

Effectiveness of structured handouts lectures and oral discussion on the performance of science students in the basic biochemistry course

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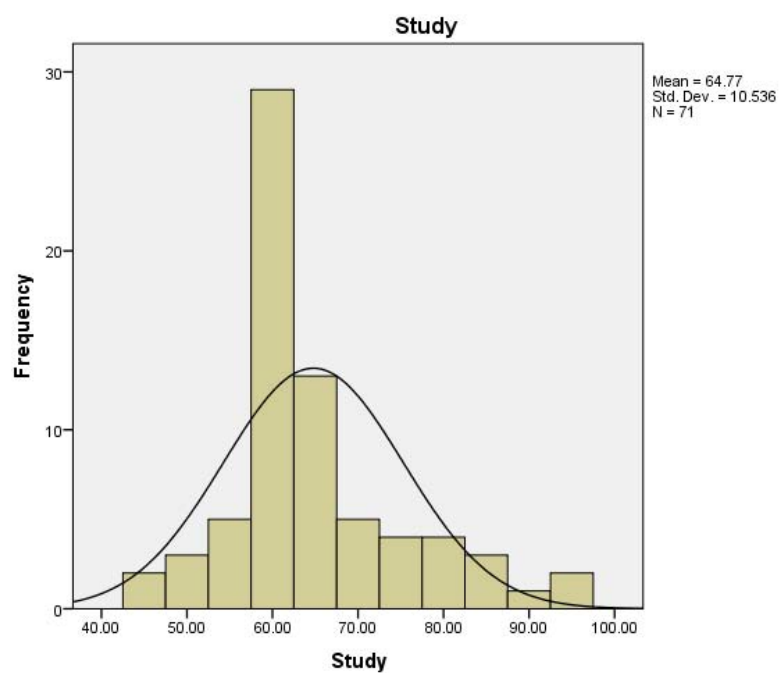
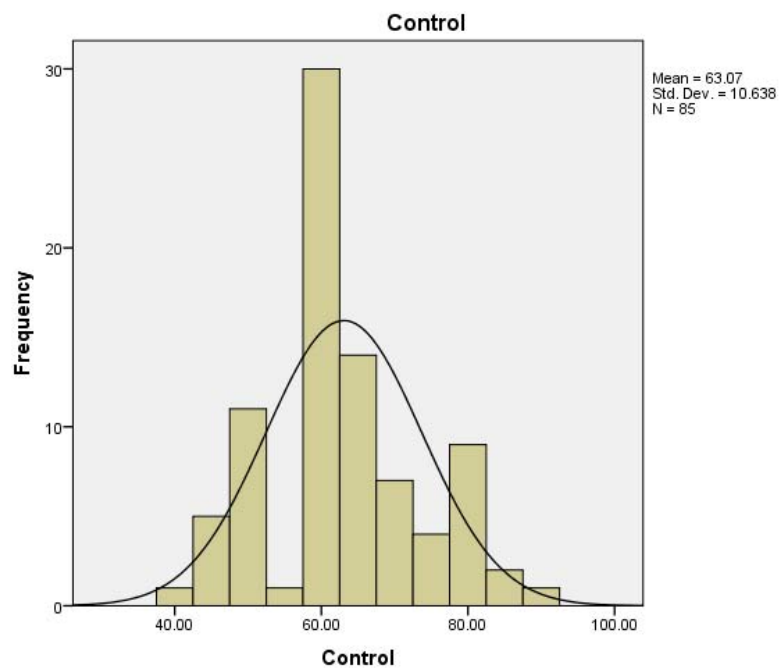
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Abstract

The aim of this article was to investigate the effect of structured handouts lectures and oral discussions on the academic performance of biochemistry students. The biochemistry course of science Bachelor students was implemented through structured handouts lectures using the lecturer and the mobile as information sources, oral discussions and practical sessions. The opinion of the students about the instruction methods was investigated through a questionnaire. The academic performance of the students was compared to the performance of a previous student batch who studied the course through traditional lectures and practical sessions only. The obtained results were analyzed using the SPSS program and the t-test percent. According to the university regulations the pass mark was set as 60. 85.9% was the percentage of pass students who studied the course through the structured handouts, oral discussion and practical session while the percentage of the pass students who studied the course through traditional lectures and practical sessions was 78.8%. However, the difference between the two percentages was insignificant (p -value = 0.25). The questionnaire analysis showed that 63.2% of the students believed that the structured handouts lectures and the oral discussions were excellent and 79.4% of the students advised the course coordinator to adopt this teaching method for the future batches. structured handouts lectures and oral discussions improved the performance of biochemistry students and they advised to adopt the method for future batches of biochemistry.

