

# Case Based Learning Versus Conventional Lecture in Clinical Pharmacology Education and its Relation to Learning Styles

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Submitted: 11.01.2020

Accepted: 12.03.2020

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**Keywords:** Case-based learning; education; pharmacology; problem-based learning; VARK methods.



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## ABSTRACT

**Objective:** The problem of the connection between theoretical knowledge and practical knowledge leads to the inadequate training of physicians that results in inaccurate prescriptions. Case-based learning (CBL) is a universal paradigm often used within the medical curriculum, and it encourages self-assessment while enabling the learner to generate analytical and diagnostic solutions to a real scenario. However, its applications are limited and more research is needed to test its compatibility with students with different learning styles.

**Methods:** CBL-based pharmacology courses have been integrated into the 3rd year curriculum of Bahcesehir University Faculty of Medicine. A 15-question questionnaire was filled out by 67 students who were informed in advance to evaluate the CBL-based lessons. In addition, 37 of the participants were asked to complete an approved VARK questionnaire. In this way, traditional education systems were evaluated in terms of learning styles with CBL.

**Results:** According to the majority of the students participating in the study, CBL is a very useful learning method compared to traditional learning methods by making it easier to direct real life cases. In addition, no significant difference was found between the answers of students with various preferences, such as multi-modal or single-modal learning styles, in terms of the evaluation of CBL.

**Conclusion:** The students' survey results showed that the CBL-based curriculum was a useful motivating method. This study shows that CBL is a teaching system that can be adapted to each type of student regardless of the learning style and it is a learning method that can be applied in other fields besides Clinical Pharmacology.

## INTRODUCTION

Case-based learning (CBL) is a learning system aiming to educate students by providing real-life cases. CBL is a derivative of Problem-Based Learning (PBL), which mainly differentiates from CBL by lacking the pre-reading material containing the initial subject such as articles. In CBL, the pre-reading material contains information about the patient such as vital and clinical cues, symptoms, lab-

oratory data and relevant literature. Thus, in contrary to PBL, which do not require a basic knowledge about the subject, CBL requires a specific level of knowledge prior to initialize the inquiry.<sup>[1]</sup> CBL is pushing students to solve real-life scenarios without accessing exterior data, so make them use their own knowledge and experience. It also provides a collective environment, thus enhancing the teamwork capability of students during generating solutions to these scenarios.<sup>[2]</sup>

Like technology, education is also changing in the current world. Novel educational modalities are integrated to traditional ways of learning in every subject, especially in medical and healthcare sciences due to challenges upon public health.<sup>[3]</sup> Over the last four decades, misconnection between theoretical knowledge and practice in medical education, cause the production of inadequate physicians.<sup>[3]</sup> Thus, problem-based and case-based medical curriculums alongside with training in community health environment were emerging as novel tools of education and enhancing the process of training via generating relevancy between medical knowledge and training.<sup>[1-4]</sup>

However, such differences require adaptation of students to these new modalities. Thus, the compatibility of these learning modalities with different types of student gives an important feedback. Despite the benefits of the CBL on practical experience, which is indispensable for medical and healthcare sciences, the applications of CBL are limited or absent in current curriculums including Clinical Pharmacology.

Learning preferences on the other hand, determine how students reach a deeper understanding by using their best modality of comprehension. Like CBL rating questionnaire, there are globally approved tests in order to evaluate learning preferences of students. Universal terms indicating different preferences generates an abbreviation called VARK (visual-aural-read/write-kinesthetic). There are numerous websites such as [vark-learn.com](http://vark-learn.com) containing detailed descriptions of VARK modalities.<sup>[5]</sup> VARK questionnaire used to determine these learning modalities of each student by classifying them in various multimodal and unimodal groups.

Aim of this article is to evaluate the benefits of CBL approach in Clinical Pharmacology sessions of third grade medical students alongside with the compatibility of CBL approach with students having different learning preferences.

## MATERIALS AND METHODS

### Sample

The study was conducted on the third-year medical students who were enrolled at Bahcesehir University Faculty of Medicine in Turkey after obtaining permission from the Institutional Ethics Committee. A cohort of 67 students voluntarily participated in the study and two separate questionnaires were used. All major topics in basic pharmacology as well as fundamental principles of Clinical Pharmacology are being covered as part of second year at Bahcesehir University Faculty of Medicine.

