Committee for the Evaluation of Chemistry Study Programs

The Open University of Israel

The Avinoam Adam Department of Natural Sciences

Chemistry

Evaluation Report

March 2012

CONTENTS

Chapter 1- Background

At its meeting on July 14, 2009, the Council for Higher Education (CHE) decided to evaluate the study programs in the field of Chemistry in higher education in Israel. The initial steps by CHE included the formulation of a self-evaluation study for each participating institution and the appointment of an evaluation committee consisting of:

- Professor Richard Eisenberg, Department of Chemistry, University of Rochester, Rochester, NY
- Professor Allen J. Bard, Department of Chemistry, University of Texas, Austin, TX
- Professor Tobin J. Marks, Department of Chemistry, Northwestern University, Evanston, IL
- Professor William L. Jorgensen, Department of Chemistry, Yale University, New Haven, CT
- Professor Joan S. Valentine, Department of Chemistry, University of California - Los Angeles, Los Angeles, CA
- Professor David Milstein, Weizmann Institute of Science, Rehovoth

Each of the committee members is a research active chemistry faculty member with broad disciplinary experience. Each non-Israeli member is a member of the U.S. National Academy of Sciences and is fully involved in all aspects of chemistry programs at the graduate and undergraduate levels.

The committee was assisted in its efforts by Ms. Alisa Elon, Coordinator of the committee on behalf of the Council for Higher Education.

Within the framework of its activity, the Committee was requested to submit the following documents to CHE:

1. A final report on each of the evaluated departments,
2. A general report on the state of the discipline in the Israeli higher education system, including recommendations to the CHE for standards and potential state-wide changes in the evaluated field of study.

The Committee's letter of appointment is attached as **Appendix 1**.

The process was conducted in accordance with the CHE's Guidelines for Self-Evaluation (of October 2009).

Chapter 2- Committee Procedures

The Committee held its first meetings on June 12, 2011 during which it discussed fundamental issues concerning higher education in Israel, the quality assessment activity, as well as Chemistry study programs.

In June 2011, the Committee held its first round of visits and went to Ben-Gurion University of the Negev, Bar-Ilan University, and the Weizmann Institute of Science. The second round of visits was carried out in December 2011 with site visits to the Hebrew University, the Open University, the Ariel University Center of Samaria, the Technion Israel Institute of Technology, and Tel Aviv University.

This report deals with the evaluation of chemistry studies at the Avinoam Adam Department of Natural Sciences in the Open University

In the preparation of this report, the committee visited the OUI campus in Raanana and met with senior faculty who are charged with the writing and preparation of course textbooks, course coordinators (all Ph.D. level chemists) who create and grade specific assignments for the course, tutors (generally current or recently graduated Ph.D. students) who meet with students through tutorials and grade assignments, current Bachelors students in the program, and university leaders and administrators. The committee was able to see the facilities for distance learning including different studios for online tutorials and the course materials assembly and distribution center. The analysis given below reflects the results of those meetings coupled with the information provided by the Open University in its self-evaluation study.

The Committee's visit to the Open University took place on December 14, 2011. The Committee thanks the management of the Open University and the Avinoam Adam Department of Natural Sciences for their self-evaluation report and for their hospitality towards the Committee during its visit at the institution.

The schedule of the visit is attached as **Appendix 2.**

Chapter 3-Executive Summary

While a basic chemistry course was among the first courses offered by OUI, it was only in 2006 that a dual-disciplinary track in Chemistry was offered. Data from the self-evaluation show that in 2009, 87 students were defined as Chemistry students, 176 students were in a "partial" chemistry program and 569 students had passed at least one course in Chemistry. Only a B.Sc. degree is offered in chemistry (B.Sc. in Natural Sciences: Emphasis on Chemistry) and in the dual-disciplinary chemistry programs. Senior faculty members are also engaged in scholarly chemical research that is done at other institutions if experimentally based. The current number of senior chemistry faculty is four.

Specific Committee recommendations:

- additional advanced level courses in chemistry, particularly in organic chemistry
- establishment of teaching laboratory sites through arrangements with universities in the north and south of Israel
- research projects for talented students with an appropriate university faculty member in laboratories close to where the students reside
- scholarship support for student research experiences in the summer
- addition of tutorials for chemistry classes at remote locations, even for small numbers of students, whenever possible
- establishment of arrangements for analyses using instrumentation (such as an NMR spectrometer) through service units of other universities, for analysis of samples prepared by students
- establishment of framework agreements with universities (in addition to TAU) for the research of OUI faculty members
- facilitation of the research activities of the senior faculty in a manner consistent with their expectations. This may require providing more resources in the way of supplies, equipment, and graduate student support
- assessment of the compensation and workload for the course coordinators and tutors on a regular basis.

