

## **EFFECTIVENESS OF BIOCHEMISTRY TEACHING-LEARNING AND EDUCATIONAL CONCEPTS OF MEDICAL SCHOOLS**

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### **ABSTRACT**

The present study investigates the effectiveness of the application of educational concepts in Biochemistry teaching and learning in five selected medical faculties of Sri Lanka. The study used a cross-sectional survey design. The study population was Biochemistry teachers, undergraduates and graduates of five medical faculties in Sri Lanka. The study instrument was questionnaires, separately designed for teachers, undergraduates and graduates. The questionnaire consist of statements related teaching and learning, and educational concepts, with five point Likert scale response. Data were collected through complete enumeration method. Both descriptive and inferential statistics was used analyse the data. The results revealed that according the undergraduates' perception faculty A and B are at highest scoring in Educational concept while teachers' perception, faculty D and E earn highest scoring for the same. According to the graduates' perception, the faculty E received the highest scoring. Similar weakness were observed in almost all the faculties. The Biochemistry modules are mostly covered traditional didactic teaching through lecture method and students rarely were given chance for self-directed learning. Even though faculties collect the feedback, objectives and teaching-learning method have not been modified based on the feedback. The students' perception showed that they were doing rote learning by memorizing the subject targeting the examination question. It is recommended that medical faculties in modify the Biochemistry curriculum with sound educational concepts and the teaching-learning should be improved further by incorporating student-centred learning approach and students should be encouraged for the self-directed learning.

**KEYWORDS:** Biochemistry, teaching-learning activities, educational concepts, rote learning, student-centred learning

### **1. INTRODUCTION**

Currently, not only in Sri Lanka, but also in the whole world, an active dialogue is going on regarding the accreditation of medical education and the need for curriculum change, innovation, and the adoption of contemporary, integrated, competency-based educational models. At the institutional level, curriculum committees struggle with requests from faculty to add new content to an overburdened didactic and clinic schedule. Therefore, preparation and planning are key elements in ensuring the session is to be systematic and effective. Learning activities guide and engage students towards the achievement of agreed learning outcomes with their educational concepts (van Diggele, Burgess, & Mellis, 2020) while both teachers and learners approach teaching and learning in different ways, with their concepts about these educational processes (Pacifico, Donkers, Jacobs, van der Vleuten, & Heene-man, 2020). Biochemistry is one of the major subjects, especially in the first two years of the MBBS program in all medical schools. Therefore, it is useful to study the different programmes on the effectiveness of Biochemistry teaching in medical education with their educational concepts. This study will assist curriculum committees to improve the teaching of core knowledge in Biochemistry in medical schools.

In this regard, the present study has been planned to analyse the effectiveness of Biochemistry teaching in medical education in different schools either as a discipline based or as an integrated curriculum. This study is aimed to analyse whether the objectives and goals of Biochemistry course modules are tailored on par with the educational concepts thus, whether meet the professional needs of the medical practitioner in discharging care to the people. The effectiveness of Biochemistry teaching was analysed through the perceptions of students, biochemistry teachers and graduates.

## **2. METHODOLOGY**

The study used a cross-sectional survey design. The study area of the research included the five medical faculties of Sri Lanka. The target population of this study included the students who were following the MBBS course in the selected universities, and the lecturers of the particular universities involved in teaching Biochemistry and medical education. Further, the graduates from these faculties in the last ten years, who registered for post-graduate programs were also selected as a target group.

Initially, document analyses were carried out for five medical schools. The documents such as handbooks, curriculum, and prospects of each medical school were used for document analysis. Based on the findings of document analysis and literature evidence, three different self-administrated questionnaires were developed for (1) undergraduate students, (2) teachers, and (3) graduates. The questionnaires consist of statements with Likert scale response. In order to study the educational concepts in the curriculum, statements related to the nature of the objectives, current educational strategies, systematic approach, and the design of the curriculum were studied. The students' questionnaire has 10 statements and the graduates' questionnaire has 9 statements. Responses were obtained using a five-point Likert scale (Likert, 1932). The designed questionnaires were piloted by administering them to 15 undergraduate medical students and 5 teachers in the Faculty of Health-Care Sciences, Eastern University, Sri Lanka, which was then excluded from the study. They were requested to fill the way they perceived it. They were also requested to comment on the questionnaire to improve it. Then the questionnaires were amended as per the comments. Moreover internal consistency was tested using Cronbach alpha. The average Cronbach alpha was 0.81.