### CBL and VARK questionnaires

The CBL rating questionnaire formed of 15 questions by using 5-points Likert scaling. Thus, every question has five options varying from the most negative to most positive answer (strongly disagree, disagree, neutral, agree and strongly agree) upon the benefits of the CBL. A CBL rat-

ing questionnaire was prepared according to similar questionnaires in different references.<sup>[6-9]</sup> Then, questions were revised and used according to the medical curriculum of Turkey. According to the ratings of participants, we compiled related questions by averaging values that generated from the worst answer (1 points) from best answer (5 points). A CBL rating questionnaire was applied to clinical pharmacology session of 67 3rd grade medical student of Bahcesehir University Faculty of Medicine. Answers of participants were evaluated solely, followed by separated analysis according to the learning types of the students. Learning preferences of 37 participants were tested via an approved VARK questionnaire. VARK questionnaire is used in order to see if the learning preferences have any effect on CBL modality. Thus, to see if CBL modality is appropriate for all students. Then, we separated the learning preferences into two groups as multimodal preference and other learning types. Multimodal preference, as it was mentioned earlier, contains students using more than one trait during learning from VARK styles. Other learning types, however, contains unimodal students who strongly or mildly use only one learning style for efficient comprehension. Standard Deviation (SD) values were calculated by traditional formula based on mean values. The Mann Whitney U test was used to generate the P value of the median score between these two groups to evaluate the CBL rating questionnaire score distribution among these groups.

### Limitations of study

The number of participants is not large to separate all learning modalities as groups. Because of the same reason, we separated students with different VARK preferences into two groups as multimodal and unimodal, in place of separating them according to all chosen modalities. Future follow-up studies will need to be conducted with higher number of volunteer students. Similar studies were compared with our results, which present a similar rating questionnaire aiming to evaluate the CBL approach on pharmacology sessions based on medical students having relatively same basic knowledge. Thus, the significance of this study enhanced via other studies showing similar feedbacks from larger or equal number of participants.

## RESULTS

Among the 15 questions aiming to rate the CBL-based Clinical Pharmacology, top three questions rated nearly equal by the participants are “this teaching method can be also used in other disciplines”, “cases helped me get familiar with clinical cases” and “cases stimulated critical thinking” with 4.37, 4.34 and 4.34 respectively (Fig 1). Other than that, the vast majority of students chose ‘agree’ and ‘strongly agree’ as answers to the remaining questions. Top three lowest rated questions are “cases encouraged me for active participation”, “cases encouraged discussion among students” and “case-based learning helped to improve my diagnostic skills and lateral thinking” with 3.88,

3.92 and 3.92 respectively (Fig 1). Even the lowest rating is far above average, which is 2.5.

VARK questionnaire shows that the vast majority of participants (40.5%) are multimodal learners, using all four modalities of VARK followed by VAK, AK, ARK, VA and AR with 10.8%, 8.1%, 8.1%, 5.4% and 5.4% respectively (Table 2). This shows that, a strong percentage of participants are multimodal with two or more learning preferences except VRK and RK with 2.7% for each one. Unimodal learners have sub-groups of mild and strong, according to the given answers. The highest percentage of unimodal learning belongs to mild visual learning with 5.4%, followed by strong aural, mild aural, mild kinesthetic and strong kinesthetic learning preference with the same score of 2.7% (Table 2). Among 37 participants, no one classified as VK, VAR, VR and read/write learner.

The significance of the median score of CBL ratings according to the two groups consisting of multimodal learners versus unimodal learners were evaluated by using Mann Whitney U test. The median rating score of 31 participant belongs to the group of multimodal learners calculated as 4.26/5, which is similar with the result of unimodal learners containing six participants by 4.03/5 (Table 1). These results show that, CBL approach is nearly equally preferable by students with different VARK modalities and applicable to all types of students since the null hypothesis indicates that two groups have similar distribution of scores.

## DISCUSSION

In order to present an effective education, sessions should cover the preferences of students alongside with good quality content and potent examples. Formal sessions of medicine can sometimes be inefficient that may reduce the urge of participation and motivation gain. According to a survey, Clinical Pharmacology sessions require a dramatic evolution due to insufficiency.<sup>[10]</sup> Another study suggest an education based on problem solving that enhances the experience gained by the session.<sup>[11]</sup> CBL approach has been found as a valuable tool that can reverse the insufficiencies generated by formal education.<sup>[12]</sup>

CBL creates a more challenging, but more pleasant education by providing creativity.<sup>[1]</sup> Intellectual freedom enhances motivation towards collaborative conversations and creativity, hence it results permanent knowledge due to deeper understanding of the subject and strengthening the benefits of the study plan, which results an increased academic performance.<sup>[13]</sup> Moreover, the use of real scenarios pushes some students to feel empathy for subjected patient and makes them consider the session more seriously as a real-life experience. Thus, content become more emotionally traumatic concerning disease consequences, thus produces interest and causes permanent knowledge. As is known that, learning creates structural changes in the brain wiring and these biological changes linked to many interdependent factors depends on motivation, mood and stress together with the variables such as