Chapter 4- Evaluation of Chemistry Studies in the Avinoam Adam Department of Natural Sciences at the Open University

- *This Report relates to the situation current at the time of the visit to the institution, and does not take account of any subsequent changes. The Report records the conclusions reached by the Evaluation Committee based on the documentation provided by the institution, information gained through interviews, discussion and observation as well as other information available to the Committee.*

Background

The Open University of Israel (OUI) occupies a unique position in the country's higher education landscape. It provides distance learning to the populace through its courses and degree programs. As such, it makes higher education more accessible to a wider segment of the population. It achieves its goal through an open enrollment policy and the delivery of carefully developed packages including textbooks and assignments at no additional cost to the student (tuition is standard). Course standards are high, and student progress is facilitated and monitored through online (or in person) tutorials. For every course, there is a proctored final examination at a specific site to which the student must come. Students are allowed to progress through each course at their own pace.

A demographic analysis of the students at the Open University shows that at the Bachelor's level, 55% of the current students are female and the mean age of all Bachelors' students is approximately 30. Chemistry degree programs are administered under the Avinoam Adam Department of Natural Sciences and are relatively new.

Education: Undergraduate Program

Unlike traditional universities, where students are admitted to structured programs of study, students at the OUI enroll in courses each semester, without enrolling for a specific program. Study materials (books, study guides, readers, etc.) are mailed to them before the beginning of the semester with instructions and homework assignments for the entire semester. Students study mainly on their own time and submit assignments according to a predetermined schedule. The individual learning process is supported by detailed personal feedback on assignments and by various learning aids, printed and electronic, mailed or delivered via the course websites. Tutorials held at study centers throughout the country help to clarify and practice applications of the subject matter and encourage socialization with peers. At the end of the semester, students take monitored written final exams at a specific location. Assignments and exams are prepared in advance to ensure that a pre-set high standard is preserved throughout the country, regardless of study center or tutor.

The undergraduate degree program in chemistry falls under the Department of Natural Sciences, one of seven academic departments at the OUI. The first departmental Bachelor's degree (B.A. in Natural Sciences) was offered in 1984. In 2006, the department was authorized to grant a dual-disciplinary B.Sc. degree with a track in Chemistry, and in 2008, with Physics. In 2009, all the undergraduate degrees granted by

the department were changed from B.A. degrees to B.Sc. degrees. The department currently offers single and dual-disciplinary undergraduate programs in Chemistry.

Each of the chemistry programs include basic courses in physics and mathematics that are necessary as background to intermediate and advanced courses and seminar courses that provide students with an updated perspective of specific research topics. English proficiency, knowledge of basic computer applications and bibliographic training in the library are required for all degrees.

The OUI offers four degree programs that involve significant chemistry instruction. These are: 1) B.Sc. in Sciences, which features the most general, least structured mix of science courses, but not a concentration in chemistry; 2) B.Sc. in Natural Sciences, which offers a general degree in the Natural Sciences; 3) B.Sc. in Natural Sciences: Emphasis on Chemistry, which features the heaviest concentration of chemistry courses, as would be required for graduate studies in chemistry; 4) Studies in Chemistry toward a Dual-Disciplinary Degree, which concentrates on two sciences, one of which is chemistry.

The self-evaluation report defined three groups of Chemistry students according to the chemistry courses that they passed. In 2009, 87 students were defined as chemistry students (as compared with 51 in 2005), 176 students took a partial program in Chemistry and 569 students had passed at least one course in chemistry. Chemistry students are relatively older than their peers in other institutions, over half are male, almost half live outside of the major cities, and 16.1% did not have a high school matriculation certificate when they began their studies.

The average grade of graduates over the past five years in the various undergraduate chemistry programs is 80.02. The OUI's open admissions policy combined with its high academic requirements results in a relatively high dropout rate in students' first courses at the OUI. As a result, students who are able to graduate are usually highly motivated and have high intellectual abilities. Because many of the students work full time during their studies, the average duration of studies for all students is 7.2 years and 6.8 years for Chemistry students.

The Committee finds the B.Sc. degree in Natural Sciences: Emphasis on Chemistry has similar course content to the B.Sc. degree in Chemistry at other universities, but there is less laboratory work in the OUI degree program. The program would benefit from additional advanced level courses in Chemistry, particularly in organic chemistry, but this effort must be balanced with the requirement that old courses be updated and refreshed. The Chemistry faculty is working hard toward both of these goals.

