

# Contextualized Class Improves Perception of Students About Spectrophotometry in Biochemistry Laboratory Practices



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## RESUMO

As aulas práticas ocupam uma considerável proporção do tempo dos estudantes do curso de Farmácia. Assim, torna-se vital que os alunos dos cursos de saúde participem de aulas laboratoriais que os remetam a uma aplicação prática. Entretanto, os estudantes têm dificuldade em correlacionar o conhecimento adquirido em outras disciplinas - especialmente Química Analítica - com Bioquímica. Neste trabalho, utilizou-se uma aula prática existente (tradicional) e uma aula prática contextualizada com um caso clínico, seguida de uma orientação dinâmica sobre espectrofotometria como análise de rotina em pesquisa científica. Com este objetivo, um grupo de estudantes foi submetido à aula prática tradicional (grupo controle, n= 65) enquanto outro foi submetido à aula prática contextualizada (grupo experimental, n= 30). Após a avaliação prática, as pontuações de ambos os grupos foram comparadas entre si. Os resultados sugerem que a contextualização das aulas práticas fornece condições para que os alunos adquiram competência técnica, aumentando sua compreensão acerca da relevância de conceitos interdisciplinares e suas aplicações.

**Palavras-Chave:** Dificuldade de Aprendizagem, Bioquímica, Curva de Calibração.

## ABSTRACT

Practical work in the laboratory occupies a considerable proportion of students' time in Pharmacy courses. Thus, it is vital for students who are taking courses in health science to experience handling practices thinking about its practical application. However, students have difficulty in correlating the knowledge acquired in other disciplines - especially, Analytical Chemistry - to Biochemistry. Here, we use an existing laboratory practice and contextualized it using a case-oriented examination and a dynamic discussion about spectrophotometry as a routine analysis in scientific research. With this goal, a group of students was submitted to a traditional practical class (control group, n= 65) while another one was submitted to an contextualized practical class (experimental group, n= 30). After a practical test, the scores of both groups were compared to each other. The results suggested that the contextualization of the practical classes could provide conditions to obtain technical competence of the students, increasing their comprehension about the relevance of interdisciplinary concepts and its applications.

**Keywords:** Learning Difficulties; Biochemistry; Calibration Curve.

## Introduction

Practical work in the laboratory occupies a considerable proportion of students' time in Pharmacy courses. Thus, it is vital for students taking courses in health science to experience handling practices thinking about its practical application. However, students have some difficulty to present a clear view of this issue and to correlate concepts from other disciplines, such as

spectrophotometry (DE ANDRADE *et al.*, 2017, pp. 24-39).

Spectrophotometric analysis is essential for determining the biomolecule concentration of a solution and is employed ubiquitously in biochemistry using a calibration curve (TRUMBO *et al.*, 2013, pp. 242-250). The application of the Beer-Lambert-Bouguer Law is routinely used to determine the concentration of protein or carbohydrate

in practical classes of biochemistry (STRONG, 1952, pp. 338-342). However, students did not realize the importance of this analytical tool in their routine as a pharmacist. In this context, students tend to simply follow an explicit set of instructions to obtain results from calibration curve without create attitudes to solve problems (ADAMS & WIEMAN, 2011, pp. 1289-1312; ANDERSON & SCHÖNBORN, 2008, pp. 309-379).

Problem-solving abilities and experimental design are important skills for any pharmaceutical and when worked aligned, theory and practice can open scope and contribute for lab skills at the same time (ALLCHIN, 2013, pp. 364-392; MEHLER, 1983, pp. 95-118; QUITADAMO & KURTZ, 2007, pp. 140-154). Thus, the contextualization of the lecture material and practical application of the calibration curve can contribute to improve how learning is carried out. This study problem is focused in finding out the influence of contextualizing a practical class on the students' practice concepts improvement in comparison with their colleagues who benefit from this curriculum through traditional practical classes (ANWAR *et al.*, 2017; DUNLOSKY *et al.*, 2013, pp. 4-58).

## Methodology

The biochemistry laboratory course has enrollments of 30-70 students per semester, who are divided into groups of three to four students each. The students work within the same group except for the practical test, in which they work in pairs. The students enrolled in the first semester of 2017 (n= 65) participated of a traditional practical class, while that ones enrolled in the second semester of 2017 (n= 30, control group) were involved in an contextualized practical class (experimental group). The variables were controlled, which means that both courses are equivalent in terms of specialty, academic level, teacher and teaching location.

An existing laboratory practice implemented successfully in previous years was used to conduct this class, which consisted of carbohydrates quantification using spectrophotometry analysis. For the traditional practical class, a protocol

containing experimental goals and general principles behind the procedures were handed out to the students one week before the class. After the professor explain the objectives of the class and deals with possible questions, a practical class begins with a revision of a flow chart presented by each student before starting the experiments. For the contextualized practical class, the same activities settled by the traditional practical class were applied but the proposal was introduced using: i) a case-study examination: the construction of such case was motivated by a problem of blood glucose levels in an adolescent. The students were required to solve the blood analysis using spectrophotometry and values of standard curve and blood sample were delivered to them at the beginning of the semester; ii) a dynamic presentation of two graduate students about the use of spectrophotometry in routine scientific analysis. The presentation included routine uses of spectrophotometry in order to generate and sustains interest, attention and critical thinking of learners.