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1- Did the oral exam induced you to revise carefully the course contents?

- a- Yes
- b- To some extent
- c- No

2- What about the difficulty of the oral exam?

- a- Easy
- b- Medium.
- c- Difficult.

3- Did the oral exam corrected some of your misconceptions?

- a- Yes.
- b- To some extent.
- c- No.

4- What is the effect of the oral exam on your performance in the continuous assessment?

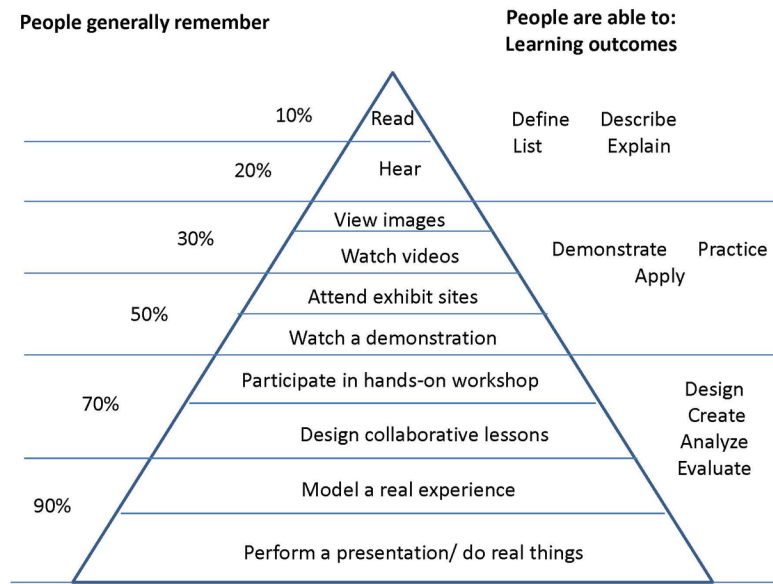
- a- Improved it.
- b- Did not affect it.
- c- Worsened it.

5- What is your opinion about the organization of the oral exam?

- a- Excellent.
- b- Very good.
- c- Good.
- d- Acceptable.
- e- Bad.

6- Would you recommend the oral exam to be adopted as a future strategy of the basic biochemistry course?

- a- Yes.
- b- No.



1- Questions covering the chapters of the first midterm exam

| | Question | Mark |
|-------|---|------|
| 1 | Define the pH? | |
| 2 | What is the glucose? | |
| 3 | What is the sugar that is found in plant cell wall? | |
| 4 | To which type of lipids the glycerol belongs? | |
| 5 | Differentiate between the LDL and HDL? | |
| Total | | |

1- Questions covering the chapters of the second midterm exam

| | Question | Mark |
|-------|---|------|
| 1 | What are the types of amino acids according to the position of the amino group? | |
| 2 | What are the branched chain amino acids? | |
| 3 | What are chemical bonds that stabilize the protein structures? | |
| 4 | What are the nucleotides ? | |
| 5 | What is the biomolecules that is known as the genetic material? | |
| Total | | |

2- Question for the last chapters

| | Question | Mark |
|-------|---|------|
| 1 | What are the enzymes? | |
| 2 | What are the types of vitamins? | |
| 3 | The iron ismineral and a rich nutritional source of it such as..... | |
| 4 | Write the reaction catalyzed by salivary amylase? | |
| 5 | What is the function of Krebs cycle? | |
| Total | | |

Name:.....
Signature:.....

