

**FORMAL REASONING ABILITIES AND UNDERSTANDING OF DIFFUSION
AND
OSMOSIS AMONG FORM FOUR BIOLOGY STUDENTS**

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ABSTRACT

Students often encounter problems in their attempt to understand some concepts in biology like osmosis and diffusion. The causes of these problems have been found to relate to students' level of understanding and formal reasoning abilities.

The main aim of this study was to assess students' understanding of two concepts in the Form Four Biology curriculum that were diffusion and osmosis. There were 98 form four biology students involved in this study and two paper and pencil tests used, the Test of Logical Thinking Skills (TOLT) and the Diffusion and Osmosis Diagnostic Test (DODT) were used. The TOLT was used to categorise the formal reasoning abilities of the students into high, medium and low while the DODT was used to assess students' understanding of diffusion and osmosis.

The DODT was also used to ascertain the problems faced by the students in their understanding of these concepts as well as to explore the students' common and recurring alternative conceptions of diffusion and osmosis.

The findings of this study showed that :

- (1) Students had a good understanding of two concepts of diffusion and osmosis. Following are the percentages of concepts arranged in a decreasing order:

(i) Membranes = 89.8%

(ii) Kinetic energy of matter = 86.7%

However, students did not have a good understanding of four concepts in the topic of diffusion and osmosis. Following are percentages of concepts arranged in a decreasing order:

- (i) Influence of life forces on diffusion and osmosis = 65.3%
 - (ii) Process of osmosis = 59.8%
 - (iii) Particulate and random nature of matter = 59.3%
 - (iv) Process of diffusion = 58.2%
 - (v) Concentration and tonicity = 53.1%
- (2) There was a total of fifteen common alternative conceptions identified from the students responses in the DODT. The number of common alternative conceptions and the percentage of students holding these alternative conceptions are listed in Table 4.19 on page
- (3) There was a total of three recurring alternative conceptions identified and these were: (a) The students perceived that the movement of particles were from high to low concentration until the two areas were isotonic. The students had the alternative conception that water will move until the two areas were isotonic and then the particles will stop moving; (b) They perceived the movement of water was from a hypertonic solution to a hypotonic solution because water will move from high to low concentration; (c) They perceived that movement of particles was from a crowded area to an area with more room in order for molecules to spread out.

- (4) There was a significant difference between the students of high formal reasoning ability as compared to the students with medium formal reasoning ability in the understanding of concepts in diffusion and osmosis in this study. The high reasoning ability students were found to perform significantly better than the medium formal reasoning ability students in their understanding of diffusion and osmosis.
- (5) There was no significant gender difference in the understanding of concepts in diffusion and osmosis in this study.

Implications of the findings were discussed and a number of recommendations were made for future research in this area of study.

Kebolehan Penaakulan Formal dan Kefahaman Proses Resapan dan Osmosis Di Kalangan Pelajar Tingkatan Empat Biologi

ABSTRAK

Didapati pelajar selalu menghadapi masalah berkaitan dengan kefahaman konsep abstrak di dalam biologi seperti proses resapan dan osmosis. Masalah kefahaman ini selalu dikaitkan dengan tahap kefahaman dan penaakulan formal pelajar.

Tujuan utama kajian ini adalah untuk mengkaji kefahaman pelajar tentang dua konsep di dalam sukatan tingkatan empat biologi. Subjek kajian terdiri daripada 98 orang pelajar (48 lelaki dan 50 perempuan) dari sebuah sekolah menengah di Wilayah Persekutuan. Dua instrument telah digunakan di dalam kajian ini. Instrumen pertama iaitu Ujian Diagnostik Resapan dan Osmosis (DODT) digunakan untuk mengkaji kefahaman pelajar tentang konsep resapan dan osmosis dan mengenalpasti salah konsepsi yang biasa dijumpai dan juga yang berulang. Instrumen kedua iaitu Ujian Pemikiran Mantik (TOLT) digunakan untuk mengukur kebolehan penaakulan formal pelajar. Dapatan kajian ini menunjukkan:

- (1) Didapati pelajar menunjukkan kefahaman yang baik untuk dua konsep di dalam tajuk resapan dan osmosis. Berikut adalah peratus kefahaman konsep oleh pelajar yang disusun dalam urutan menurun:
 - (i) Membran = 89.8%
 - (ii) Tenaga kinetik molekul = 86.7%

Tetapi, pelajar menunjukkan kefahaman yang kurang baik untuk empat konsep di dalam tajuk resapan dan osmosis. Berikut adalah peratus kefahaman konsep oleh pelajar yang disusun dalam urutan menurun:

- (i) Pengaruh daya kehidupan ke atas proses resapan = 65.3%
dan osmosis
 - (ii) Proses osmosis = 59.8%
 - (iii) Pergerakan rawak molekul = 59.3%
 - (iv) Proses resapan = 58.2%
 - (v) Kepekatan larutan = 53.1%
- (2) Terdapat sejumlah limabelas salah konsepsi biasa dijumpai dari respons pelajar di dalam DODT. Salah konsepsi dan peratus pelajar yang mempunyai salah konsepsi ini disenaraikan di dalam Rajah 4.19.
- (3) Terdapat sejumlah tiga salah konsepsi berulang yang telah dikenalpasi dan ianya adalah: (a) Pelajar menganggap pergerakan zarah adalah dari kawasan kepekatan tinggi ke kepekatan rendah sehingga kedua-dua kawasan menjadi isotonik dan zarah akan berhenti bergerak; (b) Pelajar menganggap bahawa air bergerak dari larutan hipertonik ke larutan hipotonik; (c) Pelajar menganggap banyak zarah di satu kawasan akan bergerak ke kawasan yang mempunyai kurang zarah.
- (4) Pelajar yang mempunyai penaakulan formal tinggi mendapat pencapaian lebih baik dalam kefahaman konsep resapan dan osmosis berbanding pelajar yang mempunyai penaakulan formal sederhana.

- (5) Tiada perbezaan signifikan di antara pelajar lelaki dan pelajar perempuan dalam kefahaman konsep-konsep dalam resapan dan osmosis.

Implikasi-implikasi daripada dapatan kajian ini telah dibincang dan beberapa cadangan untuk kajian lanjutan di dalam bidang kajian ini telah disyorkan.

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