

**UNIVERSITI TEKNOLOGI MARA**

**THE DESIGN OF A  
PHARMACOKINETICS SOFTWARE  
APPLICATION TO ENHANCE THE  
TEACHING AND LEARNING OF  
PHARMACY STUDENTS AND  
PHARMACISTS**

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## ABSTRACT

Pharmacokinetics is taught at various levels during the four-years of a typical pharmacy undergraduate program; the basic principles of pharmacokinetics, pharmacokinetics influence on formulation design, and clinical applications in patient care are all taught in separate semesters. The aim of the project is to develop an integrated software package to augment the teaching and learning of pharmacokinetics to undergraduate pharmacy students, covering various aspects of pharmacokinetics from basic principles, pharmacokinetic calculations and their application, including therapeutic drug monitoring (TDM) in clinical practice and bioequivalence calculations for industry. JAVA object-oriented language is utilised, using the NetBeans integrated development environment to allow for a modular design with the ability to build additional functionality into the system when required. The software in its current form provides a comprehensive source for pharmacokinetic calculations, including modules for IV bolus, IV infusion, oral dose, relative and absolute bioequivalence as well as TDM calculator. One-compartment calculations are used in all cases and non-compartmental analysis is utilised for the bioequivalence calculations. A database of patient information consisting of multiple drugs of interest, with corresponding plasma concentration values is constructed to allow students to observe real data and appreciate variability of pharmacokinetic parameters in different clinical conditions. In addition, computer-assisted learning (CAL) modules are also prepared using Adobe Captivate to assist students in understanding selected pharmacokinetics and TDM topics. Calculations from the software are validated using calculations from Microsoft Excel, manual calculations, and calculations by Hospital Putrajaya pharmacists, and are found to be comparable. A user satisfaction survey was also conducted among students and pharmacists with an overall positive response. Numerous software packages are commercially available to assist in performing pharmacokinetics calculations. However, the developed software is the first attempt to produce a comprehensive package to include multiple points of calculation including compartmental and non-compartmental analysis, TDM and bioequivalence, as well as learning modules, all integrated within one software environment suitable for both pharmacy students and pharmacists.

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# CHAPTER ONE

## INTRODUCTION

*“Learning and innovation go hand in hand. The arrogance of success is to think that what you did yesterday will be sufficient for tomorrow.”*

*William Pollard*

### 1.1 Introduction

For decades, student achievements have been quantified by assessing how well they master a curriculum, mainly through a conventional examination system, thus putting content mastery by students and delivery by educators as the primary focus of education [1]. A system built on content mastery, placing content delivery at the centre of the educational process, may not be, at this present time, the ideal teaching methodology, considering how technology and stakeholder expectations are changing, moving towards a more consumer-driven, service-oriented society [1]. Current students thus need to be equipped with skills beyond mere theoretical knowledge. At a time when information is widely abundant and freely accessible, a practitioner must have the skills to evaluate such information and discern the important and the unimportant, as well as develop habits to facilitate lifelong learning. These skills need to be developed with the assistance of suitably qualified educators [1]. Therefore, the predominant practice of using classroom time for transmission of factual information needs to be changed as information transmission can be easily achieved with the use of other methods, such as e-learning. Instead, classroom time should be better utilised to improve critical thinking and problem-solving skill, train students to apply theory into application, and develop communication and interpersonal skill [1].

Various efforts have been made to improve the teaching and learning