As the population is small, the whole population was included in the study to increase the precision of the results. With the approval of the Dean and the Head of the Department of Biochemistry, with the help of the academic staff of each faculty, the students and teachers were approached during their free time. The graduates of each faculty who were following postgraduate studies at PGIM, Colombo were approached during their free time. They were informed about this study and consent was obtained. The questionnaires were distributed among those who gave consent to respond.

The total score of response was calculated in percentage. Thereafter, the percentage of response was compared with the inference table (Table 2.1), which has been a modification of the Dundee Ready Education Environment Measure (DREEM) analysis (Roff, 2005).

**Table 2.1: Inference table based on response percentage**

The % of response	Inference
00-49	Unsatisfactory(U)
50-74	Satisfactory (S)
75-89	Good(G)
90-100	Excellent(E)

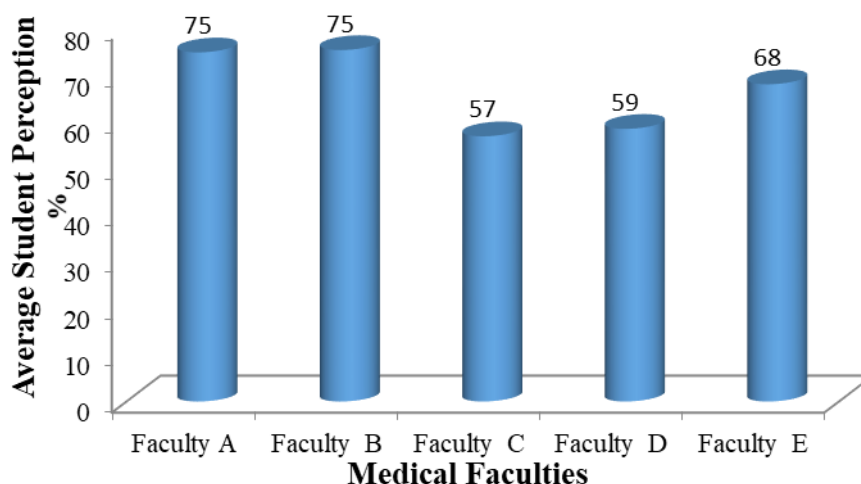
In order to compare the medical schools, the perceptions score among five faculties were compared using ANOVA.

### 3. RESULTS

The response rate for students' questionnaires in Faculties A, B, C, D and E were 98%, 72%, 77%, 75% and 61% respectively. The teachers' response rates in the Faculties A, B, C, D and E are 78%, 63%, 75%, 58% and 60% respectively. The number of responses from graduates of faculties A, B, C, D and E was 12,11,11,19 and 14 respectively.

Educational concepts include innovative trends in medical curriculum and course design, based on contemporary educational theories. According to the students' perception, a significant difference ( $p < 0.05$ ) was observed in one-way ANOVA in the educational concepts among the faculties. The highest percentages of perceptions (Fig 3.1) on educational concepts were observed in faculties A and B (75%) in contrast to faculties C (57%), D (58%) and E (69%). As per the inference table (Table 2.1), faculties A and B are at a good level and the other three faculties are at a satisfactory level in relation to the educational concepts. In the in-depth analysis, scores were considered case by case for every ten items of the students' questionnaire. According to the inference table (Table 2.1), each question was rated and presented in table 3.1. As per the rating, memorizing most of the subjects to study for examination (question no.9) was at an unsatisfactory level in all five medical faculties where most students used "rote learning".