1- Questions covering the chapters of the first midterm exam

| | Question | Mark |
|-------|---|------|
| 1 | Define the pOH? | |
| 2 | What is the Fructose? | |
| 3 | What is the polysaccharide that is stored in the liver and muscles? | |
| 4 | What are the types of derived lipids? | |
| 5 | Differentiate between the chylomicrons and lipoproteins? | |
| Total | | |

1- Questions covering the chapters of the second midterm exam

| | Question | Mark |
|-------|---|------|
| 1 | Define the essential amino acids? | |
| 2 | What is the amino acids that is used by animals as a precursor of thyroid hormones? | |
| 3 | What the shapes of the proteins secondary structures? | |
| 4 | What are the components of nucleotides ? | |
| 5 | What are the major types of RNA? | |
| Total | | |

2- Question for the last chapters

| | Question | Mark |
|-------|--|------|
| 1 | What are the classes of enzymes? | |
| 2 | Enumerate the fat soluble vitamins? | |
| 3 | The calcium ismineral and a rich nutritional source of it such as..... | |
| 4 | Write the reaction catalyzed by the pepsin? | |
| 5 | What is the glycolysis? | |
| Total | | |

Name:.....
Signature:.....

Objectives of the handout:

- 1- Definition and classification 2- Monosaccharides 3- Disaccharides
4- Oligosaccharides 5- Polysaccharides 6- Artificial sweeteners

What are the carbohydrates (definition)?

.....

Types of carbohydrates

1-.....2-.....

3-.....4-.....

Monosaccharides

Definition.....

Classification of monosaccharides

Classification is depending on:

1-.....2-.....

Fill the following table with suitable sugar examples mentioning their chemical structure

| According to the functional group | | According to the number of carbon atoms |
|-----------------------------------|---------|---|
| Ketoses | Aldoses | |
| | | Trioses |
| | | Tetroses |
| | | Pentoses |
| | | Hexoses |

| | Question | Excellent | Very good | Good | Acceptable | Weak | No response |
|---|--|-----------|-----------|------|------------|------|-------------|
| 1 | What is your evaluation for the structured handouts lectures? | | | | | | |
| 2 | What is your classification for the order of the subjects in the structured handouts? | | | | | | |
| 3 | What is the effectiveness of using mobile devices during the structured handouts lectures? | | | | | | |
| 4 | What about the recall of information from the structured handouts lectures? | | | | | | |
| 5 | How would evaluate the performance of the instructors? | | | | | | |

| | Question | Yes | No | No response |
|---|---|-----|----|-------------|
| 1 | Did the structured handouts lectured confused your understanding for the basic biochemistry course subjects? | | | |
| 2 | would you advice to adopt the structured handouts lectures as a future teaching method for the basic biochemistry course? | | | |

Effectiveness of structured handouts lectures and oral discussion on the performance of science students in the basic biochemistry course

ABSTRACT

The aim of this article was to investigate the effect of structured handouts lectures and oral discussions on the academic performance of biochemistry students. The biochemistry course of science Bachelor students was implemented through structured handouts lectures using the lecturer and the mobile as information sources, oral discussions and practical sessions. The opinion of the students about the instruction methods was investigated through a questionnaire. The academic performance of the students was compared to the performance of a previous student batch who studied the course through traditional lectures and practical sessions only. The obtained results were analyzed using the SPSS program and the t-test percent. According to the university regulations the pass mark was set as 60. 85.9% was the percentage of pass students who studied the course through the structured handouts, oral discussion and practical session while the percentage of the pass students who studied the course through traditional lectures and practical sessions was 78.8%. However, the difference between the two percentages was insignificant (p -value = 0.25). The questionnaire analysis showed that 63.2% of the students believed that the structured handouts lectures and the oral discussions were excellent and 79.4% of the students advised the course coordinator to adopt this teaching method for the future batches. structured handouts lectures and oral discussions improved the performance of biochemistry students and they advised to adopt the method for future batches of biochemistry.

Keywords: *Interactive lectures, student centered teaching, face to face discussion, fighting of cheating, fighting of cues*

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1 | INTRODUCTION

Involvement of students in the content of a lecture to ensure two way interaction is known as the interactive lecture. The sources of information in the interactive lectures are the books and the internet while the teacher acts as a facilitator and proof reader. If the students did not find an information, the teacher can act as a source of information (Steinert and Snell, 1999; Lom, 2012).