Two weeks after the practical class, both groups of students (traditional and contextualized practical class) were submitted to a practical test, where academics were challenged to use spectrophotometry to quantify carbohydrate or protein in two unknown samples. Knowledge assessment of the groups was performed according to the student's grade (ANWAR *et al.*, 2017; DALE, 1946; WALKER & RAPLEY, 2008), which had a maximum value of 1.0 and the results were compared.

## Results and Discussion

In our teaching experience, we have noticed that the students are underprepared to work successfully in a bench work situation using a calibration curve to quantify macromolecules in the Biochemistry course. There are a number of reasons that can explain this lack of preparation, but the major one is a lack of effective thinking about the skill acquired during previous disciplines (EILKS & HOFSTEIN, 2015; GUPTA, 2012). In order to help students to better

understand the expectations of the teaching class and to help them to think about how to correlate the principles of spectrophotometry to the biochemistry activities, we've used an existing laboratory practical and contextualized it using a case-oriented examination and a dynamic discussion about spectrophotometry as a routine analysis in scientific research.

As shown in Figure 1, when exposed to traditional class, 87% of the students scored lower than 0.5 [63% lower than 0.25; 24% higher than 0.25], and only 13% of the students showed grades higher than 0.5 [6.5% lower than 0.75; 6.5% higher than 0.75]. In contrast, regarding the students who have been exposed to the contextualized practical class, 54.1% of the students scored lower than 0.5 [12.5% lower than 0.25; 41.6% higher than 0.25], and 45.9% higher than 0.5 [16.6% lower than 0.75; 29.3% higher than 0.75].

## Conclusion

Our results indicate that the contextualization of the practical classes can provide technical competence to the students, increasing their comprehension about the relevance of interdisciplinary concepts. Experimental work with

problem challenges linked with the students' career makes learning relevant for them, and it is expected that they will engage in class. This result demonstrated the benefits of meaningful learning experiences in the practical biochemistry course. The students' learning is significant when they are motivated and able to correlate the acquired knowledge.

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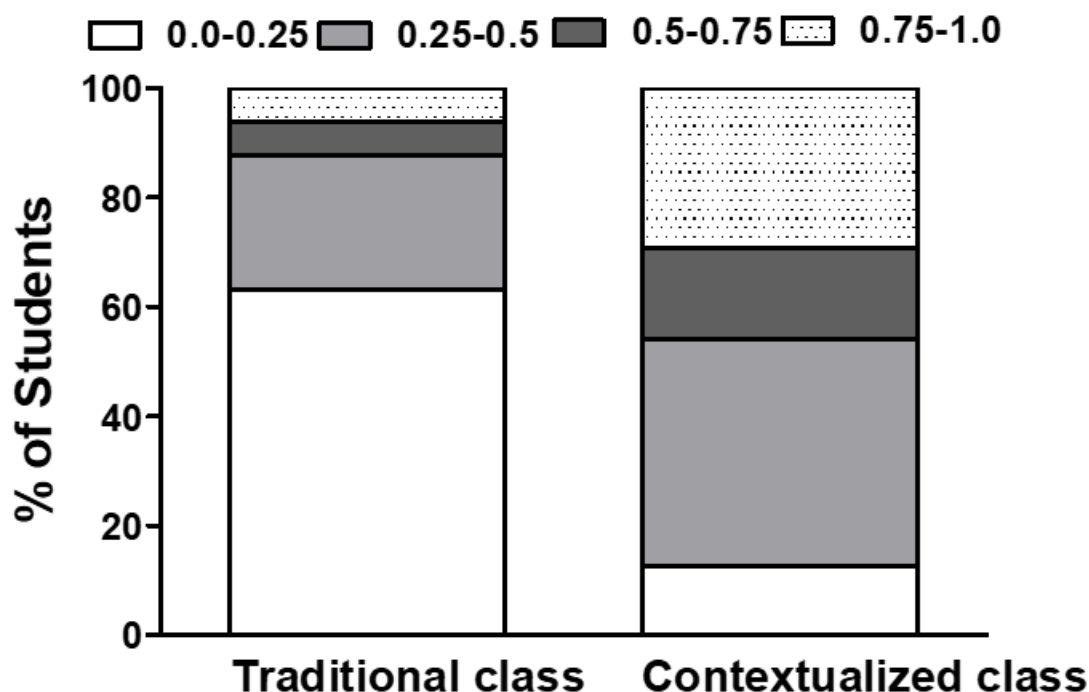


Figure 1 – Students' grades according the different classes used in this study.

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