**Table 1.** Descriptive statistics of the distribution of CBL rating scores according to multimodal and other learning types

	Multimodal learning types (n=31)	Unimodal learning types (n=6)	p value
Mean±SD	4.23±0.50	4.10±0.35	
Median	4.26	4.03	0.274
Min-Max	2.87–5.00	3.73–4.73	

Mean values of the ratings given by multimodal student group and other learning group were calculated separately. SD values were calculated via traditional formula and the deviation on the mean value was indicated by (±) symbol. Significance of the median value was described as P value and calculated by using Mann Whitney U test. Min-max values were indicated by considering the lowest and highest given answer to CBL rating questionnaire. SD: Standard deviation; n: Number of participants; Min-Max: Minimum-maximum.

**Table 2.** Learning type distribution of participants

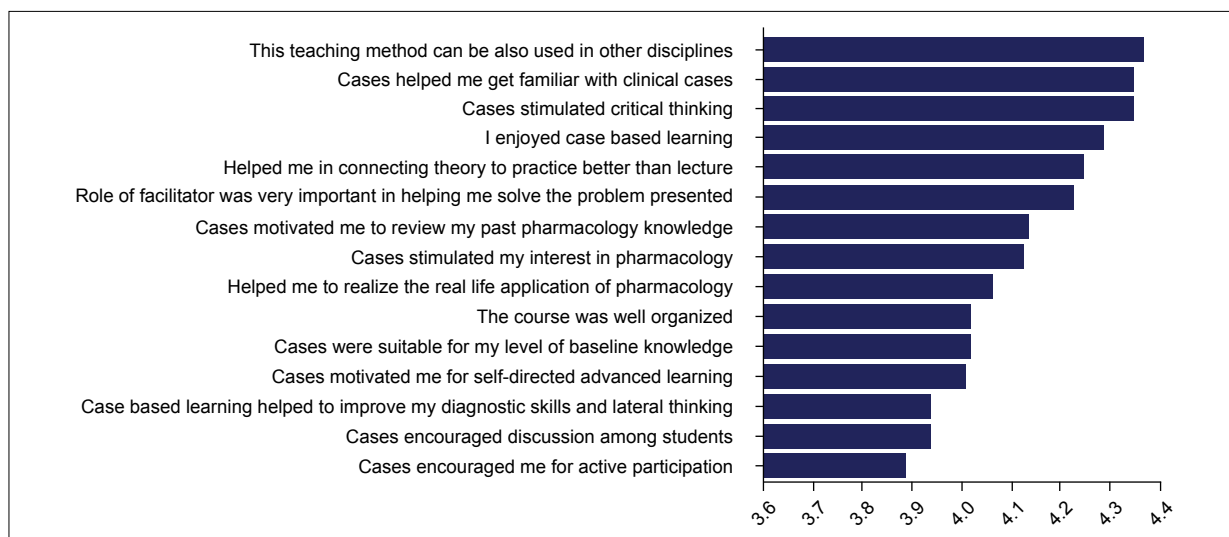
Learning type	Frequency	Percent
Multimodal (VARK)	15	40.5
Multimodal (VAK)	4	10.8
Multimodal (AK)	3	8.1
Multimodal (ARK)	3	8.1
Multimodal (VA)	2	5.4
Multimodal (AR)	2	5.4
Mild Visual	2	5.4
Multimodal (VRK)	1	2.7
Multimodal (RK)	1	2.7
Mild Kinesthetic	1	2.7
Strong Aural	1	2.7
Mild Aural	1	2.7
Strong Kinesthetic	1	2.7
Total	37	100

Frequency of each learning preference describes the exact number of participants suitable to that specific category. Percentage values of each category was calculated by taking 37 participants as 100%.

VARK: Visual-aural-read/write-kinesthetic; VAK: Visual-aural-kinesthetic; AK: Aural-kinesthetic; VA: Visual-aural; AR: Aural-read/write; VRK: Visual-read/write-kinesthetic; RK: Read/write-kinesthetic.

sleep, nutrition and exercise.<sup>[14,15]</sup> Mutual communication between the teacher and students together with student-student interplay requires self-confidence. Thus, alongside with the practical experience, CBL sessions creates an opportunity to regain the motivation and self-confidence through expressing ideas without the influence of pressure and prepares the student to interactive conversations and aid to overcome the public stress.

