Applying the learning theories to medical education: A commentary

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Abstract: Medical education of today continues to evolve to meet the challenges of the stakeholders. Medical professionals today are expected to play multiple roles besides being experts. Thus, the curriculum has to be developed in a manner that facilitates learners to achieve the intended goal of becoming a medical professional with multiple competencies. The understanding of learning theories will be helpful in designing and delivering the curriculum to meet the demands of producing a medical professional who would meet the CanMEDS model. This commentary explores and reflects on the learning theories of behaviorism, cognitivism and constructivism as they have evolved over time and the application of these learning theories in medical education, particularly in the context of medical education in Malaysia. The authors are convinced that these three theories are not mutually exclusive but should be operationalized contextually and throughout the different stages of learning in the MBBS curriculum. Understanding these theories and their application will enhance the learning experience of students.

Key words: learning theories, behaviourism, cognitivism, constructivism, medical education

Introduction

Formal education in the formative years of the developing child have evolved over the years and have become the fabric of modern living. Education plays the key to success in life and both learners and educators host a variety of methods to ensure successful learning. Learning is a life-long process and is particularly important in the developmental stages of the individual. The individual's ability to grasp information, assimilate and accommodate such information has been utilized to prepare instructional materials for effective learning and efficient adoption for understanding of such materials in achieving learning outcomes.

The potential of learning can be exploited through an understanding of the principles of learning, the environment the child grows in and the external influences he is exposed to that impacts on him. This is explicable through the learning theories enunciated by psychologists.

Behaviorism is the earliest of the three classical theories of learning popularised by Watson following observations drawn from Pavlov's conditioning theory. Other workers like Thorndike and Skinner contributed to the principles drawn by Watson that behavior that is observed and measured in response to external stimuli and environment underpinned learning and behavior. Classical conditioning, operant conditioning and social modeling are the three aspects of behaviorism. Behaviorists have maintained that the 'mind' has little place in learning as explicit measurable variables are lacking.[1, 2, 3]

The cognitivist revolution replaced behaviorism in the 1960s as the dominant paradigm. *Cognitivism* focuses on the inner mental activities – opening the "black box" of the human mind is valuable and necessary for understanding how people learn. Mental processes such as thinking, memory, knowing, and problem-solving need to be explored. Knowledge can be seen as schema or symbolic mental constructions. Learning is defined as change in a learner's schemata.[4, 5, 6]

Unlike processes involved in behaviorism and programmed instruction, *constructivism* relates to a contextualized process of constructing knowledge rather than acquiring it. Knowledge is constructed based on personal experiences and hypotheses of the environment. Learners continuously test these hypotheses through 'social negotiation'. The learner is 'not a blank slate but brings past experiences and cultural factors to a situation'.[7, 8]

Medical education of today continues to evolve to meet the demands of stakeholders. The 1996 CanMEDS Competency Framework defined clusters of competencies referred to as "physician roles" where

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apart from being a medical expert (the central role), a physician is also a communicator, collaborator, health advocate, manager, scholar, and professional.[9] In order to achieve these competencies, the medical curriculum of today has to be developed in a manner that facilitates students' learning to achieve these goals.

This essay will attempt to reflect on the three main learning theories as they were developed since the 1900s and explain their basis for learning in medical education using examples the writers are familiar with in the Malaysian context. We shall also try to compare the differences in the three main theories used in the discussion i.e. behaviorism, cognitivism and constructivism.

The gender used in the discussion 'he/his' will refer to both male and female gender and is not exclusive in its meaning.

The Theory of Behaviorism

Behaviorism assumes a learner is essentially passive; responding to environmental stimuli. The learner starts off as a clean slate (i.e. *tabula rasa*) and behavior is shaped through positive reinforcement or negative reinforcement. Both positive reinforcement and negative reinforcement increase the probability that the antecedent behavior will happen again. In contrast, punishment (both positive and negative) decreases the likelihood that the antecedent behavior will happen again. Learning is therefore defined as a change in behavior in the learner. The behaviorists found the"'works' of the mind too difficult to observe and conveniently excluded it from their initial findings. They clung to the concept that only behavior that is observable and measurable should be studied and applied. Whilst the behaviorist approach can be applied to learning and behavior, educational "gurus" question its application to more complex learned behaviors especially when linguistics and problem solving activities are concerned.

