Ophthalmic learning through the lens of cognitivism and constructivism

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Learning in ophthalmology is multi-faceted, from understanding the fundamentals of eye anatomy and physiology to higher order skills such as performing cataract and vitreoretinal surgery. Having a strong foundation in the basics is a necessity for higher order knowledge synthesis, which enables ophthalmologists to deal with complications in theatre as they arise, making complex clinical decisions, as well as advancing clinical research. In this essay we will briefly explore two learning theories which are core to the understanding of medical education itself; relating these to the discipline of ophthalmology to facilitate understanding.

Distinction between the theory and principle

The distinction between a theory and principle is an area of medical education which often causes students lots of confusion. There are a few different perspectives about the essence of what constitutes a theory. It's sometimes described as a "comprehensive, coherent and internally consistent system of ideas about a set of phenomena". Essentially, this is the framework which learners can use – amongst other things – to make sense of today's world [1]. A principle on the other hand follows more along the lines of instructions, guidelines and rules – which are meant for practice. These are generally phrased as a clear statement. For example, "intraocular pressure must be checked in patients with suspected glaucoma".

In essence, a good principle is one that encompasses literature which supports it, and has a broad relevance which can be generalised [2]. It should also be relevant to both educational practices as well as assessments. To highlight the difference between an educational principle and an educational theory, we can say that a principle is generally a rule or instruction made as a statement – whereas a theory follows more along the lines of a schema of notions grounded in evidence.

There are five established learning theories: cognitive learning theory, behaviourism learning theory, constructivism learning theory, humanism learning theory and connectivism learning theory. For this exploration we will focus on cognitivism and constructivism – exploring how they may be incorporated into ophthalmic learning.

Cognitivism

Cognitivist theory stemmed from the essential criticism arising from another theory – behaviourism, which only focuses on behaviours (in particular on stimuli and response), whilst ignoring some of the higher mental processes which are manifest in the learning process. It focuses on the thought processes behind behaviours which occur. These are made up of 'meaning making', 'perception' and 'memory'. These are used to elucidate what's happening on a deeper level within the mind itself.

The understanding of memory is an area which naturally follows when learning about this theory. Memory is an integral part of our lives and its study is intricately linked to understanding how each of us learns. There are many facets to memory itself [3]. It involves three fundamental processes ranging from encoding to storage to retrieval. The first stage involves encoding. This relates to how information is initially put into the memory itself and this leads nicely onto the next stage, the storage stage, which pertains to how information is stored in the memory. The third stage, retrieval, deals with how information is retrieved [4]. For example, learning the Ray Diagrams in optics and committing this to memory – recalling them during a refraction assessment.

Memory can be described as short-term – tautologically this is known to have a relatively short time span and is limited in its overall capacity in terms of how much can be stored (this varies between individuals depending on their cognitive capabilities). On the other hand, some of this short-term memory is encoded for longer-term use. Contrasted with shorter-term memory this has an unlimited capacity and it can be used to form more substantial and meaningful relations when encoding novel information. The term for this is elaboration [5]. Learning to recognise retinal detachments with frequent exposure and elucidating underlying causes.

Furthermore, the encoding stage is split into three main domains, visuals (pictures), acoustics (sounds) and semantics (meanings). In essence, this theory deals with details of how information is ultimately received and organised and then stored by the mind – which is seen to be alike to a processor.

Application of cognitivism

With relation to applying the principle, it would be worthwhile to focus on the encoding elements of the educational theory. As aforementioned these comprise of the visual, acoustic and semantic domains. If we're to deliver a lesson to undergraduates studying ophthalmology we could focus on the visual domain to illustrate the passage of light through the cornea, pupil and lens before the retina (illustrative example).

We could do this through visuals and diagrams showing a source of light entering the eye and numerically ordering the parts of the eye it travels through. By illustrating these steps through the cornea initially, then through the pupil and lens to the retina, we can teach undergraduates the fundamentals of eye anatomy. These may also be done through the use of flashcards commonly used for revision purposes by undergraduate medical students. In terms of learning via acoustics, teachers could disseminate audiobooks talking about the passage of light to similarly enable learning to come about. Semantically, we could link the idea in with creating a mnemonic for an ophthalmic concept and this assists with deep memory encoding. For example, a simple 'ABCD' for starting to list some medications that can cause cataracts (Amiodarone, Busulfan, Chlorpromazine and Dexamethasone).