Excellent laboratory instruction is provided, but only at the central campus, which is a burden for the students who must travel to laboratory classes from far away. The committee recommends that additional teaching laboratories in the north and south of the country be established through arrangements with different universities. The Committee noted that the teaching laboratories in other universities are not always in use year round. The OUI should explore possible arrangements to have access to these laboratories.

The faculty recognizes the great importance to the student of an undergraduate research experience in a faculty member's research laboratory, but such an experience is often not

possible due to constraints of time or distance. Nevertheless, students taking advanced Chemistry courses should be encouraged to discuss research possibilities with OUI faculty, and the faculty should then try to match up students with appropriate research laboratories close to them. Fellowship support for student research experiences, particularly in the summer, would be highly desirable.

Although participation in the tutorials is not required in any course, it is clear to the committee that they play an extremely valuable role in facilitating mastery of the material in each course. For this reason, the committee recommends that more tutorials be opened at remote locations, even for small numbers of students, whenever possible.

It was the impression of the committee that while the supplied study materials and the tutorials appear excellent, it would be helpful for the students to have some inspiring lectures from visitors from other universities in Israel (or, when possible, from overseas). These could also make connections to real world examples of the usefulness of chemical concepts and systems in the course work.

Recommendations:

- **Additional advanced level courses in chemistry, particularly in organic chemistry.**
- **Provide teaching laboratory sites at universities in the north and south of Israel.**
- **Recommend research projects to advanced students and try to match them up with appropriate university faculty member laboratories close to them.**
- **Provide scholarship support for student research experiences in the summer.**
- **Add tutorials for chemistry classes at remote locations, even for small numbers of students, whenever possible.**
- **Include some inspiring lectures of visitors from other universities in Israel (or, when possible, from overseas) in the courses.**

Faculty

The Chemistry Group is one of four programs within the Avinoam Adam Department of Natural Sciences with several B. Sc. programs of study. The organization of faculty at OUI is based on three categories: senior faculty members, academic teaching staff (course coordinators) and tutors. The senior faculty is responsible for curriculum design, course development, selection of course materials, and supervision of ongoing teaching and counseling. They are also expected to carry out research and to participate in the academic management of the university. The academic teaching staff coordinates distance teaching and the learning process, and provide group tutoring and individual support. Some of them also carry out research and some assist as academic advisors. Tutors meet with the students, either face-to-face or remotely periodically.

Senior Faculty. There are four active senior faculty members in the chemistry program, one of who is head of the Department of Natural Sciences, engaged in teaching and research. The senior faculty members are appointed with multi-year contracts, but do not receive tenure. Senior faculty members from other disciplines participate in courses in the chemistry-related B.Sc. programs, e.g. in mathematics and physics courses.

Course Coordinators. There are 10 academic teaching staff course coordinators (7 are full time at OUI with 3 full time in the chemistry program; one is 50% time and two are 10% time at OUI and in the chemistry program). The position of course coordinator is unique to OUI. Each course has a coordinator, who serves as the active manager and administrator. The coordinator's duties include the preparation of homework assignments and exams, oversight of the course's tutors, some tutoring of study groups themselves, maintenance of the course's website, and all logistical items for the course such as classroom scheduling. Consequently, the coordinator has much interaction with the students and is viewed by the students in a similar manner to the professor in a traditional course. The coordinators also work with the responsible senior faculty member to update and modify the course's content.

The course coordinators are chosen by the senior faculty, and all current coordinators for chemistry courses have a Ph.D. in Chemistry. They are given training through an orientation course upon first appointment. The position has four ranks; promotion depends on education and performance in the current rank. For full-time employment, each coordinator is normally responsible for more than one course. However, their compensation is affected by the course enrollment, and they may receive less than 100% compensation, if a threshold enrollment is not reached. This uncertainty and what appears to be an excessive workload can be dispiriting.

Tutors. The academic teaching staff also includes course tutors who are appointed to short-term contracts. The course tutors function in a manner similar to teaching assistants in a traditional course. They hold weekly tutorials, often by videoconference, to go over the material covered in the course as well as homework assignments. The tutors are compensated on a per-course basis and according to the number of tutoring hours, so their employment status has uncertainty until the course registration is complete.

The tutors are recruited by the course coordinators. They often have a Ph.D. or are graduate students in a doctoral program. The tutors are also given an extensive training workshop to improve their effectiveness as teachers. A significant challenge for both the tutors and course coordinators arises from the heterogeneity of the student population ranging from high school students to people 20-years older, who are pursuing career changes.