Oral exams and discussions are face to face discussions aiming to investigate the students strong and weak points with regard to the studied curriculum. Oral exam are classified to different types depending the students, the way and the structure of the exam. The advantages of the oral exams include; they provide direct contact with the students, highlight the strong and weak areas of each student and prevention of cheating and cues. The oral exams suffer from lack of standardization, lack results reproducibility, shortage of experienced and well trained examiners and time consumption (Guilbert, 1987; Huxham et al, 2012).

This article investigated the effect of structured handouts lectures as a type of interactive lectures and planned oral discussions on the performance of science students in the basic biochemistry course.

2 | MATERIAL AND METHODS

2.1 | Description of the basic biochemistry course

The basic biochemistry course is taught for the chemistry and biology students with slight differences. The course content is divided to two parts; part one is associated with chemistry and function of biomolecules including the water, carbohydrates, lipids, amino acids and proteins, nucleotides and nucleic acids, enzymes, vitamins and minerals while part two is associated with the study of digestion and absorption and the catabolic pathways associated with energy production from glucose.

The course was carried out through traditional lectures and practical sessions. The performance of the students in the course was not satisfactory for the students nor the instructors neither the faculty management.

To overcome the unsatisfactory students' performance, the course instructors introduced a new interactive lectures and oral discussion at the end of the course. The students evaluation was divided to continuous assessment and final assessment.

The total mark of the continuous assessment was 50 marks divided to five components; 25 marks for the practical sessions activities and exam, 10 marks for two midterm exams conducted at the end of the fifth and ten weeks, 5 marks for assignment and 10 marks for the oral exam. The final exam was composed of six questions; best answer questions (40 questions; 20 marks), short answer questions (20 answers; 10 marks), matching question (10 items; 5 marks), fill the gap with one word (5 words; 5 marks), correct the wrong word (10 words; 5 marks) and short essay question (choose one title from three titles; 5 marks).

2.2 | Study community

The study community of this research was two student batches; study batch which was taught the course through the structured handouts lectures and oral exam and discussion (71 students) and control batch (85 students) which was studied the course through traditional lectures and practical sessions.

2.3 | Creation of the structured handouts

The structured handouts were prepared by stating the handout objectives and writing questions and titles to be answered by the students depending on the reference text book, internet and the teacher as information sources. Usage of the mobile devices during the lecture was highly encouraged. Part of the carbohydrates chemistry and functions is presented in [Fig. 1] as example of the structured handouts.

[\[Insert Fig.1\]](#)

2.4 | Oral exam structure

Oral exam was organized for each student for the purpose of fighting cheating in the two midterms, giving the students a chance to redress and improve their performance in the continuous assessment and improving the students oral communication capabilities.

To avoid the disadvantages of the oral exams, a written questions were prepared with an empty column for the student to write his mark [Fig.2]. Four related copies of the oral exam were prepared considering the individual academic differences between the students. For example students with low academic performance were asked only one question and they were allowed to grade themselves while students with excellent performance were asked excess oral not written questions within the same question so as to explore their merit. For example if a student answered the question what is glucose? as it is an aldohexose monosaccharide another more difficult question was asked to him such as; give an example of glucose epimers?

[\[insert Fig.2\]](#)

2.5 | The questionnaire structure

Two questionnaires were prepared; one for the structured handouts lectures and the other was for the oral exam. The questionnaire of structured handouts lectures was composed with seven questions; five questions were with six options and two questions with three options. Generally, the questionnaire was associated with opinion of the students about the evaluation of the structured handouts lectures, the sequence of the lectures subjects, effectiveness of using the mobile devices to search for information, information recall from the structured handouts lectures, the performance of the instructors, did the usage of the structured handouts lectures confused your understanding of the basic biochemistry subjects? and would you advice to adopt the structured handouts lectures as a future teaching method for the basic biochemistry course? [Fig.3]. The questionnaire of the structured handouts lectures was handled to the students at the end of the final lecture.