A large amount of early behaviorist work was done with animals and generalized to humans. Ivan Pavlov's experimental work on dogs illustrated the impact of stimulus on responses and paved the way to the use of rewards to learn i.e. the classical conditioning reflex. This formed the basis for John Watson in 1925 and later Joseph Wolpe in 1958 to apply experimental findings to learning in humans. It also led to the development of educational psychology.[1, 2, 3]

B.F Skinner introduced operant conditioning as re-enforcers, whether they were positive or negative, to achieve desirable goals which were pleasurable or comfortable to the learner. Later 'punishment' re-enforcers were included for the 'not-so pleasurable behavior remedy.[10]

In medical education today, many of the principles of Skinner are employed especially in relation to giving feedback on students' assignments and performance.[11] By providing them feedback with critical comments the reinforcing effect is evidenced by the student's ability to improve his performance and to defend his cases. This contributes to effective formative assessment. Motivation is sustained through encouragement and positive comments when a student successfully completes his assigned tasks.

The behavioral approach of 'modelling', introduced by Bandura in the 1940s lent to the basis that people learn through observing others' behavior, attitudes, and outcomes of those behaviors. "Most human behavior is learned observationally through modeling: from observing others one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action."[12] Medical undergraduates are naturally placed in a learning environment where positive and negative elements are present for them to use as models for their learning.

The under-pinning principles of behaviorism (classical conditioning, operant conditioning and modeling)

clearly spell out that current behaviours of the learner are learned outcomes. These principles can be used to enhance or modify behavior. The latter is especially applicable when deviant or socially unacceptable behavior is observed.

A useful link in learning is to evaluate the outcome of the evoked response to stimulus (i.e the task) through feedback. This process of getting feedback is a powerful tool as the learner will be given an opportunity to correct his mistakes to get the optimum and correct outcome. The process will also determine the actual development of the individual so that the instructor will provide contents that will fulfill his capacity for learning. Taking remedial measures when the operator does not get the desired response is a good re-enforcer for effective learning.

When one extrapolates the concepts of behaviorism to learning one can demonstrate the application of the principles. For instance when a question is posed, and adequate time is given for a response, the learner uses his conditioning response to reply. The teacher then comments on the response, whether it is correct or incorrect, using appropriate verbal and body language. The teacher who is utilizing the behaviorist approach would use re-enforcers to make learning efficient and effective. In this model, the teacher is in control and learning can be construed as 'passive'. But all three elements of classical conditioning, operant conditioning and modeling may operate during the process.

The Application of Cognitivism

Unlike behaviorism, cognitivism emphasizes that people are not "programmed animals" who merely respond to environmental stimuli; people are rational beings who require active participation in order to learn, and whose actions are a consequence of thinking. Changes in behavior are observed, but only as an indication of what is occurring in the learner's mind. Cognitivism uses the mind as the computer: information comes in, gets processed, and certain outcomes are produced. It reflects on the crucial role of the mind as it involves several abstract yet not so easy measurable attributes. Thinking, memory, self-reflection and motivation are attributes that make learning effective. The sequential steps in learning of the recipient as a learner is portrayed through *information processing* after receiving information through the sensory-motor processes, encoding and committing to short (working) and long term memory. However, this simple array of processes would not explicitly explain the variety of outcomes seen in the learner given the same stimulus or data. Much of these differences could be due to varying learning styles, especially when it involves the more experienced or adult learner. This clearly points to the characteristic traits learners have especially in higher order learning and problem solving.

