Current Research Interests

1. **Hemodialysis**: The redesign of hemodialyzers to incorporate the use of advanced materials to address protein catabolism which is currently indirectly indicated by following the presence of urea. As it turns out, urea levels in a patient are difficult to interpret, because low urea level can either be caused by dialysis or poor nutrition, the latter of which is associated with higher morbidity and mortality. In hemodialysis, an artificial kidney (hemodialyzer) is typically used to remove waste and extra chemicals and fluid from the blood. Doctors need to make accesses (entrance and exit) into the blood vessels, which is done by minor surgery to an arm or leg. There is some amount of discomfort experienced by the patient at each session and often times the process has to be repeated multiple times per week. Although necessary, dialysis has adverse affects on quality of life and with serious negative effects on family members. The high need for kidney transplants are overwhelming the existing and foreseeable future supply of moderately effective performing hemodialyzers. In addition, there is no guarantee that a transplanted kidney will be accepted by the new host; indeed predicting the success of a transplant is still very uncertain. Therefore, it is urgent to develop more reliable, safe and effective hemodialyzers for a patient (human or animal) as an alternative to a kidney transplant.

2. **Engineering Education**: We seek to use Problem-based Learning (PBL), coupled with process simulators, which is a commonly used systemic approach to resolving problems or meeting challenges encountered in practice, to help prepare students for their careers. In this respect, the intent is to begin the development of students toward expert level. Cognitive psychology (Chi, Feltovich and Glazer, 1979) and naturalistic decision making communities have developed an extensive amount of literature documenting the differences between novice and expert performance. It is well established that individuals learn by building on what they know. However, chemical engineering students often enter their junior year with various misconceptions, almost zero knowledge of the domain and a minimum understanding of how the discipline is organized. Therefore, developing learning events for these students (novices) require us to understand what the differences are between students and experts in order to develop suitable instructional strategies. In order to design training that supports the learning process, it is essential to define the two levels of proficiency – expert and novice and understand the differences between them.