[\[Insert Fig.3\]](#)

The questionnaire of the oral exam contained six questions with different answering options. The questions were 1) did the oral exam induced you to revise carefully the course content?; 2) what about the difficulty of the oral exam?; 3) did the oral exam corrected some of your misconceptions?; 4) what is the effect of the oral exam on your performance in the continuous assessment?; 5) what is your opinion about the organization of the oral exam?; 6) would you recommend the oral exam to be adopted as a future strategy of the basic biochemistry course? [Fig.4]. The oral exam questionnaire was delivered to each student after the end of his oral discussion session.

[\[insert Fig.4\]](#)

2.6 | Statistical analysis

The t-test percent of the StatPac program and the SPSS statistical program were used for the comparison between the results of the two study groups.

3 | RESULTS

3.1 | Comparison of the final results of the two study groups

The success percentage of the batch taught with structured handouts lectures and oral exams discussions (study group) was 85.9% compared to 78.8% for the batch which studied the course through traditional lectures and practical sessions (control group). The two means were insignificantly different (p -value= 0.25). The better performance of the study group may be due to the different teaching method. The high mean mark of the study group may be referred to the different teaching method (Table.1).

The marks of the study groups were skewed to the left (0.87) more than the control group (0.34). The skewness values showed that the structured handouts lectures and oral exam

had negative effect on the marks, although the success percentage of the study group was better than the control group (Table.1) [Fig. 5 and Fig.6].

[\[Insert Fig.5\]](#)

[\[Insert Fig.6\]](#)

3.2 | Results of the students opinion about the structured handouts lectures

The response of the students to the questionnaire questions were as follows:

What is your evaluation for the structured handouts lectures?

The response of the students to this question showed that the structure handouts lectures and oral exams were excellent teaching strategy since 43 rated it as excellent, 17 as very good, 5 as good and three rated it as acceptable while no one believed that it was a weak teaching strategy. Since the majority of the students were satisfied by the structured handouts lectures, this teaching method may be recommended for university teaching (Table.2).

What is your classification for the sequence of the subjects in the structured handouts?

Four students were not satisfied by the sequence of the subjects and two did not respond to the question. The sequence of the subjects need to be revised (Table.2).

What is the effectiveness of using mobile devices during the structured handouts lectures?

In some lectures the instructor permit the students to use their mobile devices to search for information. Eight students expressed that the usage of the mobile devices in the lectures was weak, so the usage of the mobile devices in the search for information should be increased (Table.2).

What about the recall of information from the structured handouts lectures?

Sixty three students expressed that recalling of the structured handouts lectures information was satisfactory while five students believed that the structured handouts lectured did not induce recall of information (Table.2).

How would evaluate the performance of the instructors?

Two student were not satisfied by the performance of the instructors and they believed that the instructors were lazy and they planned to use the students to do their job (Table.2).

Did the structured handouts lectures confused your understanding for the basic biochemistry course subjects?

Twelve students stated that the structured handouts confused their understanding for subjects of the basic biochemistry course. The percentage of the students who were confused by the structured handouts was 17.6% and this why the success percentage of the course was 85.9% (Table.2) .

would you advice to adopt the structured handouts lectures as a future teaching method for the basic biochemistry course?

fifty four (79.4%) students advised the instructors to adopt the structured handouts lectures as a future teaching method for the basic biochemistry course while nine students (13.2%) did not advice to adopt the structured handouts as a future teaching method. However, five students did not respond to this question (Table.2).

As a conclusion, the structured handouts lectures satisfied the majority of the students but special attention should be drawn to the sequence of the course topics, usage of mobile devices during the lectures and the way of the instructors performance.

3.3 | Results of the students opinion about the oral exam and discussions

The questions of the oral exam questionnaire were answered by the students as follows:

Did the oral exam induced you to revise carefully the course contents?

Sixty two students out of seventy one stated that the oral exam convinced them to revise the basic biochemistry course content. The response of the students reflected the effectiveness of the oral exam in inducing the students to do some efforts to improve their performance in the course (Table.3).

What about the difficulty of the oral exam?

Most of the students (50/71) expressed that the oral exam was easy and helpful while 9 students mentioned that the oral exam was difficult (Table.3).