Jean Piaget contributed immensely to the understanding of the individual's capability of assimilating and accommodating information and pioneered the concepts of schemes to explain how assimilation may advance to accommodation when the 'primary schemes' no longer are able to handle 'experiences and information'. The external behavior of the individual is a manifestation of the mental processing and organization occurs according to these schemes. The entire process is directed by a 'biological drive' and the manifestation i.e. behavior, is a result of balance between schemes and environment (equilibration). Vygotsky also included socio-cultural contextual influences in learning, building on Piaget's theories. The latter theory could be applied to the socially disadvantaged individuals who do not perform as well as those who come from a stable and conducive environment.[7, 8]

Cognition in education is operational in medical education. Gestalt's views of learning have been incorporated into what have come to be labeled cognitive theories. Two key assumptions underlie this cognitive approach: that the memory system is an active organized processor of information and that prior knowledge plays an important role in learning. Cognitive theories look

beyond behavior to consider how human memory works to promote learning, and an understanding of short term (working) memory and long term memory are important to educators influenced by the cognitive theory.[9] A practical example where the Gestalt theory is seen is when medical students are taught to use 'problem solving approaches' in establishing medical diagnosis.[13] When a patient presents with an acute abdomen, no specific diagnosis is arrived at. The patient needs to be seen as a whole and evaluated as other signs may be present or the patient may volunteer information which may not be apparent from the initial clinical examination. By taking a holistic view of patient into consideration, the Gestalt theory becomes obvious.

The Gestalt principle as employed by Briggs is also used in medical education in the form of single-best answer options for written examinations.[14] The subject material relates to five options in the answers. Only one is correct. The student will analyze the question before choosing the best answer.

The example above shows the utilization of the cognitive functions of the brain. It also illustrates the principles of problem solving approach, implicit in cognitivism. The doctor is expected to process all information from physical examination and history in his brain, organize the data, prioritize, exclude information that does not directly relate to the disease and make a probable diagnosis. Kohler referred to this mental processing as being used all the time for problem solving. Current teaching in clinical medicine using the problem based learning (PBL) is all about cognition. The prioritization of clinical triggers and problems in order to arrive at a diagnosis is not very different from the experiments done by Kohler on his chimpanzees.[15]

The Value of Constructivism

Building on the concepts of *Cognitivism*, the term constructivism has been introduced as another aspect of active learning. Constructivism relates to learning being an active process. This principle is vital to the learner taking control over the learning process. The older individual and adults adopt this process of constructivism as they become self-directed learners, become aware of context and appreciate the active process through experiential learning. Coupling learning with skills permits the development of experiential learning, an attribute promoted in vocations. The learner is expected to operate active knowledge construction exhibiting adaptive skills. This is also referred to as situated learning as learners construct knowledge individually and socially.

Vico in the 18th century proposed that the learner learns to construct knowledge for himself based on what he can explain. Piaget clung on to his concepts of assimilation and accommodation to reach a level of equilibrium. But he also added that the learner acts on what he has gained from experience. This was supported by von Glaserfield who supported the views of others that individuals interpret and 'construct a reality largely based on the interaction with others and the environment'. The socio-cultural elements have important influencers as introduced by Vygotsky.[7, 8, 16]

The constructed knowledge is 'manipulated' through beliefs, mental structure and experiences lending to the uniqueness of learning. This contributes to different learning styles of individuals which teachers and instructors need to be aware of. This philosophy will assist teachers as curriculum delivery is not based only on the contents of materials presented. Knowledge cannot be passively transferred to the learner. The learner needs to understand the lesson in a way unique to him.

In order to make learning effective, teachers will have to evaluate these unique differences in learners. The aim is to make learning efficient and effective so that the objectives of education are met. In this process, Vygotsky included the role of language and culture as contributors to effect active knowledge acquisition. Language is the controlling factor in instruction and communication. The individual cannot receive knowledge and instructions if there are barriers in

communication. Clearly this is playing a bigger role in multicultural Malaysia.