**Figure 3.1: Variation of Educational concepts among faculties, based on students' perception**



**Table 3.1: Students' perception of educational concepts**

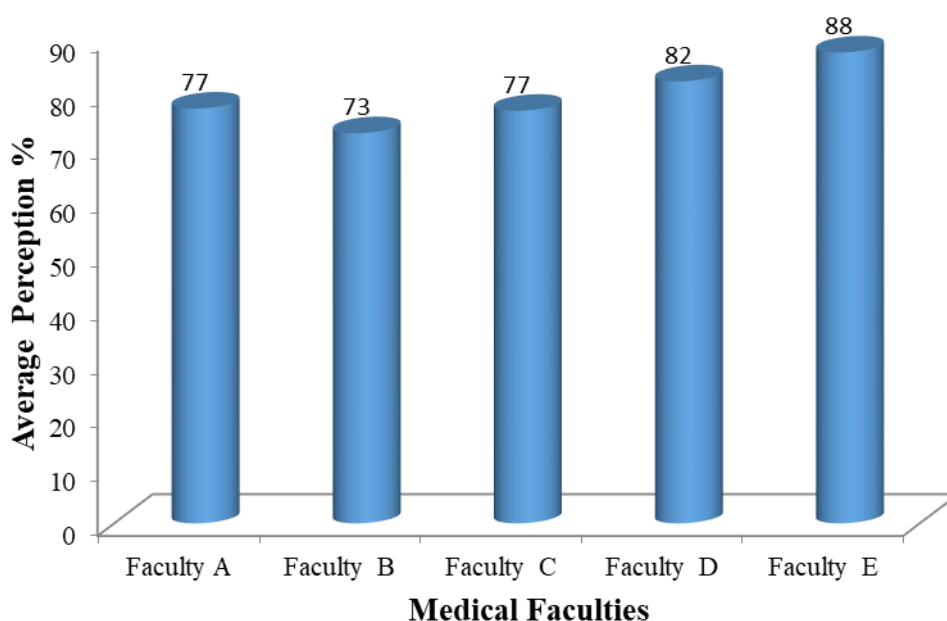
Statement		Faculty				
		A	B	C	D	E
Q1	Objectives are provided for all sections of the curriculum by the Biochemistry staff	E	E	S	G	G
Q2	Objectives are clear and achievable	G	G	S	S	S
Q3	Objectives are given for each teaching session	E	E	S	S	S
Q4	Most of the objectives in Biochemistry are covered by lectures	U	U	U	U	U
Q5	Each module/part is introduced stepwise from my basic knowledge of the subject.	G	G	S	S	S
Q6	Teachers informed us about the assessment methods at the beginning of the course	E	E	S	S	S
Q7	I have learned and achieved the objectives from the learning session (Lecture or tutorial etc...)	G	G	S	S	S
Q8	I learned different topics through discussion with other students	G	G	S	S	S
Q9	I memorized most of the subjects to study for the examination	U	U	U	U	U
Q10	I learned principles and applied them to new situations	G	S	S	S	S

E-Excellent; G-Good; S- Satisfactory; U-Unsatisfactory

The question number nine was reverse coded (i.e. strongly agree is 0 - strongly disagree is 4) (Heaven, 1983; Spector 1992) because memorizing the contents for the examination is not acceptable as stated by Entwistle and McCune (2004). The majority of the students in all the faculties selected the strongly agree and agree levels. Therefore, the score was low. It indicates that most of the students memorized the lessons in Biochemistry subject for the examination.

However, the teachers' perceptions related to the educational concepts (Fig 3.2) showed that there were no significant differences ( $p>0.36$ ) among the faculties. As per the teachers' perception, faculty E has the highest level (88%). Faculty B was at a satisfactory level and the other four faculties were at a good level, the way they perceived the educational concepts as per the inference table (Table 2.1).

**Figure 3.2: Variation of educational concepts among different faculties, based on teachers' perception**



**Table 3.2: Rating of teachers' perception of concepts**

Statement		Faculty				
		A	B	C	D	E
Q1	The current Biochemistry curriculum is adequate to practice medicine	G	E	E	E	G
Q2	Objectives were prepared by the staff of the Biochemistry department	G	S	E	E	E
Q3	Objectives were prepared in consultation with teachers of other related disciplines like pharmacology, medicine, microbiology etc.	G	E	S	S	G
Q4	Objectives are provided before starting the session for all sections of Biochemistry	E	G	E	E	E
Q5	Objectives are clearly worded with appropriate action verbs	E	G	G	G	E
Q6	Objectives are clearly explained to the students	E	S	E	E	E
Q7	Objectives are provided in cognitive, affective and psychomotor domains	G	G	S	S	S
Q8	Allocation of time for student learning is adequate	S	S	U	S	G
Q9	Objectives are modified based on feedback after implementation	U	U	G	G	G
Q10	Objectives are updated based on new knowledge	S	G	E	E	G

