to the combination of action potentials created in the firing of individual neurons throughout various regions of the brain. The resulting neural pattern is distinctive (for instance, the act of sleeping produces a different neural pattern from when someone is asked to mentally rotate a 3D object along its axis). If so, is there a particular neural pattern at the point where someone says "Oh I get it!" By examining enough students who indicate comprehension of a particular concept, can we arrive at a distinctive neural pattern called Understanding? **Thought Experiment** Suppose we gather a group of students and set them a puzzle. As they try to solve it, we monitor their brainwave activity using electroencephalography. In our case, let's say the puzzle involves five animals which have to cross the river. Two animals must always be on the boat, and the carnivores on the boat must not outnumber the herbivores. Once the students think they've figured out the solution, they key it in by tapping a button. Let's call this the "oh I get it" moment, "OIGI" for short. Students who tap the button and get the correct solution are classified as "OIGI-C" (correct) and those who provide an incorrect solution are classified as "OIGI-A" (attempted). Students who don't tap at all are classified as "ST" (still thinking). Now we take the brainwave recordings of all the OIGI-C students and do a comparison. Is there a common pattern/level of neural stimulation which can be observed that is not present in the A or ST students?

| | If the answer is yes, then perhaps understanding[10] does have a distinctive neural pattern that allows for identification? The next step would then be to test for the existence of such a pattern in different scenarios.

Now imaging a scene from the future: as students step into class, the scanner on the door checks their blood glucose level and logs their neural activity for use as a baseline against neural activity during the class itself.

The content for class is delivered by video. On the side, a teacher monitors the brainwaves of each student for OIGI moments at specific time stamps in the video where a concept is being introduced or has to be applied.

For students who do not display any OIGI moment, the teacher can provide further explanation for the students.

At this point I invite you the reader to question the premise that understanding has, and can be identified by, a particular neural signature. Does the thought experiment work and if so how does it pave the way for individualised teaching made possible by tools that can assess a student's subjective frame of mind, beyond what a teacher can deduce from external indicia? |
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5.2 China Initiative

| Phase 1 | Collaboration with Sowers Action, liaising with its officers in Yunnan Province and arranging for field trips to specific rural communities with a view to determining:

    a) State of educational infrastructure (physical)
    b) Pressing concerns of households
    c) Type of educational content desired
    d) Attitude of local authorities towards foreign involvement
    e) 3 specific villages to which assistance will be rendered

At the same time, Ellume will look for volunteers through local teacher networks at the provincial level. |
| --- | --- |
| Phase 2 | This stage begins once the education infrastructure is in place (in particular, stable power sources, wifi and computers).

1) Learning in place - web based educational qualifications

Teaching is done partly through the web by volunteer teachers and partly through the recruitment of local allies. A central assumption to Ellume's operations is that intelligence is normally distributed in any given population. By locating the brighter students and instilling in them a responsibility to pass on knowledge to their peers after they have internalised the same, we ensure that there will be individuals who are able to perpetuate the learning process even in circumstances where volunteer teachers are engaged in other commitments. |

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[10] It might be the case that there are different types of understanding. For example, the neural activity involved in solving a maths problem could be different from understanding the concept of carbon dating and using that to explain why metals cannot be carbon dated.

		For many students, the purpose of education is a certificate that leads to better job prospects. With this practical concern in mind, Ellume will attempt to partner with local educational institutions to provide online certification for the students and have organisations recognise such certifications. The goal is to avoid the situation where children are forced to leave their support network for larger cities because these places offer higher education facilities and greater employment opportunities.
Phase 3	1)	Working in place - web based employment In the context of the China Initiative, it is impractical to provide education which does not lead to an enhancement in employment prospects. With the help of other organisations, Ellume will canvass support from newer industries keen on keeping labour costs competitive and whose business operations can accommodate employees who work remotely.
	2)	Living in place Ellume's long term goal is one where the villages no longer experience a net population drain, with younger individuals being able to find employment online, where the general rural population benefits from the application of scientific techniques to their farming, with the effect that the social support system in the form of families and relatives is preserved, and a net cash surplus is generated which can pay for essential services and products that cannot be replicated at the village level (e.g medication, hospital facilities, electronics).

6. OPERATIONAL ISSUES

Ellume currently has one member and director. It is envisaged that Phase 1 activities will be rolled out between 2023 and 2024. In the meantime, the incorporation of Ellume on 21 May 2020 has provided part of the groundwork required to put the envisaged activities into operation.

To better comply with corporate governance guidelines, steps are being taken to expand the board to at least three executive directors by 2024 with two independent non-executive directors by 2025.

7. FUNDING

7.1 Main Sources

It is envisaged that Ellume will derive revenue from the following sources:

1. Initial personal funding
2. Crowdfunding
3. Ongoing retainers with schools to conduct sabbaticals and related enrichment courses (these are largely Phase 1 activities which will serve to defray operational expenses)
4. Courses/Seminars for the public
5. Government grants
6. Donations -- Ellume is currently incorporated as a non-profit company limited by guarantee. The eventual goal is to obtain IPC (Institutions of a Public Character) status to incentive donors.

POSTSCRIPT

To the reader: if you've made it thus far, thank you. Thank you for taking the time in a world where comfortable distractions lie within arm's reach and are legion. The production of this primer has occurred in fits and starts but at long last there is some semblance of its final form. The road ahead is by no means certain but our common convictions shall light the way.