The benefits of this approach revolve around the visual stimulus helping to form a deeper understanding of what's actually going on in the system. It can be of particular benefit to learners who have been shown to respond more positively to visual learning styles. One of the drawbacks of this is that it can be incredibly complicated to visually illustrate

some more difficult concepts which would aid the encoding stage. For example, the route from the optic nerve through the lateral geniculate nucleus to the primary visual cortex – as taught in neuro-ophthalmology when teaching occurs in relation to visual pathways.

'Blooms taxonomy' is commonly accepted as a derivative of the theory of cognitivism. In essence, this pushes for the coming together of higher-order thought from lower-level cognitive skills [6]. For example, in ophthalmology, knowledge of the fundamentals of eye anatomy are required to understand the more complex intricacies of cataract surgery.

Higher order learning comprises mainly of synthesis and evaluation. This involves combining information before a unique end product – as well as making choices which ultimately require the understanding of the underlying values inherent. For example, complications which may occur during phacoemulsification and how to deal with the particular complication encountered – like a posterior capsular rupture.

Constructivism

Constructivism deals with how we all form our own perspectives and ideas about the world – through unique, individual conceptions and experiences. This theory enables learners to solve issues and problems in unfamiliar and novel situations. One of the core tenets behind this theory is that learning is unique for each of us because of our individually unique set of experiences, circumstances and resulting perceptions. It is often said accordingly that it's not possible to separate an individual's personal experience from knowledge [7,8]. We can relate this to ophthalmic training by acknowledging how different individuals will have had differing levels of experience with eye pathologies. For example, former optometrists and their knowledge of refraction, and former orthoptists and their knowledge of defects in eye movements.

There are some key principles surrounding this educational theory. It is noted that conceptual growth comes from negotiation of meaning and that learning should be situated in realistic settings. Furthermore, it is noted that assessment and testing should be integrated with the tasks involved rather than as separate activities [2,9].

This idea was expanded upon and the argument is made that education is about conceptual change and not merely the acquisition of information [8]. The reason for this is that as we progress along the learning journey our worldview changes. Crucially, it's important to distinguish that it's not the acquisition of information which brings about such change, but rather, the way that this is consequently structured and the evolving thought processes therefrom.

Application of constructivism

There are a few key principles stemming from constructivism and these include accepting that learners are active participants, they are self-regulating, that social interaction is necessary for effective learning to occur, and that they are encouraged to make sense of the information for themselves [10]. Group collaboration between ophthalmologists during teaching afternoons, allowing them to bring their own cases and presentations into the learning sessions to discuss these is demonstrative of this.

In saying that learning should be situated in realistic settings, we could use learning about the use of slit lamps in ophthalmic outpatient clinics as a context where this could apply. Learners should be given first-hand instructions then examined on their knowledge of pathologies as cases arise (e.g. lens subluxation in patients with Marfan's syndrome).

We can apply the principle that learners are self-regulating to the Problem Based Learning education model in group learning about glaucoma. It has been postulated that the teacher is someone whose aim to is to guide the process rather than direct – and that this learning session is based upon learner's prior knowledge [11,12].

The lesson may involve starting with a case and then drawing on individuals' experiences and knowledge to find out what they know already about the pathophysiology of glaucoma. What could lead to increased intraocular pressure? How could treatment be tailored to this patient's needs and circumstances? This involves developing learning outcomes that learners leave to study independently in preparation for the next session. This may involve looking into the medical and surgical management of glaucoma, the rationale for these approaches – allowing learners to elaborate on these.

Conclusion – more insights into ophthalmic learning

Knowledge of learning theories would be useful for ophthalmologists as well as other physicians to explore. This may enable a deeper understanding about the rationale behind the different activities' students and trainees are exposed to in the learning process. Ranging from eye anatomy and physiology, to complex cataract surgeries, to dealing with complications that may arise in ophthalmic theatres – there is a case to be made that learning about the acquisition of knowledge may lead to more insightful learners and ultimately practitioners.

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