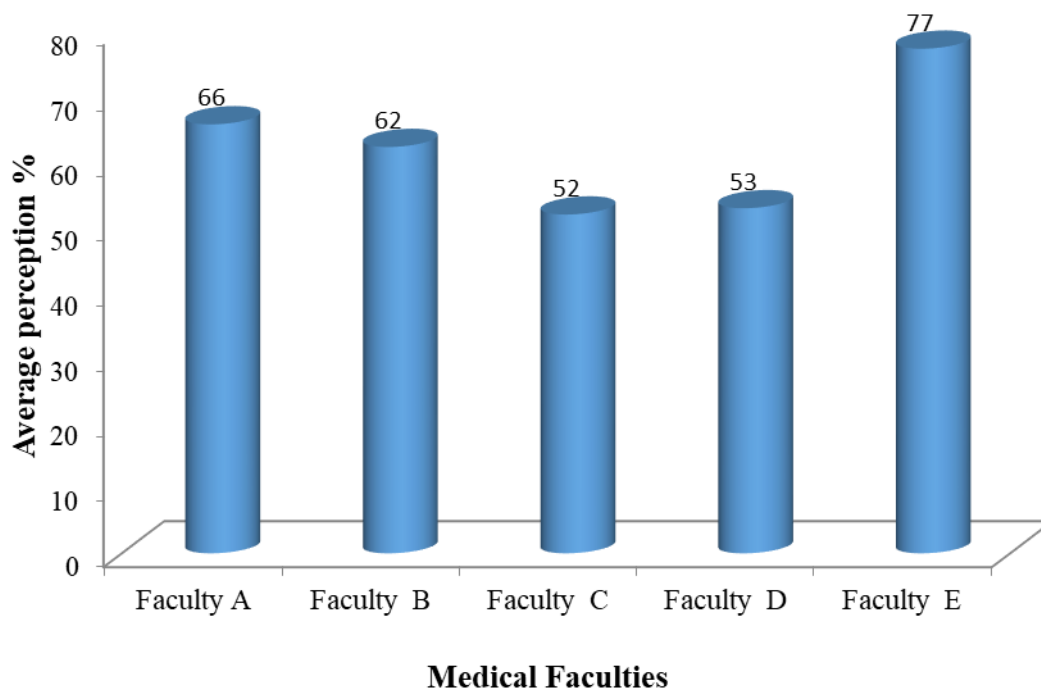
*E-Excellent; G-Good; S- Satisfactory; U-Unsatisfactory*

According to table 3.2, the statement “Objectives are modified based on feedback after implementation” (question no. 9) was at an unsatisfactory level in faculty A and B while it was a good level in the other three. Likewise, the

statement “Allocation of time for student learning is adequate” (question no. 8) is unsatisfactory in faculty C. The statement about the explanation of the objective to the students (question no. 6) was satisfactory in faculty B while an excellent level in other faculties as per the rating scale.

In the graduates’ view (Fig 3.3), there were significant differences in educational concepts ( $p < 0.05$ ) among faculties. According to graduates’ perception Faculty E was at a good level (77%) and the other four faculties are at a satisfactory level. Among these, faculties C & D were perceived as low in the educational concepts by graduates.

**Figure 3.3: Variation of educational concepts among different faculties, based on graduates’ perception**



**Table 3.3: Rating of graduates’ perception of educational concepts**

Statement		Faculty				
		A	B	C	D	E
Q1	Objectives were provided for all sections in the Biochemistry teaching	G	S	S	S	G
Q2	Objectives were clear and achievable	G	S	S	U	E
Q3	Objectives were covered at the particular session	S	S	S	S	G
Q4	Objectives were provided before starting the session for all sections of the Biochemistry	S	S	S	S	E
Q5	Objectives were clearly worded with appropriate action verbs	G	S	S	S	G
Q6	Objectives were clearly explained to the students	S	S	U	S	G
Q7	Most of the objectives in Biochemistry were covered by lectures	U	U	U	U	U
Q8	Each module/part was introduced stepwise from my basic knowledge of the subject.	G	S	S	S	G
Q9	Learned and achieved the objective from the learning session (Lecture or tutorial etc...)	G	G	S	G	G