Overall, the course coordinators and tutors are doing an excellent job, as judged from the comments of the students and the success of the OUI. They have helped create a new and effective teaching mode that is in tune with the diversity and complexity of modern life. They are at the forefront of online education that will continue to evolve in parallel with video and print technologies.

Recommendations:

- **The appropriateness of the compensation and workload for the course coordinators and tutors needs to be assessed on a regular basis.**

Research

Research by senior faculty (and some academic staff) is carried out in collaboration with laboratories in Israel or abroad. There are no research laboratories at the OUI facility. This research is largely supported by external funding sources through competitive grants. Start-up grants in the experimental sciences of about $27K are given to new faculty by the Open University Research Authority, with the understanding that proposals to external funding sources will be submitted. The Committee endorses the concept of OUI faculty carrying out research while recognizing the considerable challenges that this entails. One senior faculty member conducts research in computational chemistry and may be able to do her research locally if a computer cluster can be developed in collaboration with faculty in Computer Science and Mathematics. A second faculty member conducts research at the Technion in an organic chemistry research laboratory, while the other faculty members have need of instrumentation that are available only in laboratories abroad.

Recommendations:

- **The research activities of the senior faculty need to be facilitated in a manner consistent with the expectations for evaluation and promotion. This may require providing more resources in the way of supplies, equipment, and graduate student support.**

Resources, Facilities

The Open University (OUI) has advanced learning technologies. Almost all courses have websites with the possibility of communication between students and teaching staff. Synchronous online tutorial sessions are available, transmitted live from either a studio on the OUI campus via the internet (Ofeq tutorials), or the instructor's computer directly to the student's computer (Interwise and Webex). Telephone contacts between instructors and students are available. Recorded courses are always available, via the Web or CDs. One current problem is that some of the students do not have computers or access to the internet.

Natural Sciences tutorials are held face-to-face in 77 study centers throughout the country. A limited number of study activities take place in ten classrooms on the Raanana campus. There are also large OUI study centers in Haifa, Jerusalem, Beer Sheba, and Givat Haviva. However, it should be noted that only 80% of the students attend the tutorials.

The laboratory unit of the Natural Sciences department, located on the Raanana campus includes two experimental labs, an observation room, a preparation room, three equipment rooms, a reagent room and a cleaning room. Each lab is equipped for up to 22 students. The lab is multidisciplinary and equipment is used for experiments in Physics, Life Sciences, Chemistry and Earth Sciences.

In addition to standard laboratory equipment, the labs include UV-vis and FTIR spectrophotometers, calorimeters, gas chromatograph, and polarimeter. Significantly, there is no NMR spectrometer, due to high cost. As NMR spectroscopy is an essential tool for characterization of organic and organometallic compounds, it is recommended by the committee that samples prepared by the students in the organic chemistry labs be measured at service units of other universities, and returned to students in the OUI courses for analysis and interpretation. A disadvantage mentioned above is that all the

laboratory courses are given in Raanana, making it inconvenient for students from remote locations. Attempts to rectify this problem through agreements with other universities have met with little success to date, but efforts to this end should continue.

Another limitation mentioned by OUI is that three technicians are too few to operate the many lab sessions held throughout the year.

There are no laboratory *research* facilities for Chemistry Faculty. The laboratory on campus serves only teaching. Faculty members doing experimentally based research are pursuing their research activities in laboratories or in collaboration with research groups at other universities, largely through personal arrangements. A framework agreement exists with Tel Aviv University.

The OUI central library, located in Raanana, is well equipped, and offers reference, loan and information services to students and faculty. Importantly, it offers the option of connecting to a wide range of leading journals for students throughout the country. Agreements with most other university libraries provide students with access to these libraries.

High quality study material including the course text is provided free to the students. All of the materials are shipped to students in packets that are assembled in a state-of-the-art warehouse and distribution facility. However, it is envisioned that the materials and their distribution will become electronically based as tablet technology and availability increase. This change is under active study but has not impacted the chemistry courses at this time.