When new tasks are introduced, the learner needs to be taught, coached and taken through all the steps as if one is using a scaffold to support learning in incremental amounts until he is competent. Scaffolding is the process of supporting students in their learning. Support structures are put into place. In some instances, the expert may have to help with aspects of the task that the student cannot do yet. The Zone of Proximal Development (ZPD) is the distance between a student's ability to perform a task under adult guidance and/or with peer collaboration and the student's ability solving the problem independently. According to Vygotsky, learning occurs in this zone.[17] It is likely that the teacher can operationalize this concept when he is demonstrating a procedure or experiment. Once the learner has performed to the satisfaction of the teacher, the latter can withdraw the 'scaffold' to allow the individual to work on his own.

The potential of the learner can be tested by stretching the ZPD after the fundamentals have been grasped. This will permit the learner to move to higher levels of ZPD working towards other areas of 'potential development'. Curriculum designs and lesson plans should bear this concept in mind so that the correct contents are delivered to ensure effective deliverability. A curriculum map often takes this into consideration so that the entire syllabus can be meaningfully drawn. Presenting learning materials beyond the actual development zone of learning can frustrate the learner.[18]

An example of the development of curriculum for medical students is used to further explain this point. The first year medical student goes through two years learning the basic sciences before he is in direct contact with patients. During this period of learning he grasps the fundamentals of disease like learning about the anatomy of the human body and how it functions. Once there is mastery of these basic sciences of medicine, he is challenged with simulated patients. The latter are healthy people who volunteer to be examined so that

the students can develop the skills of eliciting a clinical history and examine a 'patient'. The clinical skills unit is a dedicated centre where a real life environment is created for the 'patient' to be seen and 'worked on'. The supervisor or preceptor begins as a demonstrator and later takes on the 'scaffold' role till competency is established. It is then established that they are capable of moving from the 'actual development' stage to the ZPD. In the third year (first clinical year) the process of clinical examination is re-visited and repeated but the students have access to real patients. It is at this stage that experiential learning is established in a clinical setting complemented by active learning through problem based and task based learning.

Task based learning (TBL) demonstrates the value of the constructivism theory of learning. It incorporates group dynamics and problem solving approaches using real life clinical problems. Students perform tasks which health care professionals are faced with in real life. To perform the tasks, students employ an active learning process and are responsible for his learning. Learning results from the process of understanding the concepts and mechanisms underlying those tasks.[19, 20]

Are the three theories exclusive?

It is interesting to see how all the three learning theories are operationalized in the teaching of medical students. The curriculum is designed to promote reflective learning. The spiraling of the curriculum is permissive in ensuring that information is given in small packets as they progress through medical school benefiting and learning from experience. The constructivist view of learning is shown by promoting active learning, avoiding teacher led instructions through problem solving exercises, invoke social learning through both problem based learning and task based learning (where study guides are used to take the students through) and retain contextual learning.

Constructivism appears to promote active learning.[21] This occurs because of awareness of the way students learn. The emphasis is on student's learning rather than

teacher's teaching. Maintaining dialogue with students and encouraging them to give opinions without regard to contents or comment on age differences allows them to operate in a non-threatening environment. Enquiry and inter-student interaction promote social interaction and confidence. Many of the tenets of active and self directed learning contribute to interest and discovery. Students learn to analyze and solve problems using their unique learning styles and experiences.

When one studies the three theories of learning i.e. behaviorism, cognitivism and constructivism from the historical perspective, it appears to have gone through an evolution process. The behaviorist was less pragmatic in excluding the impact of the thinking process of the mind as they were not easily measurable. This clearly is unacceptable today as we see the uniqueness of the mind of individuals as characteristic to both personality and behavior.[22, 23]

On the other hand it would not be pragmatism if we thought each theory was exclusive and that learning could be explained by each theory in isolation. In the behaviorist approach reliance on the stimulus-response is invoked as a vital learning principle. In learning this process is experienced commonly. We have shown how tasks are carried out through this teacher led rather passive method. The advocates of this theory see the value when we want to accomplish a job under controlled conditions within a short period. The therapist also uses the principles for changing behavior that is not pleasurable.