Our questionnaire shows that, CBL approach on Clinical Pharmacology significantly improved the way of learning when compared to traditional lecture. Participants highly approved the adoption of CBL modality to other medical sessions as well as other fields (Fig 1). Alongside with the questions about improvements of CBL modality, two



**Figure 1.** Clinical Pharmacology Case Based Learning (CBL) rating questionnaire. CBL rating questionnaire that have 15 questions selectively prepared to evaluate the 3<sup>rd</sup> grade Clinical Pharmacology session was presented to 67 previously informed 3<sup>rd</sup> grade medical students. Answers were classified and mean values of each question were calculated according to the 5-point Likert scale by considering all of the participants.

questions underline the organization of the course and the suitability of the real-life cases to 3<sup>rd</sup> grade medical student's basic knowledge were also rated "agree" as average (Fig 1). It is equally important to present the specific innovative approach in well-organized fashion in order to observe its beneficial traits.

According to a study, which tests the CBL approach in Pharmacology sessions on 68 3<sup>rd</sup> grade medical students in Palestine shows similar formative results. Vast majority of the participants (70% to 96%) think that CBL improves critical thinking, analytical skills, collaborative skills and academic success. Moreover, similar questions are presented in the questionnaire to test the suitability of real-life cases to 3<sup>rd</sup> grade medical students.<sup>[7]</sup> Another study integrates the CBL approach to undergraduate pharmacology sessions by presenting an approved real-life scenario approved by a clinician. Same study describes the traditional learning style as "monotonous and a passive way of learning".<sup>[6]</sup> Majority of the Bachelor of Medicine and Bachelor of Surgery (MBBS) participants (76%) rates that, CBL style is an effective tool of learning and enhances the academic success.<sup>[6]</sup> Additionally, a study compared two groups of students composing of 50 students taking Biochemistry sessions by exposing one group to the CBL style, while subjecting the other group to traditional lectures on the same subjects.<sup>[8]</sup> According to a CBL rating test of 4-points Likert questionnaire, 84% to 98% of students resides in the CBL group shows a significantly higher motivation towards Biochemistry sessions as well as ranked CBL modality as a very effective learning methodology.<sup>[8]</sup> Similarly, the comparative benefits of the CBL-based Pharmacology was studied in another article, which indicates an enhanced interest to Pharmacology.<sup>[9]</sup> Benefits of CBL approach were shown in numerous studies that involves comparative interventions on different physicians.<sup>[1,16,17]</sup> Aforementioned, simulative education based on

real-life cases imbues students with good preclinical experience acting as a scaffold for professional knowledge.<sup>[18,19]</sup> Moreover, preclinical experience on prescribing has been shown to enhance professionalism in the future.<sup>[20,21]</sup> A study based on Delphi method had been performed with 252 learning outcomes prepared by experts in order to evaluate Clinical Pharmacology and Therapeutics (CPT) in Europe, mainly to define the compatibility of graduate students for safe and sufficient prescribing.<sup>[22]</sup> According to that study, experience on prescribing has been shown to be more important than basic and Clinical Pharmacology knowledge, which indicates the importance of efficient assimilation of the knowledge with preclinical practice.<sup>[22]</sup>

Both of these studies mentioned above, have questions to compare the traditional lectures with CBL sessions and all participants, including our cohort highly agreed with the superiority of CBL with higher benefits, attractiveness and motivation.<sup>[6-9]</sup> Despite the similarities of highest rated questions in these studies between our study, there is no similarity in the lowest rated questions. In our study, the top three lowest rated questions briefly define the urge of participation, discussion and higher lateral thinking providing higher diagnostic skills. Positive pressure upon participation and the pressure towards discussion alongside with the pressure towards collaborative thinking are one of the highest rated questions in these studies. The lowest rated questions in these studies composed of positive effects on analysis and critical thinking, which were rated comparatively higher in our study.<sup>[7,8]</sup> These oscillations between different cohorts may describe the attitudes of students over education. In our cohort, some students choose not to participate the CBL session, despite they think it is more beneficial and enjoyable compared to traditional lectures, which arguably trivialize the low rating over participation. Moreover, student participation may



have regional differences. Another comparatively lower ranked question is the ability of students to make efficient collaboration during Clinical Pharmacology sessions. In our study the rating for this question was not as high as would otherwise be expected from a CBL session, the reason for that may be the teams were consisted of high number of students that was not optimal for collaboration. Students rated as past pharmacological knowledge was triggered by CBL approach as well as interest towards Clinical Pharmacology (Table 1). One of the most important and well-scored question in our questionnaire reflecting the main objective of Clinical Pharmacology is “CBL approach helped me to realize the real-life application of pharmacology” (Table 2).