Recommendations:

- **In cases of absence of analytical instrumentation (such as an NMR spectrometer), consider analysis of samples prepared by students at service units of other universities.**
- **Establish framework agreements with universities (in addition to TAU) for research of OUI faculty members.**
- **Investigate access to teaching laboratory sites through arrangements with universities in the north and south of Israel.**

Signed by:

Prof. Richard Eisenberg
Committee Chair

Prof. Allen J. Bard

Prof. Tobin J. Marks

Prof. William L. Jorgensen

Prof. Joan S. Valentine

Prof. David Milstein

Appendices

Appendix 1- Copy of Letter of Appointment

March, 2011

Prof. Rich Eisenberg
Department of Chemistry
University of Rochester
USA

שר החינוך
Minister of Education
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Dear Professor Eisenberg,

The State of Israel undertook an ambitious project when the Israeli Council for Higher Education (CHE) established a quality assessment and assurance system for Israeli higher education. Its stated goals are: to enhance and ensure the quality of academic studies; to provide the public with information regarding the quality of study programs in institutions of higher education throughout Israel; and to ensure the continued integration of the Israeli system of higher education in the international academic arena. Involvement of world-renowned academicians in this process is essential.

This most important initiative reaches out to scientists in the international arena in a national effort to meet the critical challenges that confront the Israeli higher educational system today. The formulation of international evaluation committees represents an opportunity to express our common sense of concern and to assess the current and future status of education in the 21st century and beyond. It also establishes a structure for an ongoing consultative process among scientists around the globe on common academic dilemmas and prospects.

I therefore deeply appreciate your willingness to join us in this crucial endeavor.

It is with great pleasure that I hereby appoint you to serve as the chair of the Council for Higher Education's Committee for the Evaluation of Chemistry Studies.

The composition of the Committee will be as follows: Prof. Rich Eisenberg (Chair), Prof. Allen Bard, Prof. William Jorgensen, Prof. Tobin Marks, Prof. David Milstein and Prof. Joan Valentine.

Ms. Alisa Elon will coordinate the Committee's activities.

In your capacity as the chair of the Evaluation Committee, you will be requested to function in accordance with the enclosed appendix.

I wish you much success in your role as chair of this most important committee.

Sincerely,
Gideon Sa'ar

Gideon Sa'ar
Minister of Education,
Chairperson, The Council for Higher Education

Enclosures: Appendix to the Appointment Letter of Evaluation Committees

cc: Ms. Michal Neumann, The Quality Assessment Division
Ms. Alisa Elon, Committee Coordinator

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Appendix 2- Site Visit Schedule

10:00-10:30	**Opening session with the heads of the institution and the senior staff member appointed to deal with quality assessment** President Vice President for Academic Affairs Dean of Academic Studies Dean of Research Dean of Academic Development and Educational Technologies CHE Quality Assessment Coordinator Representative, the Evaluation Department	Prof. Judith Gal-Ezer Prof. Sonia Roccas Prof. Anat Barnea Prof. Yoav Yair Dr. Ronit Bogler TBN
10:30-11:15	**Meeting with the academic and administrative head of the Avinoam Adam Department of Natural Sciences** Chair of the Department and of the Chemistry group	Prof. Itzhak Dotan
11:15-12:15	**Meeting with senior academic staff (representatives of relevant committees)*** Senior faculty of the Chemistry Group Head of the Natural Sciences Academic Sub-committee Head of the Accreditation Committee Head of the Study Program Approval Committee Academic Appointments Committee representative	Prof. Itzhak Dotan will join the senior faculty members during the first part of the meeting Dr. Inbal Tuvi-Arad Dr. Igor Rahinov Dr. Ofer Reany Prof. Yosef Verbin Dr. Aviad Bar-Haim Prof. Daphna Ephrat Prof. Miriam Souroujon
12:15-13:00	**Meeting with academic teaching staff***	Dr. Dorota Czarki, Dr. Chava Gal, Dr. Varda Itach, Dr. Dina Einot-Yogev, Dr. Ada Neer, Dr. Merav Hadad, Ms. Idit Barlas

13:00-13:45	**Lunch (closed working meeting in the same room)**	
13:45-15:00	**Tour of campus (Multimedia studios, library, offices of faculty members, Science student lab etc.)**	Guided by Prof. Yoav Yair (Dean of Academic Development and Educational Technologies) and Prof. Itzhak Dotan (Head of Natural Sciences Department).
15:00-15:30	**Meeting with Tutors***	Dr. Evelina Bart Dr. Michal Cacher Dr. Pavel Leiderman Dr. Avital Steinberg
15:30-16:15	**Meeting with B.Sc. students***	
16:15-16:35	**Closed working meeting**	
16:35-17:30	**Summation meeting with heads of the institution and of the department** President Vice President for Academic Affairs CHE Quality Assessment Coordinator Chair of the Department of Natural Sciences	Prof. Judith Gal-Ezer Dr. Ronit Bogler Prof. Itzhak Dotan
17:30-18:00	**Closed working meeting**	