Chapter 66
Smart Device Clickers:
Learning Basic Sciences and Biotechnology

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ABSTRACT

In the traditional instructional paradigm, faculty members act like actors on a stage. They memorize their speech and deliver it to the audience, many times with very little to no interaction at all with the audience. On the other hand, in the student-centered learning paradigm, faculty members act like coaches interacting full time with their team. This chapter is based on a study conducted at a Brazilian Federal University. The study depicts the distance between science production and teaching, and reports on experiences using smart phone clickers to track and analyze students' content acquisition. The objective is to improve the interactive quality of teaching and learning, thus promoting steps to shift towards a student-centered instructional paradigm. Although smartphones were used in this study, with wearable technologies continuing to grow, other wearables such as smart glasses and smart watches could be used instead.

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INTRODUCTION

Humankind has been improving technology since antiquity, enabling advances in knowledge beyond what is visible. The exploration of events invisible to the naked eye began with the vastness of the sky, diving into the cellular and molecular world, giving rise to Biotechnology. Within the technological advances, Biotechnology has made it possible to understand complex systems such as Molecular Genetics, Cellular Biochemistry, Immunology, Physiology, Pathology, etc. Therefore, the advancement of Science, Technology and more specifically Biotechnology has made it possible to comprehend the assemblage of survival strategies in the array of living systems on this planet. (Flood, 1993) On the one hand, this context enabled the elucidation of a variety of biological "black boxes", and on the other, the amount of new abstract knowledge developed on a daily basis makes the study of molecules, cells, systems and organisms increasingly more complex.

Studying complex systems is not an easy task due to the number of interconnected facts to be known in order to properly understand the phenomenon. (Flood, 1993) This difficulty is many times intensified because basic Science subject matter is still mostly taught using traditional methodology, in other words, teacher-centered where memorization is the main evaluated aspect (Bradforth et al., 2015). In the teacher-centered scenario, students generally address learning in a passive form. They focus on the speech given by the teacher, memorize, and then repeat facts on tests, used to classify or rank students without being "assessed" by providing necessary feedback to congratulate achievement or indicate more or better learning strategies are required. Consequently, quite often information is quickly lost. On the other hand in the student centered paradigm students more often establish connections with what is said, understand the phenomenon reaching the "bottom line" (essence) of the content. Consequently, new knowledge is gained permitting students to draw their own conclusions (Chin & Brown, 2000) (Figure 1).

Analyzing the annual outcome report of the Immunology Department at a Brazilian federal university, the authors observed the need to initiate a change in the teaching paradigm of its faculty members due to a high student failure index. The initial study compared faculty teaching strategies with student outcomes. In summary, the study revealed the intentional use of strategies to overcome long learned

Figure 1. Comparison between aspects of deep learning and surface learning
(Adapted from Chin & Brown, 2000)