In the education industry behaviorist approaches are seen in the classroom situation and applying appropriate reinforcement techniques may contribute to desired outcomes. Hence, in all spheres of life, behaviorism plays an important role. The situation dictates its appropriate application.

The strength of cognitivism is the inclusion of the operation of the mind. Intelligence and beliefs that affect learning and higher order thinking which cannot be explained by using the behaviorist approach.

Whilst the behaviorist was concerned with observable and measurable behaviors using the stimuli-response model, Piaget referred to intellectual intelligence being measured by problem solving and essay writing.

Social and cultural learning are elements missing in the behaviorist approach. It would be prudent to include these vital elements in learning. Bandura alluded to attention, retention, reproduction and reinforcement as observable cognitive functions derived from the modeling approach. Vygotsky's views on socio-cultural factors affecting learning are relevant and will play an integral role in learning and practice.

The value of behaviorism is seen in execution of procedures in science and technology where the learner is given training to operate a device or procedure correctly. In industry it is quite easy to teach or train an individual to execute a particular component of the operation factory line. Although the trainee can complete the task using the principles of behaviorism, he will be perplexed if there is a 'hang-up' in the machinery. He will not be able to trouble shoot. This needs cognitive functions through a problem solving approach. An 'expert' who has experience in solving the problem will have to be called in. The example clearly spells out the differences in learning between behaviorist and cognition approaches.

The constructivist differs from both behaviorists and cognitivists in including a higher level of learning where he is able to interpret 'multiple realities'. Creativity and critical thinking are evident as problem solving takes place using prior knowledge. Both social factors and internal negotiations are operational as not only is he deriving inferences using reflection and metacogntive approaches, but he is sharing the 'real' experiences with others in the group, if the event requires so. This process enhances his learning and skillfulness.

One excellent example is the use of computer aided education in developing instructional materials.[24] Following the principles of constructivism, the educational material could be presented to fit the

demands of the learner. The text could be made interactive to keep pace with the learner's mode of learning, multimedia with hypertext linkages can lead to innovative learning. For instance, if the learner is using a text that relates to pelvic infection and he has learnt about the microorganisms two years ago, when he sees that a common bug that causes the disease is the gonococcus, the hyperlink takes him to the bacteriology lesson he was taught. This refreshes his memory and enhances the meaningfulness of the current topic on pelvic infection. Assessment tools at the end of the text based on real case scenarios will stimulate his thinking and problem solving skills and makes learning effective.

This 'branched design' of learning is possible because of the constructivist approach to learning and has been found to be a more effective tool for learning with computer aided materials. Certainly this delivery tool has merits especially when self directed learning is promoted compared to the conventional 'linear formats'.

Guides and regulations must be built in if this constructivist theory is used in designing educational materials. The learner could quite easily 'wander' away from the main objective of learning if the hyper linking is not regulated. This occurs in web based learning where discipline is lacking resulting in the task not being completed. In fact such deviation from the learning task, ironically is more prevalent due to metacognition.

Conclusion

The three learning theories underpin the principles of learning that are implicitly expressed in designing and the delivery of the medical curriculum. The flaws in trying to explain learning based on behaviorism alone are now apparent as socio-cultural influences and the working of the mind are essential in learning. Mental processing of information drawn through the sensori-motor functions and utilization through schemas are vital. One is able to appreciate how higher order thinking, problem solving and problem based learning incorporate the elements of cognitivism, metacognitivism and social learning into the learning strategy. As the complexity of human behavior and learning would require clearer understanding of intelligence quotient and emotional intelligence, metacognition and constructivism approaches tend to be ideal in explaining complex learning required especially when problem solving, creative thinking and exemplary learning are required.

The modern educationist is now replete with more understanding of the learner and is aware of the uniqueness exhibited by adult individuals in learning. An eclectic or heterogenous approach to understanding learning and behavior would add flexibility to medical curriculum design and achieving the goals of the learning exercise.

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