Did the oral exam corrected some of your misconceptions?

Fifty three students mentioned that the oral exam corrected some misconceptions for them. The opinion of the majority of the students reflected the effectiveness of the oral exam as an information correction method (Table.3).

What is the effect of the oral exam on your performance in the continuous assessment?

The continuous assessment of ten students was negatively affected by the oral exam while the continuous assessment of forty eight students was improved by the oral exam. The response of the students to this question favored the oral exam since the continuous assessment of the majority of the students was improved (Table.3).

What is your opinion about the organization of the oral exam?

Five students were not satisfied by the organization of the oral exam. Some effort should be exerted (Table.3). the majority of the students (63) rated the oral exam as excellent or very good.

Would you recommend the oral exam to be adopted as a future strategy of the basic biochemistry course?

Sixty student (84%) recommended to adopt the oral exam as future strategy for the basic biochemistry course, eight student did not recommend and three students did not respond (Table.3).

4 | Discussion

While the majority of the previous studies proved the effectiveness of the student centered learning in improving the academic performance and achievements of students (Gelisl, 2009; Armbruster et al, 2009; Ganyaupfu, 2013; Cormier and Voisard, 2018), some studies mentioned that it negatively affected the students' academic performance (Andersen & Andersen, 2017). However, the results of this study showed that the structured handouts lectures as a type of student centered learning positively affected the student success percentage and the mean mark of the batch while it negatively affected the skewness of the students marks. We believe that the better performance of the student taught by the structured handouts was lectures was because of following the Edgar dale cone [Fig. 7]. However, the Edgar Dale cone was associated with the percentage of information remembering and ability to perform skills depending on the teaching methods. Edgar Dale cone stated that people remember 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they hear and see, 70% of what they say and write and 90% of what they do [10] (Davis and Summers, 2015).

[\[Insert Fig.7\]](#)

The perceptions of the university students is variable (positive and negative) depending on different factors including the cultural context, the organization of the student centered learning sessions and the roles of the participants. Positive perceptions were reported by several studies [11-13] (Meng and Onwuegbuzie, 2015; Zeki and Güneyli, 2014; Wright, 2011). Complex and negative perceptions of postsecondary biology students about the student centered learning was previously declared [14] (Heim and Holt, 2013).

Regarding the effectiveness of the oral exams on the academic performance of the undergraduate students, Huxham et al, (2012) stated that the oral exams are powerful in improving the academic performance of the students [4].

Concerning the perceptions of students about the oral exams, some of the literature mentioned that the students opinion was positive [15] (Kelly et al, 2010) while other

researchers concluded that students prefer written exams rather than the oral exams [16] (Watering et al, 2008).

5 | CONCLUSIONS

The conclusions of this study were:

- 1- The structured handouts lectures and the oral exams improved the performance and the mean mark of the undergraduate science students in the basic biochemistry course while it worsened the skewness of the student marks.
- 2- The majority of the students recommended to adopt the structured handouts lectures (79.4%) and the oral exams (84%).
- 3- the structured handouts lectures were excellent information recall inducers since 92.6% expressed that their information recall was improved by the structured handouts lectures.
- 4- The oral exam was excellent method for student's misconceptions correction.
- 5- Usage of the mobile devices in the implementation of the course and the organization of the oral exam was acceptable but need to be improved.

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Table 1: Comparison between the performance of the study groups in the final student evaluation results

| | Study group* | Control group** | p-value |
|-----------------------------|-----------------|-----------------|---------|
| Number of students | 71 | 85 | - |
| Percentage of pass students | 85.9% | 78.8% | 0.25 |
| Mean mark \pm SD | 64.8 \pm 10.5 | 63.1 \pm 10.6 | 0.32 |
| Minimum mark | 45 | 40 | - |
| Maximum mark | 93 | 90 | - |
| Skewness | 0.87 | 0.34 | - |

Although the performance of the study group was better than the performance of the control group, the variation was insignificant and the skewness of the study group was shifted to the left more than the control group.

* Student batch studied the course through structured handouts lectures and oral exam.

