MOE TRF Programmatic Grant

TITLE

Visual Attentional Focus in Expert Reasoning to Improve Accuracy in Diagnostic Imaging

ABSTRACT

Scope: The *Programmatic* proposal comprises **three** education research studies as *Ideation/Proof of Concept* projects to address the challenge of training novices for expert performance in reading X-rays. The reading of X-rays is entirely dependent on *visual perception* and on the *interpretation* of specific radiographic characteristics. Hence, the overall aims of the studies are, firstly, to understand the role of visual search strategies in the novices' perception and interpretation of X-rays through the use of eye-tracking. The second aim is to develop and implement interventions to reduce radiographic diagnostic errors, and to measure the effectiveness of these interventions where possible. The students involved are enrolled in the NUS undergraduate *Dentistry*, NUS postgraduate *Radiology* residency, and NYP diploma in *Dental Hygiene & Therapy* (DHT) courses.

Significance: Nationally, the importance of training novices for expert performance is significant in healthcare. On graduation, radiologists shoulder the important task of reading and reporting all radiology images referred by their medical colleagues. Dentists are professionally expected to read and diagnose all radiographs taken in dental practice. Professionals in Dental Hygiene & Therapy are expected to recognise abnormal radiographic anatomy in the provision of supervised dental care.

Approach: The common theoretical framework of the proposed research is underpinned by the *Cognitive-Constructivist* and *Social-Constructivist* paradigms of learning. Theoretical models of formative feedback highlight the value to learners (i) when feedback is targeted at task performance gaps, (ii) where feedback generates new learning behaviours, and (iii) when the feedback framework is designed around analyses of cognitive task and error. Accordingly, formative feedback comprising teacher-feedback and student-perceptual feedback incorporating eye movements are the principal interventions in the common methodological approach. Two research questions will be asked: (i) How do novices read X-rays and what is the associated diagnostic performance? (ii) Do the ways novices read X-rays change with time through feedback, and do these changes lead to better diagnostic quality? The experimental design involves randomisation of junior students into two equal groups to receive formative feedback in one and together with perceptual feedback in the other. Senior students form the control group which receive no feedback. Eye tracking will be implemented for junior students only.

Implementation: Eye tracking will be carried out with the *Tobii X2-60* eye trackers (Tobii Technology AB, Sweden). Eye tracking measures consist of (i) *cognitive processing*, (ii) *target findability*, and (iii) *target recognisability* when reading X-rays. Diagnostic performance from X-ray reading comprises (i) the quantitative scores from each assessment exercise and scored as a percentage of achievement and (ii) the number of true-positive (TP), true-negative (TN), false-positive (FP) and false-negative (FN) diagnoses. The accuracy of diagnostic performance for each assessment exercise will be scored as [(TP+TN) / (TP+TN+FP+FN)] x100.

Evaluation: *Multiple regression* statistics will be applied to analyse the association between eye-tracking and diagnostic performance data for each individual participant. The *Jackknife free-response Receiver Operating Characteristic* (JAFROC) analysis will also be used to measure diagnostic performance in reading X-rays in the projects managed by NUS Dentistry and NUS Diagnostic Radiology.

Project Team members	Role	Institution
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