*E-Excellent; G-Good; S- Satisfactory; U-Unsatisfactory*

According to an in-depth analysis of graduates’ perceptions (Table 3.3), most of the statements were above the satisfactory level in faculty B, C and D. The statements, objectives were clear and achievable (question no. 2) and objectives were clearly explained to the students (question no. 6) were in unsatisfactory level in faculty D and C. The statement that most of the objectives in Biochemistry were covered by lectures (question no.7) was found to

be unsatisfactory in all the faculties. This is because in a traditional teacher-centred system, objectives were covered only by the lecture method but now this has been improved to student-centred system where the lecture method is one of the various methods to achieve the objectives.

#### **4. DISCUSSION**

When analyzing the educational concepts, a Biochemistry curriculum can be considered as educationally sound when it has been developed on par with current and accepted innovative educational trends. Under the educational concepts, the clarity of the objectives, achievement of the objective, teacher-student interaction and the assessments were addressed.

##### **4.1 Faculty A**

As per the students' view, it can be noted that students were still memorizing the biochemistry subject for the examination purpose. Educational philosophies do not encourage the students to memorize the facts and figures and welcome their attitude to become lifelong learners (Biggs, 1999). A lifelong learner is a person who continuously works on gaining knowledge and furthering his skills in a particular subject area throughout his lifetime (Knapper and Cropely, 2000). According to Knowle's adult learning concept, memorizing is not acceptable for lifelong learning (Knowles, 1980). Achieving the objective is more important than passing an examination through memorization. The memorizing of subject content was not only the problem in faculty A but also in all other faculties. The overall perception of the undergraduate medical students on the educational concepts was at a good level.

In the student-centred approach, active participation of the students in the learning process is expected (Bergmark & Westman, 2018). Thus there are several methods of teaching-learning activities, among which, the lecture method is one. In the document analysis, the faculty documents showed that Teaching-learning methods involve lectures, small group discussions, tutorials, laboratory practicals, fixed learning modules, guided learning sessions and seminars. However, students reported that most of the biochemistry objectives were covered by lectures and laboratory practicals. The same was observed in graduates' perceptions. Though different teaching-learning approaches have been planned in the curriculum, it has not been successfully implemented. There may be several reasons for the unsuccessful implementation such as lack of facilities and increased student-teacher ratio.

The feedback of students is an essential component of student-centered learning (Ramani, Konings, Ginsburg, & van der Vleuten, 2019). From the teachers' view, it is evident that the biochemistry objectives were not modified based on the students' feedback. Though the faculty obtained feedback from students, there was a problem in implementation, including in Biochemistry. Except for the feedback, other aspects are above satisfactory level. The overall teachers' perception of educational concepts was at a good level. The perception of undergraduate students and teachers on giving the objectives for each session was excellent, while the graduates' perception ranked it as good. This showed that faculty A had improved its curriculum according to the educational concepts.

##### **4.2 Faculty B**

Students' perception of the educational concepts in faculty B was more or less similar to that of faculty A. Educational concepts in the curriculum were satisfactory as per the perception of teachers and graduates and it was at a good level according to students. As in faculty A, here too teachers' perception was unsatisfactory regarding the upgrading of objectives, based on the feedback of the students.

Teachers felt that the allocation of time for students' self-directed learning was inadequate. Thus they expect more duration for the Biochemistry session. However, it is ideal if each content area of Biochemistry is taught with relevant content from other subjects that will be used together in clinical practice. Hence rather than balancing time for Biochemistry, the guiding principles that define objectives should be the contribution of Biochemistry to the clinical situation.

Teachers' perception was satisfactory in explaining objectives clearly to the students. It can be improved further, by using clinical relevance for each objective. The teachers' perception of the preparation of objectives by the staff of the Biochemistry department is satisfactory. From the teachers' interview it can be noted that the objectives are prepared by a committee including teachers from other disciplines. Hence, it is highly recommended that the service of an experienced Biochemistry teacher with international experiences in modern educational principles should be obtained, when objectives were modified.