According to the results in Table 2, the vast majority of our students prefer multimodal learning. A study presents the results of VARK status over the total cohort of 600 medical students shows that, more than 40% of their students are using all four modalities of VARK.<sup>[23]</sup> Additionally, two different studies indicates that multimodal learners forms the majority (60%) of their students.<sup>[24,25]</sup> These results are highly similar to our results that 40% of our participants also prefer all four modalities during education, while more than 80% of our students are multimodal learners. Furthermore, the distribution scores of two groups containing students preferring more than one VARK modality versus students preferring only one modality are similar with no significant difference.

Despite the beneficial aspects of CBL, the organization of the course would also need to be improved and the cases would need to be revised to improve learning. The role of the facilitator needs to be defined better in order to facilitate student participation and discussion. The efficacy of future CBL sessions will depend on the quality of the cases and active role of the facilitator.

#### Ethics Committee Approval

The study was conducted on the third-year medical students who were enrolled at Bahcesehir University Faculty of Medicine in Turkey after obtaining permission from the Institutional Ethics Committee.

#### Informed Consent

Informed consent has been approved by the Ethics committee and obtained from the participants.

#### Peer-review

Internally peer-reviewed.

#### Authorship Contributions

Concept: F.Ö., A.C.Ö., A.S., D.K.; Design: F.Ö., A.C.Ö., M.Y., A.S., D.K.; Supervision: F.Ö., F.N., D.K.; Fundings: Not applicable; Materials: F.Ö., C.B.Ö., A.S.; Data: F.Ö., M.Y., A.S., D.K.; Analysis: F.Ö., M.Y., A.S., F.N.; Literature search: F.Ö., A.C.Ö., A.S., F.N.; Writing: F.Ö., A.S., F.N.; Critical revision: F.Ö., A.C.Ö., M.Y., A.S., F.N., D.K.

#### Conflict of Interest

The authors declare that there is no conflict of interest.

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## Klinik Farmakolojide Vaka Temelli Öğrenmenin Konvansiyonel Öğretim Şekli ile Kıyaslanması ve Öğrenme Stilleri ile İlişkisi

**Amaç:** Teorik bilgi ile pratik bilgi arasındaki bağlantı sorunu, doktorların yetersiz eğitim almasına ve isabetsiz reçetelendirmelerin yapılmasına sebep vermektedir. Vaka temelli öğrenim (VKÖ) genellikle medikal müfredat içerisinde kullanılan evrensel bir paradigmadır ve öğrenen kişiye gerçek bir senaryoya analitik ve tanısal çözümler ürettirirken, öz değerlendirmeye de teşvik eder. Buna karşın, uygulamaları sınırlıdır ve farklı öğrenim stilline sahip öğrencilere uyumluluğunun testi için daha fazla araştırma gerekmektedir.

**Gereç ve Yöntem:** VKÖ-bazlı farmakoloji dersleri, Bahçeşehir Üniversitesi Tıp Fakültesinin 3. sene müfredatına entegre edilmiştir. VKÖ-bazlı derslerin değerlendirilmesi adına 15 soruluk bir anket, önceden bilgilendirilen 67 öğrenci tarafından doldurulmuştur. Buna ek olarak, katılımcılardan 37'sinden onaylı bir VARK anketini doldurması istenmiştir. Bu sayede VKÖ ile geleneksel öğrenim yöntemleri öğrenim stilleri açısından değerlendirilmiştir.

**Bulgular:** VKÖ, çalışmaya katılan öğrencilerin büyük çoğunluğuna göre gerçek hayattaki vakaların yönlendirilmesini kolaylaştırarak geleneksel öğrenme yöntemlerine kıyasla oldukça faydalı bir öğrenim yöntemidir. Ayrıca, çok modüllü veya tek modüllü öğrenim stilleri gibi çeşitli tercihlere sahip öğrencilerin cevapları arasında VKÖ değerlendirilmesi açısından anlamlı bir fark görülmemiştir.

**Sonuç:** Öğrencilerin anket sonuçları, VKÖ-bazlı müfredatın motive edici yararlı bir yöntem olduğunu göstermiştir. Bu çalışma, VKÖ'nün öğrenme stiline bağımsız şekilde her öğrenci tipine uyarlanabilir bir öğretim sistemi olduğunu ve Klinik Farmakolojinin yanı sıra diğer alanlarda uygulanabilir bir öğrenme yöntemi olduğunu göstermektedir.

**Anahtar Sözcükler:** Eğitim; farmakoloji; probleme dayalı öğrenme; vaka temelli öğrenme; VARK yöntemleri.