** Student batch studied the course through traditional lectures and practical sessions.

Table 2: Students Evaluation for the structured handouts lectures**A**

| | Question | Excellent | Very good | Good | Acceptable | Weak | No response | Total |
|---|--|-----------|-----------|------|------------|------|-------------|-------|
| 1 | What is your evaluation for the structured handouts lectures? | 43 | 17 | 5 | 3 | 0 | 0 | 68 |
| 2 | What is your classification for the sequence of the subjects in the structured handouts? | 41 | 13 | 8 | 0 | 4 | 2 | 68 |
| 3 | What is the effectiveness of using mobile devices during the structured handouts lectures? | 25 | 14 | 20 | 1 | 8 | 0 | 68 |
| 4 | What about the recall of information from the structured handouts lectures? | 38 | 14 | 11 | 0 | 5 | 0 | 68 |
| 5 | How would evaluate the performance of the instructors? | 44 | 12 | 8 | 2 | 2 | 0 | 68 |

B

| | Question | Yes | No | No response | Total |
|---|---|-----|----|-------------|-------|
| 1 | Did the structured handouts lectures confused your understanding for the basic biochemistry course subjects? | 12 | 51 | 5 | 68 |
| 2 | would you advice to adopt the structured handouts lectures as a future teaching method for the basic biochemistry course? | 54 | 9 | 5 | 68 |

Generally the majority of the students were satisfied by the structured handouts lectures but some determinants need to be tackled such as the sequence of topics and the usage of the mobile devices during the lectures for the information search

Table3: Response of the students to the oral exam evaluation questions

| Question | No |
|--|----|
| 1- Did the oral exam induced you to revise carefully the course contents? | |
| a- Yes | 62 |
| b- To some extent | 2 |
| c- NO | 7 |
| d- No response | 0 |
| e- Total | 71 |
| 2- What about the difficulty of the oral exam? | |
| a- Easy | 50 |
| b- Medium | 12 |
| c- Difficult | 9 |
| d- No response | 0 |
| e- Total | 71 |
| 3- Did the oral exam corrected some of your misconceptions? | |
| a- Yes | 53 |
| b- To some extent | 11 |
| c- NO | 5 |
| d- No response | 2 |
| e- Total | 71 |
| 4- What is the effect of the oral exam on your performance in the continuous assessment? | |
| a- Improved it | 48 |
| b- Did not affect it | 13 |
| c- Worsened it | 10 |
| d- No response | 0 |
| e- Total | 71 |
| 5- What is your opinion about the organization of the oral exam? | |
| a- Excellent | 43 |
| b- Very good | 20 |
| c- Good | 1 |
| d- Acceptable | 2 |
| e- Bad | 5 |
| f- No response | 0 |
| g- Total | 71 |
| 6- Would you recommend the oral exam to be adopted as a future strategy of the basic biochemistry course? | |
| a- Yes | 60 |
| b- No | 8 |
| c- No response | 3 |
| d- Total | 71 |

The majority of the students were satisfied by the oral exam and its organization. The oral exams improve the academic performance of the students and they advised to organize the oral exam for the future batches.

Fig.1: The first page of the carbohydrates structured handouts.

The students filled the gaps using three sources of information; the text book of the course, the instructor and the internet using their mobile devices

Fig.2: Two models of the organized oral exam. The oral exam was divided to three parts; the first one was associated with the chapters covered by the first midterm, the second was for the chapters covered by the second midterm and the third covered the chapters which were not included in the first and second midterms. The students had the chance to improve their achievement in the first and second midterm.

Fig.3: The questionnaire for the evaluation of the structured handouts lectures by the students.

Fig.4: The oral exam evaluation questionnaire.

Fig.5: The histogram of the study group marks. The skewness of the study group marks was strongly shifted to left compared to the control group (skewness= 0.87).

Fig.6: The histogram of the control group marks. The marks of the control group were slightly shifted to the left compared to the study group (skewness= 0.34).

Fig.7: The Edgar Dale's cone of learning. Edgar dale stated that the students/people remember 70% of what they write. However, the structured handouts lectures depended on the students for the search of information and filling the information gaps in the handouts.