#### **4.3 Faculty C**

The overall perception of undergraduate students and graduates about educational concepts was satisfactory and it was at a good level according to teachers in faculty C. Like in faculties A and B, most of the objectives were covered by lectures and students were memorizing the subject content for examination. According to the teachers' perception, Biochemistry objectives were formulated by the Biochemistry teachers and they practised discipline-based teaching-learning. The teachers' perception was unsatisfactory for the allocation of time for students learning. In the discipline-based curriculum, it has been proved that non-essential subject content has been accommodated in the curriculum (Puri, 2002). This will leave no room for student learning. Reduction of non-essential parts of the curriculum is inevitable. The students learning time can be increased through the student-centered learning approach in teaching-learning activities (Irby et al., 2010).

According to the graduates' perception, objectives were not clearly explained to the students. However, undergraduate students' response was satisfactory which indicates that the objectives were clear. This showed the improvements in the teaching-learning activities and approaches over time. Most of the faculties have revised their teaching strategies and refined objectives liberal on providing learning outcomes to students in keeping with the countries higher education policy quality assurance requirements. Hence they are becoming more educationally sound irrespective of the type of curriculum they have adopted.

The overall perception of students, teachers and graduates about educational concepts and teaching-learning activities was at a satisfactory level but score-wise lower than other faculties. All the aspects of teaching-learning activities were at a satisfactory level as per students' perception. Similar to the faculties A and B, here also the pre-requisite course was not at a satisfactory level. The teachers were unsatisfactory with the use of powerpoint presentations but mostly relied on chalk and talk lectures. Students' perception of the learning environment and resources management is satisfactory but teachers' perception is good. It was noted that students were given handouts for sessions (students' perception is good about handouts). A study conducted by Benson et al. (2009) provides evidence that students may place greater emphasis on lecture material than on textbooks.

#### **4.4 Faculty D**

In faculty D, the overall perception of students and graduates about the educational concepts was satisfactory and it was at a good level according to teachers. Similar to the previously mentioned faculties, here too students stated that subject matters were memorized by students and examination-oriented studies takes place. Further, the lecturing method was mostly practised in the faculty to teach Biochemistry. This was stated by graduates too. The teachers' perception of the preparation of objectives in consultation with teachers of other related disciplines was satisfactory. The documents of the faculty showed that they have integrated a module-based curriculum. In an integrated curriculum, the objectives should be designed in consultation with other disciplines.

Therefore, the satisfactory level of teachers should be brought up to a higher level. The teachers' perception was satisfactory in the cognitive, affective and psychomotor domains of the objectives. Since the faculty is practising integrated curriculum and integrated teaching, it can be further improved. Similar to faculty C, here too the teachers were satisfied with the adequacy of time for student learning. According to the graduates' perception, it was noted that objectives were not informed clearly in the past, but undergraduate students' perception was satisfactory. This shows improvement in the design of the objectives.

#### **4.5 Faculty E**

The undergraduate students, teachers' and graduates' perceptions of the educational concepts were satisfactory. Like the other four faculties, students memorized most of the subjects for examination in faculty E. Perception of teachers regarding the three domains in the objectives was at a satisfactory level like in faculties C and D. It can be improved by having integrated teaching approaches including self-directed learning like problem based learning. The perceptions of both teachers and graduates of faculty E were an excellent level in the preparation of objectives with appropriate action verbs by the staff of Biochemistry. Also, their perception was an excellent level about the explanation of the objectives to the students before starting the session. But all those aspects of educational concepts were satisfactory as per the undergraduate students' perception.

#### **5. CONCLUSION**

It was noted that most of the objectives were covered by lectures and students were memorizing the subject content for examination and examination-oriented studies take place. Further, the lecturing method was mostly used by most of the faculty to teach Biochemistry. Though graduates stated that the objectives were not informed, the undergraduate students' perception was satisfactory about the objectives. So biochemistry curriculum was improved in all faculties according to the educational concepts and it can be improved further by having integrated teaching approaches including self-directed learning like problem based learning

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